VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY, MADURAI-625009

(Autonomous)

B.Tech.- ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

CHOICE BASED CREDIT SYSTEM

REGULATIONS - 2021

BATCH: 2023 - 2027

CURRICULUM FOR SEMESTERS I TO VIII

SEMESTER – I

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21IP101	Induction Programme *(Common to all B.E./B.Tech. Programmes)*	-	0	0	0	0
		THEORY					
2.	21EN101	Professional English – I *(Common to all B.E./B.Tech. Programmes)*	HS	3	2	0	4
3.	21MA101	Matrices and Calculus *(Common to all B.E./B.Tech. Programmes)*	BS	3	2	0	4
4.	21PH101	Engineering Physics *(Common to all B.E./B.Tech. Programmes)*	BS	3	0	0	3
5.	21CH101	Engineering Chemistry *(Common to all B.E./B.Tech. Programmes)*	BS	3	0	0	3
6.	21CS101	Problem Solving and Python Programming. *(Common to all B.E./B.Tech. Programmes)*	ES	3	0	0	3
7.	21TA101	தமிழர் மரபு /Heritage of Tamils	HS	1	0	0	1
		PRACTICAL COURSES					
8.	21CS102	Problem Solving and Python Programming Laboratory *(Common to all B.E./B.Tech. Programmes)*	ES	0	0	4	2
9.	21PC101	Physics and Chemistry Laboratory *(Common to all B.E./B.Tech. Programmes)*	BS	0	0	4	2
		Total Credits					**22**

SEMESTER- II

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1.	21EN102	English – II *(Common to all B.E./B.Tech. Programmes)*	HS	3	0	0	3
2.	21MA103	Sampling Techniques and Numerical Methods *(Common to B.E. CSE/B.Tech. Programmes /B.E.ECE)*	BS	3	2	0	4
3.	21PH103	Physics for Information Science *(Common to B.E. CSE/B.Tech. Programmes)*	BS	3	0	0	3
4.	21ME101	Engineering Graphics *(Common to all B.E./B.Tech. Programmes)*	ES	2	0	2	3
5.	21EE104	Basic Electrical and Electronics Engineering for Information Science *(Common to B.E. CSE/B.Tech. Programmes)*	ES	3	0	0	3
6.	21AD101	Programming Paradigm in C	PC	3	0	0	3
7.	21CH103	Environmental Science *(Common to all B.E./B.Tech. Programmes)*	BS	2	0	0	2
8.	21TA102	தமிழரும் தொழில்நுட்பமும் /Tamils and Technology	HS	1	0	0	1
PRACTICAL COURSES							
9.	21EM101	Engineering Practices Laboratory *(Common to all B.E./B.Tech. Programmes)*	ES	0	0	4	2
10.	21AD102	Programming Paradigm in C Laboratory	PC	0	0	4	2
Total Credits							**26**

SEMESTER- III

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1.	21MA203	Discrete Mathematics *(Common to B.E.CSE/B.Tech. Programmes)*	BS	3	2	0	4
2.	21AD201	Operating System Principles	PC	3	0	0	3
3.	21AD203	Data Structure Design using Python	PC	3	0	0	3
4.	21AD205	Principles of Artificial Intelligence	PC	3	0	0	3
THEORY WITH PRACTICAL COURSE							
5.	21AD206	Software Engineering Principles and Design	PC	2	0	2	3
PRACTICAL COURSES							
6.	21AD202	Operating System Principles Laboratory	PC	0	0	4	2
7.	21AD204	Data Structure Design using Python Laboratory	PC	0	0	4	2
Total Credits							**20**

SEMESTER- IV

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1.	21MA208	Probability and Statistics *(Common to B.E.CSE/B.Tech. Programmes)*	BS	3	2	0	4
2.	21AD207	Analysis of Algorithms	PC	3	0	0	3
3.	21AD208	Database Design and Engineering	PC	3	0	0	3
4.	21AD210	Computer Networking Principles	PC	3	0	0	3
5.	21AD212	Principles of Machine Learning	PC	3	0	0	3
PRACTICAL COURSES							
6.	21AD209	Database Design and Engineering Laboratory	PC	0	0	4	2
7.	21AD211	Computer Networking Principles Laboratory	PC	0	0	4	2
8.	21AD213	Machine Learning Laboratory	PC	0	0	4	2
Total Credits							**22**

SEMESTER- V

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1.	21AD301	Deep Learning Techniques	PC	3	0	0	3
2.	21AD302	Data Science and Analytics	PC	3	0	0	3
3.	21AD304	Full Stack Development	PC	3	0	0	3
4.	21PADXX	Professional Elective I	PE	3	0	0	3
5.	21PADXX	Professional Elective II	PE	3	0	0	3
6.	21MCC01	Constitution of India	MC	1	0	0	0
7.		Internship**	EE	0	0	0	1
PRACTICAL COURSES							
8.	21AD303	Data Science and Analytics Laboratory	PC	0	0	4	2
9.	21AD305	Full Stack Development Laboratory	PC	0	0	4	2
10.	21EN301	Professional Communication Laboratory *(Common to all B.E./B.Tech. Programmes)*	HS	0	0	2	1
Total Credits							**21**

SEMESTER- VI

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1.	21AD306	Natural Language Processing	PC	3	0	0	3
2.	21PADXX	Professional Elective III	PE	3	0	0	3
3.	21PADXX	Professional Elective IV	PE	3	0	0	3
4.	21XXXXX	Open Elective – I	OE	3	0	0	3
5.	21XXXXX	Open Elective – II	OE	3	0	0	3
6.	21MCC02	Essence of Indian Traditional Knowledge	MC	1	0	0	0
7.	21OCADXX	One Credit Course	EE	0	0	2	1
THEORY WITH PRACTICAL COURSE							
8.	21AD308	Computer Vision	PC	2	0	2	3
PRACTICAL COURSES							
9.	21AD307	Natural Language Processing Laboratory	PC	0	0	4	2
Total Credits							**21**

SEMESTER- VII

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1.	21AD401	Data Visualization	PC	3	0	0	3
2.	21XXXXX	Open Elective – III	OE	3	0	0	3
3.	21XXXXX	Open Elective – IV	OE	3	0	0	3
PRACTICAL COURSES							
4.	21AD402	Data Visualization Laboratory	PC	0	0	4	2
5.	21AD403	Project Work 1	EE	0	0	4	2
Total Credits							**13**

SEMESTER- VIII

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1.	21PADXX	Professional Elective – V	PE	3	0	0	3
2.	21PADXX	Professional Elective – VI	PE	3	0	0	3
PRACTICAL COURSE							
3	21AD404	Project Work-II	EE	0	0	20	10
Total Credits							**16**

****Industrial training for a period of minimum 2 weeks during the summer / winter vacation**

Total Credits: 161

SEMESTERWISE CREDIT DISTRIBUTION

Sem./Cat.	I SEM	II SEM	III SEM	IV SEM	V SEM	VI SEM	VII SEM	VIII SEM	Total Credits
HS	5	4	-	-	1	-	-	-	10
BS	12	9	4	4	-	-	-	-	29
ES	5	8	-	-	-	-	-	-	13
PC	-	5	16	18	13	8	5	-	65
PE	-	-	-	-	6	6	-	6	18
OE	-	-	-	-	-	6	6	-	12
EE	-	-	-	-	1	1	2	10	14
Total	22	26	20	22	21	21	13	16	**161**

Sl. No.	Category	Topic
1.	HS	Humanities and Social Sciences including Management (HS)
2.	BS	Basic Sciences (BS)
3.	ES	Engineering Sciences including Workshop, Drawing, Basics of Civil / Electrical / Mechanical / Computer etc. (ES)
4.	PC	Professional Core Courses (PC)
5.	PE	Professional Electives: Courses relevant to chosen specialization / branch (PE)
6.	OE	Open Electives: Electives from other Technical and / or emerging Courses (OE)
7.	EE	Project Work, Seminar and Internship in Industry – Employability Enhancement Courses (EE)

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: COMPUTATIONAL INTELLIGENCE

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PAD01	Cognitive Computing	PE	3	0	0	3
2.	21PAD02	Recommender System	PE	3	0	0	3
3.	21PAD03	Distributed computing	PE	3	0	0	3
4.	21PAD04	Quantum Computing	PE	3	0	0	3
5.	21PAD05	Cloud Computing	PE	3	0	0	3
6.	21PAD06	Soft Computing Essentials	PE	3	0	0	3
7.	21PAD07	Generative AI	PE	3	0	0	3
8.	21PAD08	Fog Computing	PE	3	0	0	3

VERTICAL 2: CYBER INTELLIGENCE

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PAD17	Cyber Threat Analytics	PE	3	0	0	3
2.	21PAD18	IoT Security	PE	3	0	0	3
3.	21PAD19	Malware Analysis	PE	3	0	0	3
4.	21PAD20	Steganalysis	PE	3	0	0	3
5.	21PAD21	Biometric Security	PE	3	0	0	3
6.	21PAD22	Block Chain and Cryptocurrency	PE	3	0	0	3
7.	21PAD23	Information Security Management	PE	3	0	0	3
8.	21PAD24	Digital Forensics	PE	3	0	0	3

VERTICAL 3: ANALYTICAL INTELLIGENCE

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PAD25	Business Analytics	PE	3	0	0	3
2.	21PAD26	Predictive Analytics	PE	3	0	0	3
3.	21PAD27	Big Data Analytics	PE	3	0	0	3
4.	21PAD28	IoT Domain Analytics	PE	3	0	0	3
5.	21PAD29	Analytics in Cloud Computing	PE	3	0	0	3
6.	21PAD30	Multivariate Data Analysis	PE	3	0	0	3
7.	21PAD31	Geospatial Data Analysis	PE	3	0	0	3
8.	21PAD32	Time Series Analysis and Forecasting	PE	3	0	0	3

VERTICAL 4: COMPUTATIONAL THINKING FOR AI DESIGN

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PAD33	Robotics Process Automation	PE	3	0	0	3
2.	21PAD34	Reinforcement Learning	PE	3	0	0	3
3.	21PAD35	Foundations of Game Design and Development	PE	3	0	0	3
4.	21PAD36	Human Computer Interaction	PE	3	0	0	3
5.	21PAD37	GPU Architecture and Programming	PE	3	0	0	3
6.	21PAD38	Web and Social Media Analytics	PE	3	0	0	3
7.	21PAD39	AI in Finance	PE	3	0	0	3
8.	21PAD40	Artificial Neural Networks and Its Applications	PE	3	0	0	3

VERTICAL 5: FULL STACK DEVELOPMENT & AI TOOLS

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PAD41	Video Creation and Editing	PE	3	0	0	3
2.	21PAD42	Essentials of UI and UX Design	PE	3	0	0	3
3.	21PAD43	Digital Marketing	PE	3	0	0	3
4.	21PAD44	Visual Effects	PE	3	0	0	3
5.	21PAD45	App Development	PE	3	0	0	3
6.	21PAD46	DevOps	PE	3	0	0	3
7.	21PAD47	Open Source Technologies	PE	3	0	0	3
8.	21PAD48	Enterprise Application Development	PE	3	0	0	3

OPEN ELECTIVES (OE) FOR EEE, CIVIL AND MECH (CUTTING EDGE TECHNOLOGIES)

Sl. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1	21OAD01	Artificial Intelligence and Machine Learning Fundamentals	OE	2	0	2	3
2	21OAD02	IoT Concepts and Applications	OE	2	0	2	3
3	21OAD03	Data Science Fundamentals	OE	2	0	2	3
4	21OAD04	Augmented Reality / Virtual Reality	OE	2	0	2	3

ONE CREDIT COURSES

Sl.No.	COURSE CODE	COURSETITLE	Category	L	T	P	C
1.	21OCAD01	Practical Machine Learning with Tensor Flow	EE	0	0	2	1
2.	21OCAD02	Practical Tableau	EE	0	0	2	1
3.	21OCAD03	Mastering Power BI	EE	0	0	2	1
4	21OCAD04	Introduction to Innovative Projects	EE	0	0	2	1

VELAMMAL

COLLEGE OF ENGINEERING AND TECHNOLOGY, MADURAI – 625009.
(Autonomous)

(Accredited by NAAC with 'A' Grade and by NBA for 5 UG Programmes)

(Approved by AICTE and affiliated to Anna University, Chennai)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

B.Tech. ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

CURRICULUM and SYLLABUS
(I to VIII SEMESTER)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER - I

21IP101	INDUCTION PROGRAMME *(Common to all B.E./B.Tech Programmes)*	L	T	P	C
		0	0	0	0

PRE-REQUISTIE:

Ability to understand the high frequency every day or job-related language and write simple connected text on topics which re familiar or of personal interest.

OBJECTIVES:

- This course aims at making students comfortable to the new environment and create a holistic outlook, and to create a desire to work for national needs and beyond.

This is a mandatory 2-week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over. The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have a broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, a citizen and a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers
And students, give a broader view of life, and build character. "

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity
This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts
Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values
This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, make decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts,

but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real-life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the underprivileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT

Students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their Knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity-based programme and therefore there shall be no tests / Assessments during this programme.

REFERENCES:

Guide to Induction program from AICTE

21EN101	PROFESSIONAL ENGLISH-1 (Common to all B.E./B.TECH. Programmes)	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To develop learner's skills in listening and responding effectively
- To apply basic grammar for better communication
- To employ reading passages for understanding vocabulary
- To construct logical sentences and participate in pair presentation, extempore
- To organize ideas for various compositions in writing

UNIT I	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	15

Listening – Listening for general information - Specific details **-** Conversation: Introduction to classmates **-** Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form; **Speaking -** Self Introduction; Introducing a friend; Conversation - Politeness strategies; Telephone conversation; Leave a voicemail; Leave a message with another person; asking for information to fill details in a form; **Reading -** Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails; **Writing -** Writing emails / letters introducing oneself; **Grammar -** Present Tense (simple, continuous); Question types: Wh/ Yes or No/ and Tags **Vocabulary -** Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts)

UNIT II	NARRATION AND SUMMATION	15

Listening - Listening to podcast, anecdotes / stories / event narration; documentaries and interviews with celebrities; **Speaking** - Narrating personal experiences / events; Interviewing a celebrity; Reporting / and summarizing of documentaries / podcasts/ interviews; **Reading** - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs; **Writing** - Guided writing - Paragraph writing Short Report on an event (field trip etc.); **Grammar** - Past tense (Simple, continuous); Subject-Verb Agreement; and Prepositions; **Vocabulary** - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III	DESCRIPTION OF A PROCESS / PRODUCT	15

Listening - Listen to a product and process descriptions; a classroom lecture; and advertisements about a products; **Speaking** - Picture description; Giving instruction to use the product; Presenting a product; and Summarizing a lecture; **Reading** - Reading advertisements, gadget reviews; user manuals; **Writing** - Writing definitions; instructions; and Product /Process description; **Grammar** - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect, Present and past perfect continuous tenses; **Vocabulary** - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words)

UNIT IV	CLASSIFICATION AND RECOMMENDATIONS	15

Listening - Listening to TED Talks; Scientific lectures; and educational videos; **Speaking** – Small Talk; Mini presentations and making recommendations; **Reading** - Newspaper articles; Journal reports - Non Verbal Communication (tables, pie charts etc,) **Writing** - Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode) **Grammar** - Articles; Pronouns - Possessive & Relative pronouns; **Vocabulary** - Collocations; Fixed / Semi fixed expressions

UNIT V	EXPRESSIONS	15

Listening - Listening to debates/ discussions; different viewpoints on an issue; and panel discussions; **Speaking** - Group discussions, Debates, and Expressing opinions through Simulations & Role-play; **Reading** - Reading editorials; and Opinion Blogs; **Writing** - Essay Writing (Descriptive or narrative); **Grammar** - Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences; **Vocabulary** - Cause & Effect Expressions - Content vs. Function words.

TOTAL: 75 PERIODS

COURSE OUTCOMES:
At the end of the course, learners will be able to:
CO1: Listen and comprehend complex academic texts
CO2: Read and infer the denotative and connotative meanings of technical texts
CO3: Write definitions, descriptions, narrations and essays on various topics
CO4: Speak fluently and accurately in formal and informal communicative contexts
CO5: Express their opinions effectively in both oral and written medium of communication

TEXT BOOKS:

1. Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University. English for Science & Technology. Cambridge University Press, 2021
2. Board of Editors, Department of English, Anna University. English for Engineers & Technologists. Orient Blackswan Private Ltd, 2020.
3. Board of Editors, Department of English, Anna University. Using English Orient Blackswan Private Ltd, 2017

REFERENCES:

1. Meenakshi Raman & Sangeeta Sharma. Technical Communication – Principles and Practices Oxford University Press, New Delhi, 2016
2. Lakshminarayanan K.R. A Course Book on Technical English. SciTech Publications (India) Pvt. Ltd., 2012
3. Ayesha Viswamohan. English For Technical Communication (With CD). McGraw Hill Education, ISBN: 0070264244. 2008.
4. Kulbhusan Kumar, RS Salaria, Effective Communication Skill. Khanna Publishing House. First Edition, 2018.
5. Dr. V. Chellammal. Learning to Communicate. Allied Publishing House, New Delhi, 2003.

21MA101	MATRICES AND CALCULUS (Common to all B.E. / B.Tech. Programmes)	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

The main objectives of this course are:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To familiarize the students with differential calculus.
- To make the students to apply functions of several variables technique to solve problems in many engineering branches.
- To make the students understand various techniques of integration.
- To prepare the student to use mathematical tools in evaluating multiple integrals and their applications.

UNIT I	**MATRICES**	**12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II	**DIFFERENTIAL CALCULUS**	**12**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications: Maxima and Minima of functions of one variable.

UNIT III	**FUNCTIONS OF SEVERAL VARIABLES**	**12**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications: Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV	**INTEGRAL CALCULUS**	**12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT V	**MULTIPLE INTEGRALS**	**12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

	TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use the matrix algebra methods for solving engineering problems.

CO2: Apply differential calculus tools in solving various application problems.

CO3: Make use of differential calculus ideas on several variable functions.

CO4: Identify suitable methods of integration in solving practical problems.

CO5: Solve practical problems of areas, volumes using multiple integrals.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
3. James Stewart, "Calculus: Early Transcendentals", 8th Edition, Cengage Learning, New Delhi, 2015.

REFERENCES:

1. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", 7th Edition, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 2009.
2. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", 5th Edition, Narosa Publications, New Delhi, 2016.
3. Ramana. B.V., "Higher Engineering Mathematics", 6th Edition, McGraw Hill Education Pvt. Ltd, New Delhi, 2010.
4. Thomas. G. B., Hass. J and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

21PH101	**ENGINEERING PHYSICS** (Common to I Year B.E. / B.Tech. Students)	L 3	T 0	P 0	C 3

OBJECTIVES:

The main objectives of this course are:

- To illustrate the students effectively to achieve an understanding of mechanics.
- To infer the students to gain knowledge of electromagnetic waves and its applications.
- To explain the basics of oscillations, optics and lasers.
- To outline the importance of quantum physics.
- To relate the students towards the applications of quantum mechanics.

UNIT I	**MECHANICS**	**9**

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum– double pendulum –Introduction to nonlinear oscillations.

UNIT II	**ELECTROMAGNETIC WAVES**	**9**

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.

UNIT III	**OSCILLATIONS, OPTICS AND LASERS**	**9**

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave – sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference– Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV	**BASIC QUANTUM MECHANICS**	**9**

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in an infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V	**APPLIED QUANTUM MECHANICS**	**9**

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, learners will be able to:
CO1: Explain the importance of mechanics.
CO2: Extend their knowledge in electromagnetic waves.
CO3: Illustrate a strong foundational knowledge in oscillations, optics and lasers.
CO4: Interpret the importance of quantum physics.
CO5: Summarize quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow, "An Introduction to Mechanics", First Edition, McGraw Hill Education, 2017.
2. E.M.Purcell and D.J.Morin, "Electricity and Magnetism", Third Edition, Cambridge University Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", Seventh Edition, McGraw-Hill, 2017.

REFERENCES

1. R.Wolfson. "Essential University Physics", Volume 1 & 2., First Edition (Indian Edition) Pearson Education, 2009.
2. Paul A. Tipler, "Physics" - Volume 1 & 2, First Edition (Indian Edition), CBS Publishers & Distributors, 2004.
3. K.Thyagarajan and A.Ghatak. "Lasers: Fundamentals and Applications", Second Edition, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R. Resnick and J. Walker, "Principles of Physics", 10th Edition (Indian Edition), Wiley, 2015.
5. N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students", First Edition, Springer Verlag, 2012.

21CH101	ENGINEERING CHEMISTRY (Common to all B.E / B.Tech. Programmes)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I	WATER AND ITS TREATMENT	9

Water: Sources and impurities, **Water quality parameters:** Definition and significance of-colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination)**. Desalination of brackish water**: Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. **Treatment of boiler feed water**: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II	NANOCHEMISTRY	9

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials**: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. **Applications** of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III	PHASE RULE AND COMPOSITES	9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers).

Properties and applications of: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. **Hybrid composites** - definition and examples.

UNIT IV	FUELS AND COMBUSTION	9

Fuels: Introduction: Classification of fuels; **Coal and coke**: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:** Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Power alcohol and biodiesel.**

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; **Ignition temperature**: spontaneous ignition temperature, Explosive range; **Flue gas analysis** - ORSAT Method. **CO_2 emission and carbon foot print.**

UNIT V	ENERGY SOURCES AND STORAGE DEVICES	9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. **Solar energy conversion:** Principle, working and applications of solar cells**; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H_2-O_2 fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2: Identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3: Apply the knowledge of phase rule and composites for material selection requirements.

CO4: Recommend suitable fuels for engineering processes and applications.

CO5: Recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhan Patrai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", 12th Edition, S. Chand Publishing, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B.B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-II M Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" 2nd Edition, McGraw Hill Education (India) Private Limited, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", 2nd Edition, Cambridge University Press, Delhi, 2019
5. O.V. Roussak and H.D. Gesser, "Applied Chemistry-A Text Book for Engineers and Technologists", 2nd Edition, Springer Science Business Media, New York, 2013.

21CS101	PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to all B.E./B.Tech Programmes)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

UNIT-I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.

UNIT-II	DATA TYPES, EXPRESSIONS, STATEMENTS	9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT-III	CONTROL FLOW, FUNCTIONS, STRINGS	9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-else-if-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT-IV	LISTS, TUPLES, DICTIONARIES	9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT-V	FILES, MODULES, PACKAGES	9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of design approaches to solve computational problems.

CO2: Develop and execute basic Python programs using expressions and input/output statements.

CO3: Utilize strings, functions and control statements to develop real world problems.
CO4: Construct programs using Python data types like lists, tuples and dictionaries.
CO5: Prepare a Python application by incorporating files and exceptions.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher,"Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
3. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc- Graw Hill, 2018.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", 1st Edition, Pearson Education, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", 3rd Edition, MIT Press, 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019

21CS102	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY *(Common to all B.E./B.Tech Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.,)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc., - operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error,voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.,

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Develop algorithmic solutions to simple computational Problems

CO2: Illustrate and execute basic Python programs using simple statements.

CO3: Build program for scientific problems using strings, functions and control statements.

CO4: Utilize compound data types lists, tuples and dictionaries for real-time applications.

CO5: Experiment the python packages, files and exceptions for developing software applications

21PC101	PHYSICS AND CHEMISTRY LABORATORY (Common to I year B.E. / B.Tech., students)	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To explain the proper use of various kinds of physics laboratory equipment.
- To extend how data can be collected, presented and interpreted in a clear and concise manner.
- To infer problem solving skills related to physics principles and interpretation of experimental data.
- To summarize error in experimental measurements and techniques used to minimize such error.
- To translate the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 7 Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young’s modulus
4. Uniform bending – Determination of Young’s modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – Determination of the velocity of sound and compressibility of liquids
10. Post office box - Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde’s string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the functioning of various physics laboratory equipment
CO2: Relate the graphical models to analyze laboratory data
CO3: Interpret mathematical models as a medium for quantitative reasoning and describing physical reality.
CO4: Explain Access, process and analyze scientific information.
CO5: Translate students to solve problems individually and collaboratively

REFERENCES:

1. “Physics Laboratory Manual”, Department of Physics, Velammal College of Engineering & Technology, Madurai (2021)
2. P. Mani, “Physics Laboratory”, Dhanam Publications, 2021.

21PC101	PHYSICS AND CHEMISTRY LABORATORY *(Common to all B.E / B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

CHEMISTRY LABORATORY

COURSE OBJECTIVES:

The main objectives of this course are:

- To inculcate experimental skills to test basic understanding of water quality parameters such as acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electro analytical techniques such as pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles.
- To analyze the quality of coal sample using proximate analysis.

List of Experiments (Any 7 experiments)

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.
2. Determination of types and amount of alkalinity in water sample.
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate. (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel.
15. Proximate analysis of Coal.

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: To analyze the quality of water samples with respect to their acidity, alkalinity, hardness and DO.
CO2: To determine the amount of metal ions through volumetric and spectroscopic techniques.
CO3: To analyze and determine the composition of alloys.
CO4: To learn simple method of synthesis of nanoparticles.
CO5: To quantitatively analyze the impurities in solution by electro analytical techniques.

Text Book:

J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, "Vogel's Textbook of Quantitative Chemical Analysis" 2009.

21TA101 **தமிழர் மரபு** **L T P C**
1 0 0 1

அலகு I **<u>மொழி மற்றும் இலக்கியம்</u>**: **3**

இந்திய மொழிக் குடும்பங்கள் – திராவிட மொழிகள் – தமிழ் ஒரு செம்மொழி – தமிழ் செவ்விலக்கியங்கள் - சங்க இலக்கியத்தின் சமயச் சார்பற்ற தன்மை – சங்க இலக்கியத்தில் பகிர்தல் அறம் – திருக்குறளில் மேலாண்மைக் கருத்துக்கள் – தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம் - பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் – சிற்றிலக்கியங்கள் – தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி – தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

அலகு II **மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை**: **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III **<u>நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்</u>**: **3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

அலகு IV **<u>தமிழர்களின் திணைக் கோட்பாடுகள்</u>**: **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் – தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் – தமிழர்கள் போற்றிய அறக்கோட்பாடு – சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் – சங்ககால நகரங்களும் துறை முகங்களும் – சங்ககாலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி – கடல்கடந்த நாடுகளில் சோழர்களின் வெற்றி.

அலகு V **<u>இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு</u>**: **3**

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும்
கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)

6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY
(Autonomous)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER- II

21EN102	ENGLISH-II (Common to all B.E./B.TECH. Programmes)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- To prepare and write convincing job applications and effective reports.
- To demonstrate their speaking skills to make technical presentations and participate in group discussions.
- To apply their Listening skill which will help them comprehend lectures and talks in their areas of specialization
- To choose appropriate soft skills to suit the situation.

UNIT I — INTRODUCTION TO TECHNICAL ENGLISH — 9

Listening - Factual and Academic speeches; **Speaking** - Asking for and giving directions - **Reading** - Technical texts from - Newspapers /websites; **Writing -** Statements - Definitions - issue based writing instructions - Checklists - Recommendations; **Vocabulary Development**- technical vocabulary; **Grammar** - Error spotting - Compound words; Soft **skills** - Leadership Skills.

UNIT II — READING AND STUDY SKILLS — 9

Listening - Listening to longer technical talks and completing exercises based on them; **Speaking** - Describing a general process; **Reading** - Reading longer technical texts - Identifying the various transitions in a text - Paragraphing; **Writing** - Interpreting charts, graphs; **Vocabulary Development** - Vocabulary used in formal letters/emails and reports **Grammar -** Impersonal passive voice, numerical adjectives - **soft skills** – Teamwork.

UNIT III — TECHNICAL WRITING AND GRAMMAR — 9

Listening - Listening to classroom lectures, talks on engineering /technology; **Speaking** - introduction to technical presentations; **Reading** - longer texts both general and technical, practice in speed reading; **Writing** - Describing a technical process; **Vocabulary Development** - Sequence words - Misspelled words; **Grammar** - Embedded sentences; **Soft skills** - Decision making.

UNIT IV — JOB APPLICATIONS — 9

Listening - Listening to documentaries and making notes. **Speaking** - Mechanics of presentations; **Reading -** Reading for detailed comprehension; **Writing** - Email etiquette - job application - Cover Letter - Resume preparation(via email and hard copy) - Analytical essay writing - **Vocabulary Development -** finding suitable synonyms - paraphrasing; **Grammar** - clauses - If conditionals -**Soft skills** - Time Management.

UNIT V — GROUP DISCUSSION AND REPORT WRITING — 9

Listening - TED talks; **Speaking** - Participating in a group discussion - **Reading** - Reading and understanding technical articles; **Writing** - Writing reports - Survey report, accident report and minutes of a meeting - **Vocabulary Development** - Verbal analogies; **Grammar** - reported speech; **Soft skills** - Conflict Resolution.

TOTAL: 45PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Interpret by reading information in technical texts
CO2: Choose appropriate language to write convincing job applications, resume and reports
CO3: Formulate the technical ideas effectively in spoken and written forms
CO4: Analyze and understand spoken language in lectures and talks
CO5: Demonstrate basic soft skills in life

TEXT BOOKS:

1. Board of Editors, Fluency in English-A Course book for Undergraduate Engineers and Technologist. Orient Blackswan Pvt Ltd, Hyderabad: 2018
2. Jawahar, Jewelcy &Rathna.P. Communicative English Workbook. VRB Publishers Pvt Ltd. Chennai. 2018.
3. Board of Editors, Department of English, Anna University, Chennai. Mindscapes-English for Technologists and Engineers. Orient Black Swan Pvt Ltd, Chennai, 2012.

REFERENCES:

1. Verma, Shalini. Technical Communication for Engineers. Vikas Publishing House Pvt Ltd. New Delhi. 2015
2. Raman, Meenakshi & Sharma, Sangeeta. Technical Communication English Skills for Engineers. Oxford University Press. 2008.
3. Rizvi, Ashraf.M. Effective Technical Communication. MC Graw Hill Education Pvt Ltd. New Delhi. 2016.

21MA103	SAMPLING TECHNIQUES AND NUMERICAL METHODS (COMMON TO B.E. CSE, ECE & B.Tech. IT)	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

The main objectives of this course are:

- To provide necessary basic concepts in probability
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To understand the basic concepts of classification of design of experiments.
- To introduce the basic concepts of solving algebraic and transcendental equations using numerical techniques.
- To introduce the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.

UNIT I	PROBABILITY	12

Introduction-Sample Spaces and Events-Axioms of Probability-Interpretations and Properties of Probabilities-Conditional Probabilities-Baye's theorem- Independence.

UNIT II	TESTING OF HYPOTHESIS	12

Large sample test based on Normal distribution for single mean and difference of means – Tests based on t, $\chi 2$ and F distributions for testing means and variances – Contingency table (Test for Independency) – Goodness of fit.

UNIT III	DESIGN OF EXPERIMENTS	12

Introduction, aim, basic designs of experiments, one way and two way classifications - Completely randomized design – Randomized block design – Latin square design.

UNIT IV	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	12

Newton Raphson method –Method of False position- pivoting – Gauss Jordan methods – Iterative method: Gauss Seidel – Matrix inversion by Gauss Jordan method – Eigen values of a matrix by power method.

UNIT V	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	12

Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's 1/3 rules, $3/8^{th}$ rule.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the concepts of Probability in Engineering problems.

CO2: Explain the test of hypothesis for small and large samples by using various test like t-test, F-test, Z-test and $\chi 2$ test.

CO3: Apply the basic concepts of classifications of design of experiments.

CO4: Solve the system of equations and the eigen value problems using iterative procedure.

CO5: Interpret the value of an unknown function at any interpolated point of the given tabulated values**.**

TEXT BOOKS:

1. JAY.L. Devore, "Probability and Statistics for Engineering and the Science", 9^{th} Edition, Cengage Learning, 2021.
2. Johnson. R.A., and Irwin Miller, John Freund, "Miller and Freund's Probability and Statistics for Engineers", 12^{th} Edition, Pearson Education, Asia, 2011.

3. Gerald. C.F., and Wheatley. P.O. "Applied Numerical Analysis", 7^{th}Edition, Pearson Education, Asia, New Delhi, 2008.

REFERENCES:

1. Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8^{th} Edition, Pearson Education, Asia, 2007.

2. Spiegel. M.R., Schiller. J., and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", 3^{rd} Edition, Tata McGraw Hill, 2012.
3. Chapra. S.C., and Canale. R.P, "Numerical Methods for Engineers", 5^{th} Edition, Tata McGraw Hill, New Delhi, 2007.
4. Grewal. B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", 9^{th} Edition, Khanna Publishers, New Delhi, 2007.

21PH103	PHYSICS FOR INFORMATION SCIENCE (Common to B.E. CSE/B.Tech. Programmes)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To infer the importance in studying electrical properties of materials.
- To extend the students' knowledge in semiconductor physics.
- To illustrate knowledge on magnetic properties of materials.
- To summarize different optical properties of materials, optical displays and applications.
- To translate an idea of significance of Nano structures, quantum confinement, ensuing Nano device applications and quantum computing.

UNIT I	ELECTRICAL PROPERTIES OF MATERIALS	9

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Wiedemann-Franz law - Success and failures - Electrons in metals - Particle in a three-dimensional box - Degenerate states - Fermi- Dirac statistics - Density of energy states - Electron effective mass - Concept of hole.

UNIT II	SEMICONDUCTOR PHYSICS	9

Intrinsic Semiconductors - Energy band diagram - Direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - extrinsic semiconductors - Carrier concentration in n-type & p-type semiconductors - Variation of carrier concentration with temperature - Variation of Fermi level with temperature and impurity concentration - Carrier transport in Semiconductor: random motion, drift, mobility and diffusion - Hall effect and devices - Ohmic contacts - Schottky diode.

UNIT III	MAGNETIC PROPERTIES OF MATERIALS	9

Magnetic dipole moment - Atomic magnetic moments - Magnetic permeability and susceptibility - Magnetic material classification: diamagnetism - Paramagnetism - Ferromagnetism - Antiferromagnetism - Ferrimagnetism - Ferromagnetism: origin and exchange interaction saturation magnetization and Curie temperature - Domain Theory- M versus H behavior - Hard and soft magnetic materials - Examples and uses - Magnetic principle in computer data storage - Magnetic hard disc (GMR sensor).

UNIT IV	OPTICAL PROPERTIES OF MATERIALS	9

Classification of optical materials - carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode - solar cell - LED - Organic LED - Laser diodes - Optical data storage techniques.

UNIT V	NANODEVICES AND QUANTUM COMPUTING	9

Introduction - Quantum confinement - Quantum structures: quantum wells, wires and dots - Band gap of nanomaterials. Tunneling - Single electron phenomena: Coulomb blockade - Resonant- tunneling diode - single electron transistor - quantum cellular automata - Quantum system for information processing - quantum states - classical bits - quantum bits or qubits - CNOT gate - multiple qubits - quantum gates - advantage of quantum computing over classical computing (qualitative).

TOTAL: 45 PERIODS

COURSEOUTCOMES:

At the end of the course, learners will be able to:

CO1: Demonstrate the classical and quantum electron theories, and energy band structures.
CO2: Infer knowledge on basics of semiconductor physics and its applications in various devices.
CO3: Summarize magnetic properties of materials and their applications in data storage.
CO4: Extend the functioning of optical materials for optoelectronics
CO5: Translate the basics of quantum structures towards quantum computing.

TEXT BOOKS:

1. Jasprit Singh, "Semiconductor Devices Basic Principles", First Edition (Indian Edition), Wiley, 2007.

2. S.O. Kasap, “Principles of Electronic Materials and Devices”, Fourth Edition (Indian Edition), McGraw Hill Education, 2020.
3. Parag K. Lala, “Quantum Computing: A Beginner's Introduction”, First Edition (Indian Edition) McGraw-Hill Education, 2020.

REFERENCES

1. Charles Kittel, “Introduction to Solid State Physics”, Indian Edition Wiley, 2019.
2. Y.B.Band and Y.Avishai, “Quantum Mechanics with Applications to Nanotechnology and Information Science”, First Edition, Academic Press, 2013.
3. V.V.Mitin, V.A. Kochelap and M.A.Stroscio, “Introduction to Nano electronics”, First Edition, Cambridge University.Press, 2008.
4. G.W. Hanson, “Fundamentals of Nano electronics”, Indian Edition, Pearson Education 2009.
5. B.Rogers, J.Adams and S.Pennathur, “Nanotechnology: Understanding Small Systems”, CRC Press, 2014.

21ME101	**ENGINEERING GRAPHICS** (Common to all B.E./B.Tech. Programmes)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To sketch the projection of points, lines and planes.
- To sketch the projection of simple solids
- To sketch the projection of sectioned solids and development of lateral surfaces
- To sketch the isometric and perspective views of simple solids.
- To sketch the orthographic projection of various objects freehandly.

UNIT I	PROJECTIONS OF POINTS, LINES AND PLANE SURFACE	12

Importance of graphics in engineering applications – Use of drafting instruments - Lettering and dimensioning.

Introduction to Orthographic projections - Principles -Principal planes-First angle projection. Projection of points located in all quadrants. Projection of straight lines inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.

Projection of planes (regular polygonal and circular surfaces) inclined to both the principal planes by rotating object method. (Not for Examination)

UNIT II	PROJECTION OF SOLIDS	12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT III	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT IV	ISOMETRIC AND PERSPECTIVE PROJECTIONS	12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method.

UNIT V	FREEHAND SKETCHING	12

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three-Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

Introduction to drafting packages and demonstration. (Not for examination).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Construct the orthographic projections of points, straight lines and plane surfaces.

CO2: Sketch the orthographic projections of simple solids

CO3: Sketch the orthographic projections of sectional solids and lateral surfaces of the solids.

CO4: Construct the isometric projections and perspective projections of simple solids.

CO5: Sketch the orthographic projection of objects using freehand.

TEXT BOOKS:

1. Natarajan K.V., “A text book of Engineering Graphics”, 31st Edition, Dhanalakshmi Publishers, Chennai, 2018.

2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", 15th Edition, New Age International (P) Limited, 2018.
3. Bhatt N.D. and Panchal V.M., "Engineering Drawing", 53rd Edition, Charotar Publishing House, 2014.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", 2nd Edition, Tata McGraw Hill Publishing Company Limited, 2013.
2. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", 2nd Edition, Oxford University, Press, New Delhi, 2015.
3. Shah M.B., and Rana B.C., "Engineering Drawing", 2nd Edition, Pearson, 2009.

21EE104	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING FOR INFORMATION SCIENCE (Common to B.E. CSE/B.Tech. Programmes)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basics of electric circuits and analysis.
- To summarize the basics of working principles and application of AC and DC machines.
- To interpret the domestic and industrial wiring.
- To demonstrate analog devices and their characteristics.
- To illustrate the application of operational amplifier.

UNIT I	ELECTRICAL CIRCUITS	9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws– Simple problems- Nodal Analysis, Mesh analysis. Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – (Simple problems only)

UNIT II	ELECTRICAL MACHINES	9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and. Construction and Working Principle of DC motors, Back EMF equation, Types, Speed and Torque Equation, Transformer-Construction, Working principle and Three phase Alternator, Synchronous motor and Three Phase Induction Motor-construction, working principle and Applications (Qualitative Analysis)

UNIT III	DOMESTIC AND INDUSTRIAL WIRING	9

Lighting, provision of sockets-MCB- Selection of wires and cables-Protection-need for earthing, fuses, relay and circuit breakers. Load calculation, generation cost and Energy Tariff calculation for domestic and industrial loads- HT & LT wiring- Power factor correction.

UNIT IV	ANALOG ELECTRONICS	9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing – Types, I-V Characteristics and Applications, Rectifier. (Qualitative Analysis)

UNIT V	OPERATIONAL AMPILIFIERS AND ITS APPLICATIONS	9

Operational amplifiers, Inverting and Non Inverting Amplifier, Summer, Differentiators, Integrator, Voltage to Current (V/I) and Current to Voltage (I/V) Converter, Multivibrator using 555timer IC.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret the electric circuit parameters of simple DC Circuits.
CO2: Explain the working principle and applications of AC and DC machines.
CO3: Demonstrate the domestic and industrial wiring.
CO4: Describe the characteristics of analog electronic devices.
CO5: Summarize the basic concepts of operational amplifiers.

TEXT BOOKS

1. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", Pearson Education, Second Edition, 2017.
2. Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
3. James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
4. Allen J.Wood & brucef.wollen berg," Power generation ,operation and control", John wiley and sons,Inc,2016.

REFERENCES

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", Fourth Edition, McGraw Hill Education, 2019.
2. Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th edition, 2017.

4. Badriram, B.H.Vishwakarma, “Power system protection and switchgear”, new age international Pvt Ltd publishers, second Edition 2011.

21AD101	PROGRAMMING PARADIGM IN C	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To develop C Programs using basic programming constructs
- To develop C programs using arrays and strings
- To develop modular applications in C using functions
- To develop applications in C using pointers and structures
- To do input/output and file handling in C

UNIT-I	BASICS OF C PROGRAMMING	9

Introduction to programming paradigms – Applications of C Language - Structure of C program – C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Preprocessor directives - Compilation process

UNIT-II	ARRAYS AND STRINGS	9

Introduction to Arrays: Declaration, Initialization – One dimensional array –Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search

UNIT-III	FUNCTIONS AND POINTERS	9

Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions –Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference

UNIT-IV	STRUCTURES AND UNION	9

Structure - Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility

UNIT-V	FILE PROCESSING AND DATA ANALYTICS	9

Files – Types of file processing: Sequential access, Random access- Command line arguments - Basics of data analytics-Types of analytics: descriptive, diagnostic, predictive, prescriptive -Data analytics lifecycle. Case study: Analyzing data using C programming

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate knowledge on C Programming constructs
CO2: Design and implement applications using arrays and strings
CO3: Develop and implement modular applications in C using functions.
CO4: Develop applications in C using structures and pointers.
CO5: Design applications using data analytics in C programming.

TEXT BOOKS:

1. Reema Thareja, "Programming in C", Oxford University Press, Second Edition, 2016.
2. Kernighan, B.W and Ritchie, D.M, "The C Programming language", Second Edition, Pearson Education, 2015
3. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.

2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, “Schaum’s Outline of Theory and Problems of Programming with C”, McGrawHill Education, 1996.

21CH103	ENVIRONMENTAL SCIENCE *(Common to all B.E / B.Tech. Programmes)*	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To appreciate the structure and function of an ecosystem and biodiversity
- To realize the environmental impacts of natural resources.
- To recognize causes, effects and control measures of different types of pollution.
- To comprehend the importance of disaster management, environmental ethics and values.
- To apprehend the important social issues and sustainable practices.

UNIT-I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	6

Multidisciplinary nature of environmental studies - ecosystem- general structure and function of an ecosystem- ecological succession-biodiversity-types-values of biodiversity- endangered and endemic species-red data book- hot spots of biodiversity-criteria- hot spots in India-threats to biodiversity (man-animal conflicts, habitat loss, poaching)-case studies-conservation of biodiversity- in-situ and ex-situ conservation.

UNIT-II	NATURAL RESOURCES AND ITS ENVIRONMENTAL IMPACTS	6

Natural resources-forest resource-ecological functions – causes, effects and control measures of deforestation-water resource-sources-conflict over water-dams benefits and problems-food resource-overgrazing- impacts of over grazing- impacts of modern agriculture-energy resource-environmental impacts of wind mills and solar panels- role of an individual in conservation of natural resources.

UNIT III	ENVIRONMENTAL POLLUTION AND CONTROL	6

Air pollution-causes, effects and control methods - water pollution- causes, effects-waste water treatment-soil pollution-causes, effects-solid waste management–e-waste- causes, effects and management-Pollution control acts-air(prevention and control of pollution) act,1981-water(prevention and control of pollution) act,1974- wildlife (protection) act,1972 - e-waste management rules,2016-case studies - role of an individual in control of pollution.

UNIT IV	DISASTER MANAGEMENT AND ENVIRONMENTAL ETHICS	6

Disaster management-causes, effects and management of- flood, landslide, earthquake and tsunami-case studies- environmental ethics- value education-traditional value systems in India-water conservation-rain water harvesting-watershed management.

UNIT V	SOCIAL ISSUES AND SUSTAINABLE PRACTICES	6

Unsustainable development- social issues-climate change-causes, effects and control measures-global warming-causes, effects and control measures-Acid rain-causes, effects and control measures-ozone layer depletion-causes, effects and control measures-nuclear accident and holocausts-EIA-Sustainable development-goals-target- green buildings- ISO 14000 series.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO 1: Explain the concept, structure and function of an ecosystem and biodiversity.
CO 2: Demonstrate the environmental impacts of natural resources.
CO 3: Select the suitable management method for pollution control.
CO 4: Practice the proper way of managing disaster with environmental ethics.
CO 5: Recognize social issues and adopt suitable sustainable practices.

Text Books:

1. Kaushik, A & Kaushik. C.P, "Environmental Science and Engineering", 6th Edition, New Age International, 2018.

2. Garg S.K & Garg, Ecological and Environmental studies, Khanna Publishers, 2015.
3. Wright & Nebel, Environmental science towards a sustainable future, 12^{th} Editon, Prentice Hall of India Ltd, 2015.

Reference Books:

1. Erach Bharucha, "Text book of Environmental studies for Undergraduate courses", 3^{rd} Edition, UGC, 2021.
2. Ravi P. Agrahari, Environmental ecology, Biodiversity, climatic change & Disaster management, 1^{st} Edition, McGraw Hill, 2020
3. Benney Joseph, "Environmental Science and Engineering", 1^{st} Edition, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017.

21TA102 **தமிழரும் தொழில்நுட்பமும்** L T P C 1 0 0 1

அலகு I **நெசவு மற்றும் பானைத் தொழில்நுட்பம்**: 3

சங்க காலத்தில் நெசவுத் தொழில் – பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள் – பாண்டங்களில் கீறல் குறியீடுகள்.

அலகு II **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்**: 3

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் – சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள் - மாமல்லபுரச் சிற்பங்களும், கோவில்களும் – சோழர் காலத்துப் பெருங்கோயில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் – நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் – செட்டிநாட்டு வீடுகள் – பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை.

அலகு III **உற்பத்தித் தொழில் நுட்பம்**: 3

கப்பல் கட்டும் கலை – உலோகவியல் – இரும்புத் தொழிற்சாலை – இரும்பை உருக்குதல், எஃகு – வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் – நாணயங்கள் அச்சடித்தல் – மணி உருவாக்கும் தொழிற்சாலைகள் – கல்மணிகள், கண்ணாடி மணிகள் – சுடுமண் மணிகள் – சங்கு மணிகள் – எலும்புத்துண்டுகள் – தொல்லியல் சான்றுகள் – சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

அலகு IV **வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்**: 3

அணை, ஏரி, குளங்கள், மதகு – சோழர்காலக் குமுழித் தூம்பின் முக்கியத்துவம் – கால்நடை பராமரிப்பு – கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் – வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள் – கடல்சார் அறிவு – மீன்வளம் – முத்து மற்றும் முத்துக்குளித்தல் – பெருங்கடல் குறித்த பண்டைய அறிவு – அறிவுசார் சமூகம்.

அலகு V **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்**: 3

அறிவியல் தமிழின் வளர்ச்சி –கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் – தமிழ் மென்பொருட்கள் உருவாக்கம் – தமிழ் இணையக் கல்விக்கழகம் – தமிழ் மின் நூலகம் – இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

1. தமிழக வரலாறு – மக்களும் பண்பாடும் – கே.கே. பிள்ளை (வெளியீடு: தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்).
2. கணினித் தமிழ் – முனைவர் இல. சுந்தரம். (விகடன் பிரசுரம்).
3. கீழடி – வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை – ஆற்றங்கரை நாகரிகம். (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print)
6. Social Life of the Tamils - The Classical Period (Dr.S.Singaravelu) (Published by: International Institute of Tamil Studies.
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu) (Published by: International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by: International Institute of Tamil Studies.)
9. Keeladi - 'Sangam City C ivilization on the banks of river Vaigai' (Jointly Published by: Department ofArchaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by: The Author)
11. Porunai Civilization (Jointly Published by: Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) – Reference Book.

21EM101	**ENGINEERING PRACTICES LABORATORY** ***(Common to all B.E / B.Tech. Programmes)***	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To draw pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- To demonstrate the basic switch board wiring, fluorescent lamp wiring and stair case wiring using various electrical components.
- To choose various joints in steel plates using arc welding work and machining various simple processes like turning, drilling, tapping in parts
- To build a tray out of metal sheet using sheet metal work.
- To develop electronic circuit and testing for soldering and desoldering using PCB board.

LIST OF EXPERIMENTS:

GROUP – A (CIVIL & ELECTRICAL)

PART – I

CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances

WOOD WORK:

- Sawing,
- Planning and Making joints like T-Joint, Cross lap and Dovetail joint.

PART – II

ELECTRICAL ENGINEERING PRACTICES

- Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin sockets.
- Staircase wiring
- Fluorescent Lamp wiring with introduction to CFL and LED types.
- Energy meter wiring and related calculations/ calibration
- Study of Iron Box wiring and assembly
- Study of Fan Regulator (Resistor type and electronic type using Diac/Triac/quadrac)
- Measurement of resistance to earth of an electrical equipment.

GROUP – B (MECHANICAL & ELECTRONICS)

PART III

MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

- Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
- Practicing gas welding.

BASIC MACHINING WORK:

- Usage of Spanners and screw drivers
- Facing and Turning.
- Taper Turning

ASSEMBLY WORK:

- Assembling a centrifugal pump.
- Assembling a household mixer.
- Assembling an air conditioner.

SHEET METAL WORK:

- Making of a square tray

FOUNDRY WORK:

- Demonstrating basic foundry operations.

PART IV

ELECTRONIC ENGINEERING PRACTICES

SOLDERING WORK:

- Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

- Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

- Study elements of smart phone.
- Assembly and dismantle of computer / laptop

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build various plumbing joints

CO2: Develop various carpentry joints.

CO3: Construct various wiring electrical joints in common household electrical wire work.

CO4: Construct various welded joints, sheet metal and basic machining operations

CO5: Develop the electronic circuit for soldering and testing using PCB board.

21AD102	PROGRAMMING PARADIGM IN C LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To develop programs in C using basic constructs.
- To develop programs in C using arrays.
- To develop applications in C using strings, pointers, functions.
- To develop applications in C using structures.
- To develop applications in C using file processing

LIST OF EXPERIMENTS

1. I/O statements, operators, expressions
2. Decision-making constructs: if-else, goto, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, Multi-dimensional arrays, traversal
5. Strings: operations, Search and Sort
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function, Recursion
7. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
8. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
9. Files: reading and writing, File pointers, file operations, random access, processor directives.
10. Data Analytics: Reading the data from CSV file and Sorting the data.

TOTAL :60PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Develop programs in C using basic constructs

CO2: Develop programs in C using arrays

CO3: Develop applications in C using strings, pointers, functions

CO4: Develop applications in C using structures.

CO5: Develop applications in C using file processing and Data analytics

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER - III

		L	T	P	C
21MA203	**DISCRETE MATHEMATICS (COMMON TO B.E. CSE & B.Tech. IT)**	**3**	**2**	**0**	**4**

COURSE OBJECTIVES:

The main objectives of this course are:

- To extend student's logical and mathematical maturity and ability to deal with abstraction.
- To understand the basic concepts of Combinatorics.
- To study about the properties and characters of different graphs.
- To familiarize the applications of algebraic structures.
- To identify the concepts and significance of lattices and Boolean algebra which arewidely used in computer science and engineering.

UNIT I	**LOGIC AND PROOFS**	**12**
Propositional Logic – Propositional Equivalences - Predicates and Quantifiers – Nested Quantifiers – Rules of Inference - Introduction to Proofs – Proof Methods and Strategy.		
UNIT II	**COMBINATORICS**	**12**
Mathematical Induction – The Pigeonhole Principle – Permutations and Combinations – Recurrence Relations – Solving Linear Recurrence Relations – Generating Functions – Inclusion and Exclusion Principle and Its Applications.		
UNIT III	**GRAPHS**	**12**
Graph Terminology and Special Types of Graphs – Matrix Representation of Graphs and Graph Isomorphism – Connectivity – Euler and Hamilton Paths.		
UNIT IV	**ALGEBRAIC STRUCTURES**	**12**
Groups – Subgroups – Cyclic groups - Homomorphism – Normal Subgroup and Cosets – Lagrange's Theorem – Definitions and Examples of Rings and Fields.		
UNIT V	**LATTICES AND BOOLEAN ALGEBRA**	**12**
Partial ordering – Posets – Lattices as Posets – Properties of Lattices - Lattices as Algebraic Systems – Sub-Lattices – Some Special Lattices: Bounded, Modular, Distributive, Complemented.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Extend student's logical and mathematical maturity and ability to deal with abstraction.

CO2: Explain the basic concepts of Combinatorics.

CO3: Make use of the concept of graph theory in computer science and engineering.

CO4: Disseminate the applications of algebraic structures.

CO5: Examine the basic theorems and properties of Lattices and Boolean Algebra.

TEXT BOOKS:

1. Rosen, K.H., "Discrete Mathematics and its Applications", 7^{th} Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 2011.

2. Tremblay J.P. &Manohar.R,"Discrete Mathematics Structures with Application to Computer Science", 1st Edition, Tata McGraw Hill Publication Ltd., New Delhi, 30th reprint 2011.
3. Liu C.L, Mohapatra D.P, "Elements of Discrete Mathematics: A computer-oriented approach", 4th Edition, Tata McGraw Hill, New Delhi, 2017.

REFERENCES:

1. Grimaldi.R.P., "Discrete and Combinatorial Mathematics: An applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2. Koshy, "Discrete Mathematics with Applications", 1st Edition, Elsevier Publications, 2006.
3. Bernard Kolman, Robert C Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 3rd Edition, Prentice Hall, New Delhi, 2015.

21AD201	OPERATING SYSTEM PRINCIPLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the basics and functions of operating systems.
- To analyze Scheduling algorithms and process synchronization.
- To analyze various memory management schemes.
- To be familiar with I/O management and File systems.
- To be familiar with the basics of virtual machines and Mobile OS like iOS and Android.

UNIT-I	**INTRODUCTION**	**9**

Computer System - Elements and organization; Operating System Overview - Objectives and Functions - Evolution of Operating System; Operating System Structures – Operating System Services - User Operating System Interface - System Calls – System Programs - Design and Implementation - Structuring methods

UNIT-II	**PROCESS MANAGEMENT**	**9**

Basic concepts – Scheduling criteria – Scheduling algorithms – Thread scheduling – Multiple processor scheduling – Operating system examples – Algorithm Evaluation – The critical-section problem – Peterson‘s solution – Synchronization hardware – Semaphores – Classic problems of synchronization – Critical regions – Monitors – Synchronization examples – Deadlocks – System model – Deadlock characterization – Methods for handling deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock detection – Recovery from deadlock.

UNIT-III	**MEMORY MANAGEMENT**	**9**

Main Memory - Swapping - Contiguous Memory Allocation – Paging - Structure of the Page Table - Segmentation; Virtual Memory - Demand Paging – Copy on Write – Page Replacement – Allocation of frames -Thrashing.

UNIT-IV	**I/O SYSTEMS**	**9**

File concept – Access methods – Directory structure – File-system mounting – Protection – Directory implementation – Allocation methods – Free-space management – Disk scheduling – Disk management – Swap-space management – Protection

UNIT-V	**VIRTUAL MACHINES AND MOBILE OS**	**9**

Virtual Machines – History, Benefits and Features, Building Blocks, Types of Virtual Machines and their Implementations, Virtualization and Operating-System Components; Mobile OS - iOS and Android.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Analyze various scheduling algorithms and process synchronization.

CO2: Explain deadlock, prevention and avoidance algorithms.

CO3: Compare and contrast various memory management schemes.

CO4: Explain the functionality of file systems I/O systems

CO5: Compare iOS and Android Operating Systems.
TEXT BOOKS: 1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, “Operating System Concepts”‖, 10th Edition, John Wiley and Sons Inc., 2018. 2. Andrew S Tanenbaum, "Modern Operating Systems", Pearson, 5th Edition, 2022 New Delhi 3. William Stallings, "Operating Systems: Internals and Design Principles”, Seventh Edition, Prentice Hall,2011.
REFERENCES: 1. Andrew S.Tanenbaum,"Modern Operating Systems”, Second Edition, Addison Wesley,2001. 2. D M Dhamdhere, "Operating Systems: A Concept-based Approach”, Second Edition, Tata McGraw-Hill Education,2007. 3. Charles Crowley, "Operating Systems: A Design-Oriented Approach”, Tata McGraw Hill Education‖,1996.

21AD203	DATA STRUCTURE DESIGN USING PYTHON	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To create and use classes, objects, methods, and inheritance in Python.
- To store and manipulate data using lists, dictionaries, and regular expressions in Python.
- To learn about the Arrays and Linked list data structures in Python.
- To implement Stack and Queues in Python
- To Perform Search operation in Graphs and Trees.

UNIT-I	OOPS CONCEPTS	9

Class, object, constructors, types of variables, types of methods. Inheritance: single, multiple, multi-level, hierarchical, hybrid, Polymorphism: with functions and objects, with class methods, with inheritance, Abstraction: abstract classes.

UNIT II	DATA STRUCTURES	9

Definition, Linear Data Structures, Non-Linear Data Structures, Python Specific Data Structures: List, Tuples, Set, Dictionaries, Comprehensions and its Types, Strings, slicing, Searching -Linear Search and Binary Search, Sorting - Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort.

UNIT-III	ARRAYS&LINKED LIST	9

Arrays - Overview, Types of Arrays, Operations on Arrays, Arrays vs List. Linked Lists – Implementation of Singly Linked Lists, Doubly Linked Lists, and Circular Linked Lists.

UNIT-IV	STACK&QUEUES	9

Stacks - Overview of Stack, Implementation of Stack (List & Linked list), Applications of Stack
Queues: Overview of Queue, Implementation of Queue (List & Linked list), Applications of Queues, Priority Queues.

UNIT-V	GRAPHS&TREES	9

Graphs -Introduction, Directed vs Undirected Graphs, Weighted vs Unweighted Graphs, Representations, Breadth First Search, Depth First Search. Trees - Overview of Trees, Tree Terminology, Binary Trees, Tree Traversals, Binary Search Trees, AVL Trees.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret the concepts of Object-Oriented Programming as used in Python.
CO2: Implement Searching and sorting in Python.
CO3: Identify the operation of Array and Linked list in Python.
CO4: Demonstrate the applications of Stack and Queues in Python.
CO5: Represent the searching algorithms in Graphs and Trees in Python.

TEXTBOOKS:

1. Michael T. Goodrich, Roberto Tamassia, and Michael H. Goldwasser, “Data Structures and Algorithms in Python” (An Indian Adaptation), Wiley, Second Edition, 2021.
2. Dr. Basant Agarwal, Benjamin Baka, “Hands-On Data Structures and Algorithms with Python: Write complex and powerful code using the latest features of Python 3.7”, Packet Publishing, 2nd Edition, 2018.
3. Narasimha Karumanchi, “Data Structures and Algorithmic Thinking with Python”, Kindle Edition, First Edition, 2015.

REFERENCES:

1. R. Nageswara Rao, “Core Python Programming”, Dreamtech Press, Second Edition,2023
2. Lee, Kent D., Hubbard, Steve, “Data Structures and Algorithms with Python” Springer, First Edition 2015.
3. Rance D. Necaise, “Data Structures and Algorithms Using Python”, John Wiley & Sons, First Edition, 2011.

21AD205	PRINCIPLES OF ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To identify the basic concepts and principles of artificial intelligence and intelligent systems.
- To develop intelligent agents that can make decisions in uncertain environments.
- To solve the search algorithms for real-world problems.
- To make use of knowledge representation systems for real-world problems.
- To build machine learning algorithms to real-world problems.

UNIT-I	INTRODUCTION TO AI AND INTELLIGENT SYSTEMS	9
Definition, Scope, and History of AI-Turing Test and its Implications, Intelligent Agents and their Classifications, Structure of Intelligent Agents, Applications of Intelligent Systems.		
UNIT-II	**PROBLEM SOLVING**	**9**
Problem Representation and State-Space Search - Uninformed Search Algorithms- BFS, DFS, UCS, Informed Search Algorithms - A* Algorithm and Heuristics.		
UNIT-III	**SEARCH IN COMPLEX ENVIRONMENTS**	**9**
Adversarial Search - Games, Optimal Decisions in Games, The Minimax Algorithm, Alpha-BetaPruning, and Constraint Satisfaction Problems (CSP), Backtracking Search for CSPs.		
UNIT-IV	**KNOWLEDGE REPRESENTATIONAND REASONING**	**9**
Propositional and Predicate Logic, Resolution and Inference Rules, Semantic Networks and Frames, Ontologies and Knowledge Graphs.		
UNIT-V	**MACHINE LEARNING**	**9**
Introduction to Machine Learning and its Types, Supervised Learning - Regression, Classification, Unsupervised Learning - Clustering, Dimensionality Reduction.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build artificial intelligence techniques to solve real-world problems.
CO2: Make use of search algorithms to solve problems in a state-space.
CO3: Select adversarial search techniques to make optimal decisions in games.
CO4: Construct knowledge representation in propositional and predicate logic.
CO5: Choose machine learning techniques to classify data and cluster data.

TEXTBOOKS:

1. Stuart Russell and Peter Norvig, “Artificial Intelligence – A Modern Approach”, 4th Edition, Pearson Education, 2021.
2. Ethem Alpaydin, “Introduction to Machine Learning”, 4thEdition, MIT Press, 2020.
3. Saikat Dull, S. Chandramouli, Das, “Machine Learning”,1st Edition, Pearson,2018.

REFERENCES:

1. Deepak Khemani, “Artificial Intelligence”, 2ndEdition, TataMcGrawHillEducation,2013.
2. Kevin Night, Elaine Rich, and Nair B., “Artificial Intelligence”,1stEdition, McGrawHill,2008.
3. PatrickH.Winston,"ArtificialIntelligence",3rdEdition, PearsonEducation,2006.

21AD206	SOFTWARE ENGINEERING PRINCIPLES AND DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the concepts of software process.
- To gain knowledge about analysis and design.
- To acquire knowledge on developing UML diagrams.
- To know about software testing and project execution.
- To learn about agile development methodology.

UNIT-I	SOFTWARE PROCESS AND DEVELOPMENT	6

Software engineering concepts – Development activities – Software lifecycle models –Classical waterfall –Iterative waterfall – Prototyping – Evolutionary –Spiral – Win Win Spiral model – Prototyping model –Increment model – RAD model – Specialized process models – The rational unified process

UNIT-II	SOFTWARE REQUIREMENTS ANALYSIS, DESIGN CONCEPTS AND PRINCIPLES	6

Software Requirement Analysis & Design - Functional and non-functional – Software requirement document – Requirement engineering process – Feasibility studies – Functional and behavioral models - Structured analysis and data dictionary–Design process and concepts–Design heuristic – Architectural design – Mapping data flow into a software architecture –Data design – User interface design – Real time software design.

UNIT-III	OBJECT ORIENTED ANALYSIS AND DESIGN	6

Introduction to OOAD with OO Basics — Unified Process - UML Diagrams – Static, Dynamic & Implementation Diagrams.

UNIT-IV	SOFTWARE TESTING & PROJECT MANAGEMENT	6

Taxonomy of software testing – Types of S/W testing – Black box testing – White box testing – Regression testing – Unit testing – Integration testing – Validation testing – System testing – Software cost estimation – Function point models – COCOMO Model – Delphi method –Project planning – Project scheduling – Risk management – Software configuration management.

UNIT-V	AGILE SOFTWARE DEVELOPMENT AND SCRUM FRAMEWORK	6

Fundamentals of Agile Process Methods – Values – Principles – stakeholders – Challenges – Agile Manifesto and Principles - Agile project management – Design and development practices in Agile projects - User Stories – Agile Testing – Scrum Framework - Scrum Practices – Applying Scrum – Need of scrum – working of scrum – Advanced Scrum Applications – Scrum and the Organization – scrum values – Scrum case study – Tools for Agile project management.

30 PERIODS

PRACTICAL EXERCISES:	30 PERIODS

I. Do the following exercises for any one project given in the list of sample projects.

1. Development of problem statement.
2. Preparation of Software Requirement Specification Document, Design Documents and Testing Phase related documents (Test Cases).
3. Identify use cases and develop the Use Case model.
4. Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram.
5. Using the identified scenarios, find the interaction between objects and represent them using UML Sequence and Collaboration Diagrams.
6. Draw relevant State Chart and Activity Diagrams for the same system.

II. Use agile methodology and scrum framework for any one project (Write User Stories and develop sprints)

Sample Projects:
Online Course Registration
Airline/Railway reservation system
e-book management system
Recruitment system
Passport automation system.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, learners will be able to
CO1: Apply software engineering principles for software development
CO2: Use software requirement specification and design software according to the specification.
CO3: Use UML diagram to design project deliverables.
CO4: Apply different testing and manage the software.
CO5: Implement Agile Scrum for software projects

TEXTBOOKS:

1. Roger S. Pressman, “Software Engineering: A practitioner’s Approach”, McGraw-Hill International Edition, Seventh Edition, 2014.
2. Craig Larman, “Applying UML and Patterns: An Introduction to Object Oriented Analysis and Design and Iterative Development”, Third Edition, Pearson Education, 2005.
3. Robert C. Martin, “Agile Software Development, Principles, Patterns and Practices”, Pearson Education Limited, First Edition, 2013

REFERENCES:

1. Martin Fowler, ―UML Distilled: A Brief Guide to the Standard Object Modeling Language‖, Third edition, Addison Wesley, 2003.
2. Ian Sommerville, "Software engineering", Pearson Education Limited, Ninth Edition, 2012
3. James F.Peters and Witold Pedrycz, "Software Engineering, An Engineering Approach", Wiley-India, Third Edition, 2007

21AD202	OPERATING SYSTEM PRINCIPLES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To install windows operating systems.
- To understand the basics of UNIX command and shell programming.
- To implement Deadlock Avoidance and Deadlock Detection Algorithms
- To implement Page Replacement Algorithms
- To implement various memory allocation methods.
- To be familiar with File Organization and File Allocation Strategies

LIST OF EXPERIMENTS

1. Installation of windows operating system
2. Illustrate UNIX commands and Shell Programming
3. Process Management using System Calls : Fork, Exit, Getpid, Wait, Close
4. Write C programs to implement the various CPU Scheduling Algorithms
5. Illustrate the inter process communication strategy
6. Implement mutual exclusion by Semaphore
7. Write C programs to avoid Deadlock using Banker's Algorithm
8. Write a C program to Implement Deadlock Detection Algorithm
9. Write C program to implement Threading
10. Implement the paging Technique using C program

TOTAL :60PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Define and implement UNIX Commands.
CO2: Compare the performance of various CPU Scheduling Algorithms.
CO3: Compare and contrast various Memory Allocation Methods.
CO4: Define File Organization and File Allocation Strategies.
CO5: Implement various Disk Scheduling Algorithms.

21AD204	DATA STRUCTURE DESIGN USING PYTHON LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the Oops concept in Python
- To implement search and sorting algorithms in Python
- To learn about the Linked lists and arrays in Python
- To implement Stack and Queue operations in Python
- To define various Tree and Graph structures in Python.

LIST OF EXPERIMENTS

11. Write a program to implement Inheritance.
12. Write a program for Linear Search and Binary search.
13. Write a program to implement Bubble Sort and Selection Sort.
14. Write a program to implement Merge sort and Quick sort.
15. Write a program to implement Stacks and Queues.
16. Write a program to implement Singly Linked List.
17. Write a program to implement Doubly Linked list.
18. Write a program to implement Circular Linked list.
19. Write a program to implement Binary Search Tree.
20. Write a program to implement BFS & DFS.

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate the Oops Concepts.
CO2: Interpret the data structure concepts.
CO3: Implement Array and Linked list operations.
CO4: Make use of Stack and Queue in real world applications.
CO5: Understand the application of Trees and Graphs.

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

SEMESTER- IV

21MA208	PROBABILITY AND STATISTICS B.Tech. AI & DS	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

The main objectives of this course are:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.
- To introduce the basic concepts of probability and random variables.
- To introduce the basic concepts of two-dimensional random variables.
- To acquaint the knowledge of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To introduce the basic concepts of classifications of design of experiments which plays very important roles in the field of agriculture and statistical quality control.

UNIT I	PROBABILITY AND RANDOM VARIABLES	12

Probability – The axioms of probability – Conditional probability – Baye's theorem - Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential and Normal distributions.

UNIT II	TWO - DIMENSIONAL RANDOM VARIABLES	12

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III	TESTING OF HYPOTHESIS	12

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV	DESIGN OF EXPERIMENTS	12

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT V	STATISTICAL QUALITY CONTROL	12

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the fundamental knowledge of the concepts of probability and have knowledge of standard distributions which can describe real life phenomenon.

CO2: Understand the basic concepts of one- and two-dimensional random variables and apply in engineering applications.

CO3: Apply the concept of testing of hypothesis for small and large samples in real life problems.
CO4: Apply the basic concepts of classifications of design of experiments in the field of agriculture and statistical quality control.
CO5: Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXTBOOKS:

1. Johnson. R.A., Miller. I.R and Freund. J.E, & quot; Miller and Freund's Probability and Statistics for Engineers & quot;, Pearson Education, Asia, 9 th Edition, 2016.
2. Milton. J. S. and Arnold. J.C., & quot; Introduction to Probability and Statistics & quot;, Tata Mc Graw Hill, 4th Edition, 2007.
3. John E. Freund, & quot; Mathematical Statistics & quot;, Prentice Hall, 5th Edition, 1992.

REFERENCES:

1. Gupta. S.C. and Kapoor. V. K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, New Delhi, 12 th Edition, 2020.
2. Devore. J.L., & quot; Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8 th Edition, 2014.
3. Ross. S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 5 th Edition, Elsevier, 2014.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., " Schaum's Outline of Theory and Problems of Probability and Statistics & quot;, Tata McGraw Hill Edition, 4 th Edition, 2012.
5. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., & quot; Probability and Statistics for Engineers and Scientists & quot;, Pearson Education, Asia, 9 th Edition, 2010.

21AD207	ANALYSIS OF ALGORITHMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand and apply the algorithm analysis techniques on searching and sorting algorithms
- To critically analyze the efficiency of graph algorithms
- To understand different algorithm design techniques
- To solve programming problems using state space tree
- To understand the concepts behind NP Completeness, Approximation algorithms and
- randomized algorithms.

UNIT-I	INTRODUCTION	9

Algorithm analysis: Time and space complexity - Asymptotic Notations and its properties Best case, Worst case and average case analysis – Recurrence relation: substitution method - Lower bounds –searching: linear search, binary search and Interpolation Search, Pattern search: The naïve string matching algorithm - Rabin-Karp algorithm - Knuth-Morris-Pratt algorithm. Sorting: Insertion sort –heap sort

UNIT-II	GRAPH ALGORITHMS	9

Graph algorithms: Representations of graphs - Graph traversal: DFS – BFS - applications - Connectivity, strong connectivity, bi-connectivity - Minimum spanning tree: Kruskal's and Prim's algorithm- Shortest path: Bellman-Ford algorithm - Dijkstra's algorithm - Floyd-Warshall algorithm Network flow: Flow networks - Ford-Fulkerson method – Matching: Maximum bipartite matching

UNIT-III	ALGORITHM DESIGN TECHNIQUES	9

Divide and Conquer methodology: Finding maximum and minimum - Merge sort - Quick sort Dynamic programming: Elements of dynamic programming — Matrix-chain multiplication - Multi stage graph — Optimal Binary Search Trees. Greedy Technique: Elements of the greedy strategy - Activity-selection problem –- Optimal Merge pattern — Huffman Trees

UNIT-IV	STATE SPACE SEARCH ALGORITHMS	9

Backtracking: n-Queens problem - Hamiltonian Circuit Problem - Subset Sum Problem – Graph colouring problem Branch and Bound: Solving 15-Puzzle problem - Assignment problem – Knapsack Problem - Travelling Salesman Problem

UNIT-V	NP-COMPLETE AND APPROXIMATION ALGORITHM	9

Tractable and intractable problems: Polynomial time algorithms – Venn diagram representation – NP algorithms - NP-hardness and NP-completeness – Bin Packing problem - Problem reduction: TSP – 3CNF problem. Approximation Algorithms: TSP - Randomized Algorithms: concept and application - primality testing - randomized quick sort - Finding kth smallest number

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Analyze the efficiency of algorithms using various frameworks

CO2: Apply graph algorithms to solve problems and analyze their efficiency.

CO3: Make use of algorithm design techniques like divide and conquer, dynamic programming and greedy techniques to solve problems

CO4: Use the state space tree method for solving problems.

CO5: Solve problems using approximation algorithms and randomized algorithms

TEXT BOOKS:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2009.
2. Ellis Horowitz, Sartaj Sahni, Sanguthevar Rajasekaran "Computer Algorithms/C++" Orient Blackswan, 2nd Edition, 2019.

REFERENCES:

1. Anany Levitin, “Introduction to the Design and Analysis of Algorithms”, 3rd Edition, Pearson Education, 2012.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Reprint Edition, Pearson Education, 2006.
3. S. Sridhar, “Design and Analysis of Algorithms”, Oxford university press, 2014.

21AD208	DATABASE DESIGN AND ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To design database using ER model and SQL.
- To apply functional dependencies and normalization concept in real time problems.
- To acquire knowledge on transactions, file organization and query processing.
- To understand basic data engineering concepts.
- To analyze the principle of data architecture and storage.

UNIT-I	INTRODUCTION AND DATABASE DESIGN	9

Database System – Purpose – Views of Data – System Structure - Models – Relational Model – ER Model - SQL Fundamentals & Features.

UNIT-II	NORMALIZATION	9

Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms – Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies & Fourth Normal Form – Join Dependencies & Fifth Normal Form.

UNIT-III	TRANSACTION AND IMPLEMENTATION TECHNIQUES	9

Transaction – ACID properties – Schedules – Serializability – Concurrency Control – Locking Protocol – Two Phase Locking – Deadlock - RAID – File Organization - Indexing and Hashing - Query Processing.

UNIT-IV	FUNDAMENTALS OF DATA ENGINEERING	9

Fundamentals Data Engineering, Data Engineering Lifecycle, Data Engineering vs. Data Science, Data Engineering Skills and Activities, Business and Technical Responsibilities.

UNIT-V	DATA ARCHITECTURE AND STORAGE	9

Principles of Data Architecture, Types of Data Architecture -Data Warehouse, Data Lake, Cloud vs. On-Premises Storage, Data Storage Systems, Distributed Storage, Object Storage, Data Platforms and Data Catalogs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify entities, attributes and their relationship, prepare ER model and use basics of SQL to write query.

CO2: Use functional dependencies, normal forms to design and normalize a database.

CO3: Summarize interleaved operations of transaction, file organization strategies, parsing and execution of SQL Statements.

CO4: Understand and summarize basics of data engineering concepts.

CO5: Analyze the principles governing Data Architecture and Storage in different applications.

TEXTBOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, “Database System Concepts”, Seventh Edition, Tata McGraw Hill, 2021.
2. Joe Reis, Matt Housley, “Fundamentals of Data Engineering”, 1st Edition, O’Reilly Media, 2022.
3. Brian Shive, “Data Engineering”, First Edition, Kindle Edition, 2013.

REFERENCES:

1. Paul Crickard, “Data Engineering with Python”, First Edition, Packet, 2020.
2. Hamid Mahmood Qureshi, Hammad Sharif, “Snowflake Cookbook: Techniques for building modern cloud data warehousing solutions”, 1st Edition, Kindle Edition, 2021.
3. Andreas Kretz, “The Data Engineering Cookbook”, The Data Engineering Academy, 2019.

21AD210	COMPUTER NETWORKING PRINCIPLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the basic fundamental concepts, functionalities of physical layer
- To understand the functionalities of data link layer.
- To learn the concepts in transport layer and application layer.
- To learn the fundamentals of cryptography.
- To understand the application layer security standards and real time security practices.

UNIT I	INTRODUCTION AND PHYSICAL LAYER	9

Data Communication – Networks – Network Types – TCP/IP model – OSI model – Layers – Physical layer –Topology – Transmission media – Switched Communications Networks – Circuit Switching – Packet Switching – Comparison of Circuit Switching and Packet Switching.

UNIT II	DATA LINK AND NETWORK LAYER	9

Error Detection and Correction – Hamming Code, CRC, Checksum– Flow control mechanism – Sliding Window Protocol – GoBack– N – Selective Repeat – Multiple access Aloha – Slotted Aloha – CSMA, CSMA/CD – Multiple Access Networks (IEEE 802.3), Token Ring(IEEE 802.5) and Wireless Networks (IEEE 802.11, 802.15) – IP addressing – Internet Protocol – ARP – RARP – IGMP – ICMP – Routing algorithms – Link State Routing – OSPF – Distance Vector Routing – RIP – DHCP

UNIT III	TRANSPORT AND APPLICATION LAYER	9

TCP and UDP– Congestion Control–Effects of Congestion–Traffic Management–TCP Congestion Control–Congestion Avoidance Mechanisms–Queuing Mechanisms– QoS Parameters - Domain Name System (DNS) – E–mail – SMTP – IMAP – POP3 – File Transfer Protocol – HTTP – SNMP.

UNIT IV	NETWORK SECURITY	9

OSI Security Architecture – Security Attacks, Services, Mechanism, Model – Symmetric Ciphers – Substitution and Transposition Techniques - Steganography – Block Cipher and DES – Key Distribution – Public Key Cryptography and RSA – Key Management - Diffie-Hellman Key Exchange – Message Authentication and Hash Functions – SHA – Digital Signature – DSS.

UNIT V	APPLICATION LAYER SECURITY AND PRACTICES	9

Electronic Mail Security: Pretty Good Privacy, S/MIME - Firewalls and Intrusion Detection Systems: Intrusion Detection Password Management, Firewall Characteristics Types of Firewalls, Firewall Basing, Firewall Location and Configurations - Blockchains, Cloud Security and IoT security.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline OSI model and the features of physical layer.

CO2: Make use of data link layer features to calculate error codes and apply protocols for the given network.

CO3: Compare congestion effects in a network and understand the concepts of application layer protocols.

CO4: Illustrate examples for cryptography techniques.

CO5: Apply security practices for real time applications.

TEXT BOOKS:

1. Behrouz A. Foruzan, “Data communication and Networking”, Tata McGraw-Hill, Fifth Edition, 2013

2. Cryptography and Network Security: Principles and Practice, 6th Edition, William Stallings, 2014, Pearson, ISBN 13:9780133354690.
3. Computer Networks -- Andrew S Tanenbaum, 4th Edition, Pearson Education, 2018.

REFERENCES:

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Morgan Kauffmann Publishers Inc., Third Edition, 2011
2. William Stallings, “Data and Computer Communication”, Pearson Education, Sixth Edition, 2000.
3. Network Security: Private Communications in a Public World, M. Speciner, R. Perlman, C. Kaufman, Prentice Hall, 2002.

21AD212	PRINCIPLES OF MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the concepts of machine learning
- To explore the different supervised learning techniques
- To learn different aspects of unsupervised learning algorithm
- To learn the role of probabilistic methods for machine learning
- To understand the basic concepts of neural networks and deep learning

UNIT-I INTRODUCTION TO MACHINE LEARNING 9

Introduction to Machine Learning (ML), Essential Concepts of ML, Types of Learning, Machine Learning Methods based on Time, Dimensionality, Linearity and Non Linearity, Early Trends in Machine Learning, Data Understanding Representation and Visualization.

UNIT-II SUPERVISED LEARNING ALGORITHMS 9

Linear, Non-Linear, Multi-Class and Multi-Label Classification, Support Vector Machine, Decision Trees: ID3, Classification and Regression Trees (CART), Regression: Linear Regression, Multiple Linear Regression, Logistic Regression.

UNIT-III UNSUPERVISED LEARNING 9

Clustering, Nearest Neighbor Models, K-Means, Hierarchical Clustering, KD Trees. Dimensionality Reduction, Linear Discriminant Analysis, Principal Component Analysis, Factor Analysis, Independent Component Analysis.

UNIT-IV LEARNING METHODS 9

Introduction, Naïve Bayes Algorithm, Maximum Likelihood, Maximum Apriori, Bayesian Belief Networks, Probabilistic Modelling of Problems, Inference in Bayesian Belief Networks, Probability Density Estimation, Sequence Models, Markov Models, Hidden Markov Models.

UNIT-V NEURAL NETWORKS AND DEEP LEARNING 9

Neural Networks, Biological Motivation, Perceptron, Multi-Layer Perceptron, Feed Forward Network, Back Propagation, Activation and Loss Functions, Limitations of Machine Learning, Deep Learning, Convolution Neural Networks, Recurrent Neural Networks, Use Cases.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the basic concepts of machine learning.
CO2: Build supervised learning models.
CO3: Construct unsupervised learning algorithms.
CO4: Implement Probabilistic Modelling for an application and analyze the results.
CO5: Understand the functions of neural network and deep learning**.**

TEXTBOOKS:

1. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
2. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 2017
3. Stephen Marsland, "Machine Learning: An Algorithmic Perspective, "Second Edition", CRC Press, 2014.

REFERENCES:

1. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, Second Edition, MIT Press, 2018.
2. Jason Bell, ―Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014.
3. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.

21AD209	DATABASE DESIGN AND ENGINEERING LAB	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To gain knowledge on basic commands of database.
- To execute constraints, views, sequence and synonyms.
- To understand execution of nested queries, procedures and functions.
- To be familiar with front end tool and database connectivity.
- To create simple datasets and implement visualization.

LIST OF EXPERIMENTS

1. Database Development Life cycle:
    - Problem definition and Requirement analysis
    - Scope and Constraints
2. Implement the database using SQL Data Definition with Constraints.
3. Query the database using SQL Manipulation and Control Statements.
4. Implementation Views, Sequences and Synonyms.
5. Query the database using Set Operators, Nested Queries and Join Queries.
6. Querying/Managing the database using SQL Programming
   - Stored Procedures/Functions
   - Constraints and security using Triggers
7. Database Design using ER Modeling, Normalization and Implementation for any application.
8. Database Connectivity with Front End Tools.
9. Case Study using Real Time Application – Collection of data – Create Dataset for the Application.
10. Create data visualization for any real time application.

Hardware: Standalone Desktops
Software: Oracle, NetBeans, VisualStudio, any open source tool for visualization

TOTAL :60PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use DDL, DML & DCL commands to experiment the creation of database.
CO2: Create an application to execute Views, Sequence and Synonyms.
CO3: Test a database application using nested queries and join queries.
CO4: Construct simple codes to execute functions and procedures.
CO5: Design an application using ER diagram, normalization and create simple dataset.

21AD211	COMPUTER NETWORKING PRINCIPLES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To learn network commands and implement flow control, error correction mechanisms
- To learn socket programming
- To implement and analyze various network protocols
- To learn different cipher techniques
- To implement the algorithms RSA, Diffie-Hellman and DSS.

LIST OF EXPERIMENTS

1. Implement commands like tcpdump, netstat, ifconfig, nslookup and traceroute, ping and traceroute
2. Implement error correction technique.
3. Implementation of socket programs using TCP & UDP
4. Simulation of sliding window protocols
5. Implementation of ARP/RARP
6. Implementation of routing protocols
7. Perform encryption, decryption using the following substitution techniques (i) Ceaser cipher, (ii) Playfair cipher iii) Hill Cipher
8. Implement RSA Algorithm
9. Implement the Diffie-Hellman Key Exchange algorithm for a given problem.
10. Implement the SIGNATURE SCHEME – Digital Signature Standard.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Implement various networking commands
CO2: Implement error correction codes
CO3: Implement network and application layer protocols using sockets.
CO4: Develop code for classical Encryption Techniques to solve the problems.
CO5: Build cryptosystems by applying symmetric and public key encryption algorithms.

21AD213	MACHINE LEARNING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To Understand the fundamental concepts of Machine Learning and its significance
- To build supervised learning models.
- To construct unsupervised learning models.
- To Introduce and implement the Naïve Bayes algorithm for probabilistic classification.
- To identify the working principles of neural network including the back propagation algorithm.

LIST OF EXPERIMENTS

1. Implement loading and exploring a machine learning dataset
2. Demonstrate various data pre-processing techniques for a given dataset.
3. Implement a support vector machine (SVM) model.
4. Develop Logistic Regression Model for a given dataset
5. Develop Decision Tree Classification model for a given dataset and use it to classify a new sample
6. Implement Naïve Bayes Classification in Python.
7. Implement Random Forest ensemble method on a given dataset.
8. Implement a principal component analysis (PCA) algorithm.
9. Implement a k-nearest neighbors (KNN) classifier.
10. Build Artificial Neural Network model with back propagation on a given dataset.

TOTAL :60PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify and apply the appropriate machine learning algorithm for a given problem.
CO2: Evaluate the Supervised learning models preprocessed through various feature engineering algorithms.
CO3: Implement and apply dimensionality reduction techniques such as principal component analysis.
CO4: Design and apply the Naive Bayes algorithm, maximum likelihood, and maximum a posteriori estimation.
CO5: Understand the basic concepts of neural network model and design the same.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER- V

21AD301	DEEP LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the fundamental techniques and principles of Neural Networks
- Identify and apply appropriate deep learning architectures for analyzing the data for a variety of problems.
- To analyze deep learning concepts with Convolutional Neural Network case studies
- To Implement different deep learning algorithms
- To study of an advanced deep learning technique

UNIT-I	INTRODUCTION TO DEEP LEARNING & NEURAL NETWORKS	9

Historical context and motivation for deep learning - Fundamentals of Neural Networks - Comparison of Biological and Artiicial Neurons - Perceptron –Model of Artificial Neuron – Feedforward neural networks - Deep networks -Regularizing a deep network, Model Exploration - Hyper parameter tuning.

UNIT-II	DEEP LEARNING ARCHITECTURES	9

Machine Learning and Deep Learning - Representation Learning - Width and Depth of Neural Networks - Activation Functions: RELU – LRELU – ERELU -Unsupervised Training of Neural Networks - Restricted Boltzmann Machines -Auto Encoders - Deep Learning Applications.

UNIT-III	CONVOLUTIONAL NEURAL NETWORK	9

Introduction to convolution neural networks: stacking, striding and pooling -Applications like image, and text classiication - Architectural Overview -Motivation, Layers, Filters, Parameter sharing, Regularization, Popular CNN Architectures: ResNet - AlexNet – Applications.

UNIT-IV	SEQUENCE MODELING: RECURRENT NETS	9

Unfolding computational graphs - Recurrent Neural Networks (RNNs), Bidirectional RNNs, Encoder - Decoder sequence to sequence architectures -Deep Recurrent Networks.

UNIT-V	ADVANCED DEEP LEARNING TECHNIQUES	9

Deep Belief Networks – Deep Boltzman Machine – Deep Associative Memory networks – Generative Neural Networks – Deep fake Technology –Case Study on designing deep learning solutions for identifying fake fingerprints, fake images and videos.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Demonstrate the basic concepts, fundamental learning techniques and layers.
CO2: Analyze and evaluate, in the context of a case study, the advantages and disadvantages of deep learning neural network architectures and other approaches.
CO3: Design convolutional networks for handwriting and object classification from images or video.
CO4: Design recurrent neural networks for sequence modeling.
CO5: Build, train and apply fully connected deep neural networks.

TEXT BOOKS:

1. Simon Haykin, “Neural Networks, A Comprehensive Foundation”, 2nd Edition, Addison Wesley Longman, 2001.
2. Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.

3. Jeff Heaton, Deep Learning and Neural Networks, Heaton Research Inc,2015.

REFERENCES:

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach", O'Reilly Media, 2017
2. Cosma Rohilla Shalizi, “Advanced Data Analysis from an Elementary Point of View”, 2015.
3. Deng & Yu, “Deep Learning: Methods and Applications”, Now Publishers,2013.

21AD302	DATA SCIENCE AND ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To gain knowledge in the basic concepts of Data Analysis
- To understand the concept and types of the analytics
- To explore the skills of Big Data Analytics
- To acquire knowledge in data interpretation and visualization techniques
- To understand the role of data analytics in Business Intelligence

UNIT-I	INTRODUCTION TO DATA SCIENCE	9

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT-II	FOUNDATION OF DATA ANALYTICS	9

Introduction, Evolution, Concept and Scopes, Data, Big Data, Metrics and Data classification, Data Reliability & Validity, Problem Solving with Analytics, Different phases of Analytics in the business and Data science domain, Descriptive Analytics, Predictive Analytics and Prescriptive Analytics, Different Applications of Analytics in Business, Text Analytics and Web Analytics, Skills for Business Analytics, Concepts of Data Science, Basic skills required for understanding Data Science.

UNIT-III	BIG DATA ANALYTICS	9

Classification of Digital Data, Structured and Unstructured Data - Introduction to Big Data: Characteristics – Evolution – Definition - Challenges with Big Data - Other Characteristics of Data - Why Big Data - Traditional Business Intelligence versus Big Data - Data Warehouse and Hadoop Environment. Big Data Analytics: Classification of Analytics – Challenges - Big Data Analytics important - Data Science - Data Scientist - Terminologies used in Big Data Environments - Basically Available Soft State Eventual Consistency - Top Analytics Tools.

UNIT-IV	EXPLORATORY DATA ANALYSIS	9

Data visualization using matplotlib, seaborn libraries, creating graphs (bar/line/pie/boxplot/histogram, etc.), summarizing data, descriptive statistics, univariate analysis (distribution of data), bivariate analysis (cross tabs, distributions and relationships, graphical analysis).

UNIT-V	LEARNING SQL WITH BUSINESS ANALYTICS	9

Learning SQL query structure with examples, Data management and query system OLTP and OLAP and Their data models, Data warehousing, ETL and data integration Dashboard creation using Tableau, Concepts of Business intelligence (BI), the relevance of BI in application to analytics industry and different domains.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Apply the skills of data inspecting and cleansing.
CO2: Classify data analytics techniques and compare with various applications.
CO3: Understand how various libraries used for data visualization.
CO4: Handle data using primary tools used for data science in Python.
CO5: Apply analytics tools for data describing and visualization.

TEXT BOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, Introducing Data Sciencell, Manning Publications, 2016. (first two chapters for Unit I)

2. Jesus Rogel-Salazar, ‘Advanced Data Science and Analytics with Python’,CRC Press Taylor and Francis Group,1st Edition , 2020.
3. BIG DATA and ANALYTICS, Seema Acharya, SubhasininChellappan, Wiley publications.2nd Edition, reprint 2019.

REFERENCES:

1. ‘Fundamentals of mathematical statistics’, S. C Gupta, V.K. Kapoor, Sultan Chand and Sons, 2014.
2. ‘Elements of Statistical Learning’- Hastie, Tibshirani, Friedman; Springer;2011.
3. ‘Data Science from Scratch’ – Grus; Google Books;2015.

21AD304	FULL STACK DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To gain knowledge on Interactive Web Page development.
- To learn about Programming servers using Node.js.
- To study client-side applications with React.
- To understand the Type script and use it.
- To study the deployment of web applications.

UNIT-I	HTML5, CSS AND JAVASCRIPT	9

HTML: Tags – structuring document – web page –Make it Prettier with CSS–Loading background images –Organizing files. JavaScript – Variables–Controlling HTML and CSS–Organizing JavaScript code

UNIT-II	SERVER SIDE – NODE.JS	9

Server–Side Action: Node and NPM – JavaScript Runtimes and Building Servers – Node Installation – NPM – NPM Commands – Initializing a New NPM/Node Project – Adding Dependencies – Semantic Versioning – Node Web Server – Advanced Node and NPM: package.json – other commands – Node: Standard Modules

UNIT-III	CLIENT–SIDE – REACT	9

Client–Side Adventures: React – History – Components – Props – Memory State – Style – Advanced React – JSX – Compile JSX – Put It All Together– Default Props – Typing Props – Component Lifecycle

UNIT-IV	TYPESCRIPT AND WEBPACK	9

TypeScript: Jumping into the Deep End – Configuring TypeScript Compilation – Types : String – Number – Boolean –Arrays – Tuples –Enums– Function – Object –Null, Void, and Undefined – Custom Type Aliases – Union Types – TypeScript == ES6 Features –Advanced TypeScript : Interfaces – Namespaces and Modules – Decorators – Third– Party Libraries – Debugging TypeScript Apps–Webpack : Bundle, and How Do I Make One–Webpack in detail – Getting Started with Webpack– Using Modules – Wither TypeScript

UNIT-V	APPLICATION DEPLOYMENT	9

MailBagServer: Basic Requirements – Setting Up the Project – Starting Point: main.ts–ServerInfo.ts– Time to Send the Mail – Time to Get the Mail – Reach Out and Touch Someone – NoSQL–NeDB– Testing–MailBagClient: Basic Requirements – Setting Up the Project – Starting Point: index.html –Redux: main.tsx – Configuration – Worker for All Seasons – Cavalcade of Components.Docker– Containers and Containerization – Installing Docker– Key Docker Commands – Creating Your Own Image – Deploying to Docker Hub – Wrapping Up MailBag

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Design Interactive Web Pages using HTML and CSS.
CO2: Develop server side coding with Node.js
CO3: Design client side applications with React
CO4: Use Typescript for web programming applications
CO5: Develop the server and client for any applications and deploy using containers

TEXT BOOKS:

1. Frank Zammetti, “Modern Full–Stack Development”, Apress, 2020
2. BRex van der Spuy “Foundation Game Design with HTML5 and JavaScript” Apress / friends of ED,2012

3. W. P. Petersen, P. Arbenz, “Introduction to ParallelComputing”, Oxford University Press, 2004.

REFERENCES:

1. PawełCzarnul, “Parallel Programming for ModernHigh PerformanceComputing “, CRC Press, 2018
2. Cyrus Dasadia, AmolNayak, “MongoDB Cookbook”, Packt Publishing , 2016
3. KrasimirTsonev, “Node.js by Example”, Packt Publishing, 2015

21AD303	DATA SCIENCE AND ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the Python Programming packages Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly, bokeh Language.
- To prepare data for data analysis through understanding its distribution.
- To expose on data processing using NUMPY and PANDAS
- To acquire knowledge in plotting using visualization tools.
- To understand and implement classification and Regression Model.

LIST OF EXPERIMENTS **9**

1. Create an empty and a full NumPy array.
2. Program to remove rows in Numpy array that contains non-numeric Values.
3. Program to build an array of all combinations of two NumPy arrays.
4. Program to add a border around a NumPy array.
5. Program to compare two NumPy arrays.
6. Write a Pandas program to create and display a DataFrame from a specified dictionary data which has the index labels.
7. Write a Pandas program to get the first 3 rows of a given DataFrame.
8. Write a Python program to draw a line with suitable label in the x axis, y axis and a title.
9. Write a Python program to draw line charts of the financial data of Alphabet Inc. between October 3, 2016 to October 7, 2016.
10. The table below gives the values of runs scored by Virat Kohli in last 25 T-20 matches. Represent the data in the form of less than type cumulative frequency distribution:

45	34	50	75	22
56	63	70	49	33
08	14	39	86	52
92	88	70	56	50
57	45	42	12	39

11. Program to find the sum and average of n integer numbers.
12. Program to find the variance and standard deviation of set of elements.
13. Program to plot a normal distribution in python.
14. Program to plot a Correlation and scatter plots.
15. Program for Linear Regression and Logistic Regression.
16. Mini project on real time applications

Tools: Python, Numpy, Scipy, Matplotlib, Pandas, statmodels, seaborn, plotly,bokeh

TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Develop relevant programming abilities.
CO2: Demonstrate knowledge of statistical data analysis techniques
CO3: Exhibit proficiency to build and assess data-based models.
CO4: Demonstrate skill in Data management & processing tasks using Python.
CO5: Apply data science concepts and methods to solve problems in real-world contexts and will communicate these solutions effectively

TEXT BOOKS:

1. Jake VanderPlas, —Python Data Science Handbook‖, O'Reilly, 2016.
2. Allen B. Downey, —Think Stats: Exploratory Data Analysis in Python‖, Green Tea Press,2014.
3. Data Science from Scratch: First Principles with Python, Second Edition by Joel Grus,2019.

21AD305	FULL STACK DEVELOMENT LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To gain knowledge on Interactive Web Page development
- To learn about Programming servers using Node.js
- To study client side applications with React
- To understand the Type script and use it
- To study the deployment of web applications

LIST OF EXPERIMENTS

1. Design Webpages for any given application
2. Write Server side programming with Node.js
3. Perform Email applications using Nodemailer Module
4. Write custom applications with Node.js and Mongo DB
5. Use React components, JSX, Class, Prop, Events
6. Write custom applications Forms with React
7. Use Type script for enhancing web application
8. Apply useCallback, use State, use Effect, useRef Hook of React to applications
9. Use Web Pack for Application
10. Bind server and client side and deploy as a deliverable application
11. Deploy applications to Docker Hub

TOTAL :60PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Design Interactive Web Pages

CO2: Develop server side coding with Node.js

CO3: Develop application using Mango DB.

CO4: Design client side applications with React and Typescript

CO5: Develop web applications and deploy.

21EN301	PROFESSIONAL COMMUNICATION LABORATORY *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are:

- To demonstrate communication skills that can lead to improved interpersonal relationships.
- To plan to set and achieve goals with focus.
- To organize themselves in work life to face the professional set up with confidence.
- To interpret ideas and participate in group discussion with positive attitude.
- To develop their confidence and help learners to attend interviews successfully.

UNIT I	COMMUNICATION AND PROFESSIONAL ETIQUETTES	6

•Importance and Types of Communication Verbal communication -Presentation skills- Non-Verbal communication - Personal Appearance, Posture, Gestures, Facial Expressions, Eye Contact and Space Distancing - Professional Etiquette

UNIT II	GOAL SETTING AND MOTIVATION	6

Short term and Long term Goals- Strategies to set and achieve goals- Motivation

UNIT III	TIME AND STRESS MANAGEMENT	6

Importance of Time - Time Management Skills - Sources of Stress - Managing Stress - Analysis of the Case Studies on time and stress management

UNIT IV	GROUP DISCUSSIONS AND POSITIVE ATTITUDE	6

Group Discussions - Leadership Qualities - Decision Making - Problem Solving - Negotiation Skills - Positive Attitude

UNIT V	RESUME MAKING AND INTERVIEW SKILLS	6

Preparing Resume - E - Resume - Covering Letter – Job Application through email - Career Portfolio - Types of Interviews - Mock Interviews

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate effective communication skills through presentations.

CO2: Utilize their knowledge of motivation in setting and achieving goals.

CO3: Examine time and stress management.

CO4: Formulate their ideas into an effective communication in formal contexts.

CO5: Develop a well-composed resume and face interviews confidently.

TEXT BOOKS:

1. Dhanavel S P, “English and Soft Skills”, First Edition , Orient BlackSwan Ltd, Hyderabad : 2012.
2. Dr. Tobin Porterfield & Bob Graham ,“The 55 Soft Skills That Guide Employee and Organizational Success,” Mason – West Publishing House , (January 4, 2018)
3. Prashant Sharma, “Soft Skills Personality Development for Life Success, “ BPB Publications, New Delhi, January 2018.

REFERENCES:

1. M. Ashraf Rizvi, “Effective Technical Communication,” Tata McGraw Hill Education Pvt. Ltd. New Delhi, 2016.
2. Mohan Krishna & Meera Banerji, “Developing Communication Skills,” First Edition, Trinity Press, 2017.
3. N. Krishnaswami& T. Sriraman, “Creative English for Communication,”Third edition, Laxmi Publications Private Limited, 2017.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER- VI

21AD306	NATURAL LANGUAGE PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the fundamentals behind the Language processing and perform word level analysis.
- To examine the NLP models and interpret algorithms for classification of NLP sentences by using both the traditional, symbolic and the more recent statistical approach.
- To understand the fundamentals of discourse analysis, inference, and knowledge representation.
- To understand the morphology, syntax, semantics, and pragmatics of the major language levels as described algorithmically for use in information retrieval and machine translation applications.
- To learn about the uses of natural language processing application and how to use fundamental algorithms in this area.

UNIT-I	INTRODUCTION TO NLP	9

Introduction to various levels of Natural Language Processing (NLP), Ambiguities and Computational challenges in processing various natural languages. Introduction to real life applications of NLP such as Spell and Grammar Checkers, Information Extraction, Question Answering, and Machine Translation.

UNIT-II	SYNTAX ANALYSIS	9

Context Free Grammars, Grammar Rules for English, Top-Down Parsing, Bottom-Up Parsing, Ambiguity, CKY Parsing, Dependency Parsing, Earley Parsing - Probabilistic Context-Free Grammars.

UNIT-III	SEMANTIC ANALYSIS	9

Representing Meaning, Lexical Semantics, Word Senses, and Relation between Senses, Word Sense Disambiguation, Word Embeddings, Word2Vec, CBOW, Skip-gram and GloVe, Discourse Segmentation, Text Coherence, Discourse Structure.

UNIT-IV	LANGUAGE MODELS	9

The role of language models, Simple N-gram models, Estimating parameters and smoothing, Evaluating language models, Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM).

UNIT-V	NLP APPLICATION (Chatbot)	9

Introduction to Chatbot Applications, Retrieval based- Conversation based, Information Extraction and its approaches, Information Retrieval, Semantic Search and Evaluation, Question Answering, Summarization, Extractive Vs Abstractive Summarization, Machine Translation.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Understand the concept of NLP and illustrate its real time application.
CO2: Illustrate the methods of syntax analysis, such as probabilistic context-free grammars.
CO3: Use semantics and discourse analysis methods to NLP and perform comparative study.
CO4: Compare language modelling techniques based on the structure of the language.
CO5: Demonstrate recent applications that use Natural Language Processing approaches.

TEXT BOOKS:

1. Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd edition, Prentice Hall, 2009.
2. C.Manning and H.Schutze, —Foundations of Statistical Natural Language Processing‖, MIT Press. Cambridge, MA, 1999.
3. NitinIndurkhya, Fred J. Damerau "Handbook of Natural Language Processing", Second Edition, CRC Press, 2010.

REFERENCES:

1. Rothman, Denis. Transformers for Natural Language Processing: Build innovative deep neural network architectures for NLP with Python, PyTorch, TensorFlow, BERT, RoBERTa, and more. Packt Publishing Ltd, 2021.
2. James Allen "Natural Language Understanding", Pearson Publication 8th Edition. 2012.
3. Tom Hoobyar, Tom Dotz, Susan Sanders, "NLP: The Essential Guide to Neuro-Linguistic Programming", 2013.

21AD308	COMPUTER VISION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the concepts of image formation and processing.
- To understand feature detection and feature matching.
- To understand the basics of feature-based alignment and motion estimation.
- To execute 3D reconstruction.
- To learn about image based rendering and recognition.

UNIT-I	INTRODUCTION TO IMAGE FORMATION AND PROCESSING	6

Computer Vision - Geometric primitives and transformations - Photometric image formation – The digital camera - Point operators - Linear filtering - More neighborhood operators – Fourier transforms - Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT-II	FEATURE DETECTION, MATCHING AND SEGMENTATION	6

Points and patches - Edges - Lines - Segmentation - Active contours - Split and merge - Mean shift and mode finding - Normalized cuts - Graph cuts and energy-based methods.

UNIT-III	FEATURE-BASED ALIGNMENT & MOTION ESTIMATION	6

2D and 3D feature-based alignment - Pose estimation - Geometric intrinsic calibration - Triangulation - Two-frame structure from motion - Factorization - Bundle adjustment – Constrained structure and motion - Translational alignment - Parametric motion - Spline-based motion – Optical flow - Layered motion.

UNIT-IV	3D RECONSTRUCTION	6

Shape from X - Active range finding - Surface representations - Point-based representations Volumetric representations - Model-based reconstruction - Recovering texture maps and albedosos.

UNIT-V	IMAGE-BASED RENDERING AND RECOGNITION	6

View interpolation Layered depth images - Light fields and Lumigraphs - Environment mattes - Video-based rendering-Object detection - Face recognition - Instance recognition – Category recognition - Context and scene understanding- Recognition databases and test sets.

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. OpenCV Installation and working with Python
2. Basic Image Processing - loading images, Cropping, Resizing, Thresholding, Contour analysis, Bolb detection.
3. Image Annotation – Drawing lines, text circle, rectangle, ellipse on images.
4. Image Enhancement - Understanding Color spaces, color space conversion, Histogram equialization, Convolution, Image smoothing, Gradients, Edge Detection.
5. Image Features and Image Alignment – Image transforms – Fourier, Hough, Extract ORB Image features, Feature matching, cloning, Feature matching based image alignment.
6. Image segmentation using Graphcut / Grabcut
7. Camera Calibration with circular grid.
8. Pose Estimation

9. 3D Reconstruction – Creating Depth map from stereo images.
10. Object Detection and Tracking using Kalman Filter, Camshift

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

- Summarize theories and methods of image processing and computer vision.
- Apply image processing techniques in OpenCV.
- Apply feature-based image alignment, segmentation and motion estimation for 2D image.
- Implement 3D reconstruction techniques.
- Design real time applications for image processing and computer vision.

TEXTBOOKS:

1. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.

REFERENCES:

1. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
2. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
3. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.

21AD307	NATURAL LANGUAGE PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To implement NLP concepts
- To implement text classification and summarization
- To understand Sentiment Analysis
- To learn spam detection model
- To design statistical processing for real-time applications

LIST OF EXPERIMENTS

1. Implementation of resume screening with python
2. Development of Sentiment Analysis with python
3. Develop Keyword extraction with python
4. Development of NLP for other languages
5. Implement NLP for whatsapp chat
6. Chatbot Implementation
7. Implement of next word prediction model

Requirement: Standalone desktops with Python

TOTAL :60PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Implement NLP concepts using python
CO2: Create NLP applications for other languages
CO3: Illustrate detection models
CO4: Develop applications using sentiment analysis
CO5: Implement whatsapp chat analysis

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY
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DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
SEMESTER- VII

21AD401	DATA VISUALIZATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
The main objectives of this course are:
- To learn about the different types of data and how to visualize them effectively.
- To develop skills in applying visualization techniques to solve problems and understand data.
- To use a structured approach to create effective visualizations.
- To extract valuable insights from large datasets using visualization.
- To build visualization dashboards to support decision-making.

UNIT-I	**INTRODUCTION**	**9**
Overview of data visualization - Data Abstraction - Data Types, Dataset Types, Attribute Types Task Abstraction – Analysis tasks abstractly, Designer or User action, Four Levels for Validation, four Levels of Design Angles of Attack Threats and Validation Approaches.		
UNIT-II	**VISUALIZATION TECHNIQUES**	**9**
Scalar and point techniques, vector visualization techniques, multidimensional techniques, visualizing cluster analysis, matrix visualization in Bayesian data analysis.		
UNIT-III	**VISUAL ANALYTICS**	**9**
Arrange Networks and Trees, Connection -Link Marks, Matrix Views, Costs and Benefits: Connection vs. Matrix, Containment- Hierarchy Heat Map, Map Color and Other Channels, Color Theory Color maps Other Channels.		
UNIT-IV	**VISUALIZATION TOOLS & TECHNIQUES**	**9**
Manipulate View- Change View over Time Select Elements Navigate: Changing Viewpoint Navigate: Reducing Attributes -Visualization Attributes, Introduction to various data visualization tools, Visualization using R		
UNIT-V	**DIVERSE TYPES OF VISUAL ANALYSIS**	**9**
Time- Series Analysis, Ranking Analysis, Deviation Analysis, Distribution Analysis, Correlation Analysis Multivariate Analysis, Integration of visualization tools with Hadoop. Visualization Dashboard Creations Dashboard creation using visualization tools for the use cases: Finance-marketing-insurance-healthcare.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, learners will be able to

CO1: Discover various data types and ways to visualize them for better understanding.
CO2: Identify visualizations techniques to specific problems using datasets.
CO3: Understand the different techniques for arranging networks and trees structured approach for visual analytics.
CO4: Show how to analyze extensive datasets using different visualization methods and tools.
CO5: Create dashboards with visualizations to help make decisions on large dataset.

TEXTBOOKS:

1. Tamara Munzer, Visualization Analysis and Design -, first edition,CRC Press 2015
2. Andy Kirk, Data Visualisation A Handbook for Data Driven Design, Second Edition,2019
3. Stephen Few, Now You See It -, Analytics Press, 2009

REFERENCES:

1. Dr.Chun-hauh Chen, W.K.Hardle,A.Unwin, Handbook of Data Visualization, Springer publication,2008
2. Ben Fry, Visualizing Data -, O'Reilly Media, 2008
3. John Verzani, Simpler- Using R for introductory statistics, Taylor&Francis, 2005

21AD402	DATA VISUALIZATION LAB	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand various type of data, apply and evaluate the principles of data visualization
- To acquire skills to apply visualization techniques to a problem and its associated dataset
- To understand the benefits and drawbacks of using connection and matrix views for data visualization.
- To identify the various visualization tools and techniques to represent large dataset.
- To learn how to bring valuable insight from a massive dataset using visualization

LIST OF EXPERIMENTS

1. Implement a Program for acquiring and plotting data
2. Implement a Program for Statistical Analysis such as Multivariate Analysis, PCA, LDA, Correlation, regression and analysis of variance
3. Implement a Program for Financial analysis using Clustering, Histogram and HeatMap
4. Implement a Program for Time-series analysis stock market
5. Implement a Program for Visualization of various massive dataset - Finance - Healthcare - Census – Geospatial
6. Implement a Program for Visualization on Streaming dataset (Stock market dataset, weather forecasting)
7. Implement a Program for Market-Basket Data analysis-visualization
8. Implement a Program for Text visualization using web analytics.

TOTAL: 60PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the concepts of data abstraction and task abstraction in data visualization.

CO2: Identify and apply the different types of visualization techniques to data.

CO3: Use visual analytics techniques to explore and analyze data.

CO4: Use visualization tools to perform diverse types of visual analysis.

CO5: Create dashboard using visualization tools for different use cases**.**

SEMESTER VIII

21AD404	PROJECT WORK II	L	T	P	C
		0	0	20	10

COURSE OBJECTIVES:

The main objectives of this course are:

- To gain domain knowledge, and technical skills to solve potential business / research problems.
- To gather requirements and design suitable software solutions and evaluate alternatives.
- To work in small teams and understand the processes and practices in the ‘industry.
- To Implement, Test and deploy solutions for target platforms.
- To prepare project reports and presentation.

The students shall individually / or as group work on business/research domains and related problems approved by the Department / organization that offered the internship / project.

The student can select any topic which is relevant to his/her specialization of the programme. The student should continue the work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work, results and discussion, conclusion and references should be prepared as per the format prescribed by the University and submitted to the Head of the department. The students will be evaluated based on the report and viva-voce examination by a panel of examiners as per the Regulations.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Gain Domain knowledge and technical skill set required for solving industry / research problems
CO2: Provide solution architecture, module level designs, algorithms
CO3: Implement, test and deploy the solution for the target platform
CO4: Prepare detailed technical report, demonstrate and present the work

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY
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VERTICAL - I

21PAD01	COGNITIVE COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To know the theoretical background of cognition.
- To understand the link between cognition and computational intelligence.
- To explore probabilistic programming language.
- To study the computational inference models of cognition.
- To study the computational learning models of cognition.

UNIT-I	PHILOSOPHY, PSYCHOLOGY AND NEUROSCIENCE	9
Philosophy: Mental-physical Relation – From Materialism to Mental Science – Logic and the Sciences of the Mind – Psychology: Place of Psychology within Cognitive Science – Science of Information Processing –Cognitive Neuroscience – Perception – Decision – Learning and Memory – Language Understanding and Processing.		
UNIT-II	**COMPUTATIONAL INTELLIGENCE**	**9**
Machines and Cognition – Artificial Intelligence – Architectures of Cognition – Knowledge Based Systems – Logical Representation and Reasoning – Logical Decision Making –Learning – Language – Vision.		
UNIT-III	**PROBABILISTIC PROGRAMMING LANGUAGE**	**9**
WebPPL Language – Syntax – Using Javascript Libraries – Manipulating probability types and distributions – Finding Inference – Exploring random computation – Coroutines: Functions that receive continuations – Enumeration.		
UNIT-IV	**INFERENCE MODELS OF COGNITION**	**9**
Generative Models – Conditioning – Causal and statistical dependence – Conditional dependence – Data Analysis – Algorithms for Inference.		
UNIT-V	**LEARNING MODELS OF COGNITION**	**9**
Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models– Learning (Deep) Continuous Functions – Mixture Models.		
		TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

Illustrate the basic components of social networks.

CO1: Summarize the theory of cognition with suitable example.

CO2: Understand and outline the architecture of cognition.

CO3: Apply mathematical functions through WebPPL.

CO4: Demonstrate applications using cognitive inference model.

CO5: Demonstrate applications using cognitive learning model.

TEXT BOOKS:

1. Vijay V Raghavan,Venkat N.Gudivada, VenuGovindaraju, C.R. Rao, Cognitive Computing:Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016.
2. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015.

3. Robert A. Wilson, Frank C. Keil, “The MIT Encyclopedia of the Cognitive Sciences”,The MIT Press, 1999.

REFERENCES:

1. Jose Luis Bermúdez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020.
2. Noah D. Goodman, Joshua B. Tenenbaum, The ProbMods Contributors, “Probabilistic Models of Cognition”, Second Edition, 2016.

21PAD02	RECOMMENDER SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the foundations of the recommender system.
- To gain the significance of content-based recommender systems.
- To learn about collaborative filtering.
- To train and design the attack resistant recommender system.
- To learn collaborative filtering.

UNIT-I	INTRODUCTION	9

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems- similarity measures- Dimensionality reduction – Singular Value Decomposition (SVD).

UNIT-II	CONTENT-BASED RECOMMENDATION SYSTEMS	9

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

UNIT-III	COLLABORATIVE FILTERING	9

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection.

UNIT-IV	ATTACK-RESISTANT RECOMMENDER SYSTEMS	9

Introduction – Types of Attacks – Detecting attacks on recommender systems – Individual attack – Group attack – Strategies for robust recommender design - Robust recommendation algorithms.

UNIT-V	EVALUATING RECOMMENDER SYSTEMS	9

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Understand the basic concepts of recommender systems.
CO2: Implement machine-learning and data-mining algorithms in recommender systems data sets.
CO3: Implement Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.
CO4: Design and implement a simple recommender system.
CO5: Evaluate the recommender systems for different applications.

TEXT BOOKS:

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Dietmar Jannach , Markus Zanker , Alexander Felfernig and Gerhard Friedrich, Recommender Systems: An Introduction, Cambridge University Press, 1st Edition, 2011.
3. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.

REFERENCES:

1. Monideepa Roy, Pushpendu Kar, Sujoy Datta, Recommender Systems: A Multi-Disciplinary Approach, 1st Edition, CRC Press, 2023.
2. Francesco Ricci, Lior Rokach, Bracha Shapira, Recommender Systems Handbook, 1st Edition, Springer, 2011.

21PAD03	DISTRIBUTED COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To study the distributed system principles and architecture models.
- To gain knowledge about various communication models.
- To understand distributed file systems.
- To learn synchronization and replication techniques.
- To study the resource management techniques.

UNIT-I	INTRODUCTION	9

Introduction – Examples of distributed systems–Trends in distributed systems – Focus on resource sharing –Challenges – World Wide Web – System models – Physical models – Architectural models – Fundamental models.

UNIT-II	COMMUNICATION IN DISTRIBUTED SYSTEM	9

Inter Process Communication – the API for the Internet protocols – External data representation – Multicast communication – Network virtualization: Overlay networks. MPI – Request–reply protocols – Remote procedure call. Distributed Objects: Java RMI – Group communication – Publish–subscribe systems – Message queues – Shared memory approaches – From Objects to Components: Enterprise Java Beans.

UNIT-III	PEER TO PEER SYSTEMS AND DISTRIBUTED FILE SYSTEMS	9

Introduction – Napster and its legacy – Peer–to–peer Middleware – Routing overlays – Overlay case studies: Pastry, Tapestry. Distributed File Systems – File service architecture – Sun Network File System –Google File System – Name Services and Domain Name System – Directory services – Case studies: The Global Name System, X.500 Directory Service.

UNIT-IV	SYNCHRONIZATION AND FAULT TOLERANCE	9

Introduction – Clocks, events and process states – Synchronizing physical clocks – Logical time and logical clocks – Global states – Coordination and Agreement – Distributed mutual exclusion – Elections – Transactions – Locks – Optimistic concurrency control – Timestamp ordering – Atomic commit protocols – Concurrency control in distributed systems – Distributed deadlocks.

UNIT-V	RESOURCE AND PROCESS MANAGEMENT	9

Resource management: Desirable features of a good global scheduling algorithm –Task assignment approach – Load balancing approach – Load sharing approach – Process management: Process migration – Threads.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Explore the system models in distributed system.
CO2: Apply various communication models in distributed system.
CO3: Explore distributed file systems.
CO4: Apply synchronization and replication algorithms in distributed system.
CO5: Use resource management algorithms for load balancing.

TEXT BOOKS:

1. George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education, 2012.
2. Pradeep K Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India, 2007.

3. Tanenbaum A.S., Van Steen M., “Distributed Systems: Principles and Paradigms”, Pearson Education, 2007.

REFERENCES:

1. Liu M.L., “Distributed Computing, Principles and Applications”, Pearson Education, 2004.
2. Nancy A Lynch, “Distributed Algorithms”, Morgan Kaufman Publishers, USA, 2003.
3. MukeshSinghal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw–Hill, 2001.

21PAD04	QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the basics of Quantum Computing.
- To familiarize the concepts of Quantum gates.
- To explore the applications of Quantum Computing.
- To understand the importance of Shor's algorithm & Grover's algorithm.
- To conceptualize the physical realization of Quantum computers.

UNIT-I FUNDAMENTALS OF QUANTUM COMPUTING — 9

From Bits to Qubits – Power of Quantum Computing – How Quantum Physics Differs from classical physics? – Obstacles and Research – Qubits - Quantum Mechanics - Computer Science Perspectives.

UNIT-II QUANTUM GATES AND CIRCUITS — 9

Quantum Gates – Single & Multiple Qubit Gates – Matrix Representation of Quantum Gates and Circuits – Bell States – Quantum Measurement – Quantum Half-Adder and Subtractor.

UNIT-III APPLICATIONS OF QUANTUM COMPUTING — 9

Quantum Teleportation – Quantum Parallelism – Superdense Coding – Quantum Cryptography - Quantum Noise and Error Correction.

UNIT-IV QUANTUM ALGORITHMS — 9

Deutsch-Jozsa Algorithm - Shor's Algorithm – Examples- Quantum Fourier Transform –Implementation- Phase estimation- Shor's algorithm using phase estimation – order finding and factoring - Grover's Algorithm (Quantum Search Algorithms)- steps- Geometric visualization- order of Grover's algorithm – Applications.

UNIT-V QUANTUM COMPUTER REALIZATION AND SOFTWARE — 9

Physical Realization of Quantum Computers – Basic requirements- Harmonic oscillator Quantum computer – Optical photon quantum computer- Optical cavity quantum Electrodynamics – Ion traps- Nuclear magnetic resonancesilicon quantum computer- Quantum Computing Software-Quantum Qudit Simulator- CAD for Quantum Computer Simulator(QCAD)- Quantum Circuit Viewer.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Apply the basic concepts in Quantum computing.
CO2: Design simple circuits using Quantum gates.
CO3: Design vital applications using Quantum computing.
CO4: Explore the applications of Apply Shor's and Grover's algorithm in Quantum computing.
CO5: Explore Quantum computing software.

TEXT BOOKS:

1. Vishal Sahni, "Quantum Computing", McGraw Hill education , First edition, 2007.
2. Dan C. Marinescu, Gabriela M. Marinescu, "Approaching Quantum Computing", Prentice Hall, 2004.

3. Mika Hirvensalo “Quantum Computing”,2nd Edition, Springer, 2004.

REFERENCES:

1. Giuliano Beneti, Giulio Casati, GuilianoStrini, "Principles of Quantum Computation and Information", Vol.1 Basic Concepts, World Scientific Publishing Company, October 2004.
2. David Mcmahon, “ Quantum Computing Explained”, Wiley-IEEE Computer Society Press, 2007.

21PAD05	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To provide an in-depth and comprehensive knowledge of the Cloud Computing fundamental issues, technologies, applications and implementations.
- To expose the students to the frontier areas of Cloud Computing.
- To motivate students to do programming and experiment with the various cloud computing environments.
- To shed light on the Security issues in Cloud Computing.
- To introduce about the Cloud Standards.

UNIT-I	FOUNDATION OF COMPUTING TECHNOLOGIES	9

History of Centralized and Distributed Computing - Overview of Distributed Computing, Cluster computing, Grid computing. Technologies for Network based systems- System models for Distributed and cloud computing- Software environments for distributed systems and clouds.

UNIT-II	INTRODUCTION TO CLOUD COMPUTING	9

Introduction to Cloud Computing- Cloud issues and challenges - Properties - Characteristics - Service models, Deployment models. Cloud resources: Network and API - Virtual and Physical computational resources - Data-storage. Virtualization concepts - Types of Virtualization- Introduction to Various Hypervisors - High Availability (HA)/Disaster Recovery (DR) using Virtualization, Moving VMs .

UNIT-III	CLOUD SERVICES	9

Service models - Infrastructure as a Service (IaaS) - Resource Virtualization: Server, Storage, Network - Case studies. Platform as a Service (PaaS) - Cloud platform & Management: Computation, Storage - Case studies. Software as a Service (SaaS) - Web services - Web 2.0 - Web OS - Case studies – Anything as a service (XaaS).

UNIT-IV	CLOUD APPLICATION DEVELOPMENT	9

Cloud Programming and Software Environments – Parallel and Distributed Programming paradigms – Programming on Amazon AWS and Microsoft Azure – Programming support of Google App Engine – Emerging Cloud software Environment.

UNIT-V	CLOUD DATA AND SECURITY	9

Cloud Access: authentication, authorization and accounting - Cloud Provenance and meta-data - Cloud Reliability and fault-tolerance - Cloud Security, privacy, policy and compliance- Cloud federation, interoperability and standards.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Articulate the main concepts, key technologies, strengths, and limitations of cloud computing.
CO2: Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
CO3: Explain the core issues of cloud computing such as security, privacy, and interoperability.
CO4: Identify possible applications for state-of-the-art cloud computing
CO5: Provide the appropriate cloud computing solutions and recommendations according to the applications used.

TEXT BOOKS:

1. Kai Hwang, Geoffrey C. Fox and Jack J. Dongarra, “Distributed and cloud computing from Parallel Processing to the Internet of Things”, Morgan Kaufmann, Elsevier – 2012.

2. Barrie Sosinsky, “Cloud Computing Bible” John Wiley & Sons, 2010.
3. Tim Mather, Subra Kumaraswamy, and Shahed Latif, Cloud Security and Privacy An Enterprise Perspective on Risks and Compliance, O'Reilly 2009.

REFERENCES:

1. Dan C. Marinescu, “Cloud Computing: Theory and Practice”, Morgan Kaufmann Publications, Third Edition, 2022.
2. Rajkumar Buyya, Christian Vecchiola, S.Thamarai Selvi, “Mastering Cloud Computing”, TMGH Publications, First Edition, 2017.

21PAD06	SOFT COMPUTING ESSENTIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- Define soft computing and explain its key characteristics, and major areas of application.
- Describe Membership Functions and their role in quantifying uncertainty in Fuzzy Logic.
- Analyze the components of a General Genetic Algorithm and understand their roles in optimization problems.
- Understand the fundamental concepts of artificial neural networks and implement simple neural networks to solve classification and regression problems.
- Design and implement hybrid soft computing systems to solve complex problems

UNIT-I	INTRODUCTION TO SOFT COMPUTING	9

Concept Of Computing Systems, Difference between Hard Computing and Soft Computing, Characteristics of Soft Computing, Major Areas of Soft Computing, Applications of Soft Computing.

UNIT-II	FUZZY LOGIC	9

Introduction, Classical Sets and Fuzzy Sets, Classical Relations and Fuzzy Relations, Membership Functions, Fuzzy Arithmetic, Classical Logic and Fuzzy Logic, Fuzzy Rule-Based Systems, Fuzzy Decision Making.

UNIT-III	GENETIC ALGORITHMS	9

History of Genetic Algorithms (GA), Biological Background of GA, Basic Terminologies in GA, Simple GA, General Genetic Algorithm, GA Operators: Encoding, Crossover, Selection, Mutation, Classification of Generic Algorithm.

UNIT-IV	ARTIFICIAL NEURAL NETWORKS	9

Fundamental Concepts of Artificial Neural Networks, Models of ANNs, Important Terminologies of ANNs, McCulloch-Pitrs Neuron, Hebb Network, Perceptron Network, Back-Propagation Network, Kohonen Self-Organizing Feature Maps, Learning Vector Quantization.

UNIT-V	HYBRID SYSTEMS	9

Integration of Neural Networks, Fuzzy Logic, and Genetic Algorithms, Sequential Hybrid Systems, Auxiliary Hybrid Systems, Embedded Hybrid Systems, Neuro-Fuzzy Hybrid Systems, Neuro-Genetic Hybrid Systems, Fuzzy-Genetic Hybrid Systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the fundamental concepts and principles of soft computing.

CO2: Perform Fuzzy Arithmetic operations and construct Fuzzy Rule-Based Systems for decision-making.

CO3: Analyze the performance of genetic algorithms and identify ways to improve their performance.

CO4: Apply ANNs for pattern recognition and data analysis using techniques like Kohonen Self-Organizing Feature Maps and Learning Vector Quantization.

CO5: Analyze Neuro-Genetic Hybrid Systems and Fuzzy-Genetic Hybrid Systems for solving complex problems.

TEXTBOOKS:

1. S. N. Sivanandam and S. N. Deepa,"Principles of Soft Computing" 4th Edition,Wiley,2018.
2. David E. Goldberg, "Genetic Algorithms", 4th Edition, Addison-Wesley Professional,2018.
3. D.K. Pratihar "Soft Computing: Fundamentals And Applications" 2nd Edition, Alpha Science International,2015.

REFERENCES:

1. Samir Roy,"Soft Computing", 5th Edition, PHI Learning Pvt. Ltd,2018.
2. Fakhreddine O. Karray and Clarence de Silva,"Soft Computing and Intelligent Systems Design"2nd Edition, Pearson Education,2004.

3. Kevin P. Murphy,"Machine Learning: A Probabilistic Perspective: 4^{th} Edition, MIT Press,2021.

21PAD07	GENERATIVE AI	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the fundamental concepts Generative AI.
- To understand integration of generative AI and NLP.
- To learn security aspects of generated content.
- To acquire knowledge on programming and problem-solving abilities.
- To get familiar with applications of Generative AI.

UNIT I	INTRODUCTION	9

History of Generative Models-History of Generative AI - Developments in Generative AI – Evaluating Generative AI - Applications of Generative AI - Regulatory and Legal aspects of Generative AI - Ethical and responsible Use - Intellectual Property Rights- Privacy and data protection-Bias and discrimination - safety and security.

UNIT II	GENERATIVE AI AND ChatGPT	9

Use cases for Generative AI - Content Creation - Image and Video Analysis - Disaster response - Fraud Detection - Decision Making - Predictive analytics - personalized services - Use cases for ChatGPT - Customer service - Naturel Language Processing - Information Retrieval -Language Translation - Policy Analysis - Speech Recognition - Virtual Assistants.

UNIT III	GENERATED CONTENT AUTHENTICATION	9

Authenticity AI generated content - Limitations and challenges of generative AI - generated content - Spread of Misinformation - Amplification of Bias - Creation of Fake identities - job displacement - Security Risks.

UNIT IV	CODING POTENTIAL OF GENERATIVE AI	9

Potential of ChatGPT in coding and Programming-Problem solving abilities (Quantitative) - Problem solving abilities (Qualitative) - Problem solving abilities of ChatGPT - How beginner start ChatGPT for problem solving - Potential of ChatGPT in Research work.

UNIT V	APPLICATIONS OF GENERATIVE AI WITH CHATGPT	9

Use cases financial Industry - Use cases in Healthcare Industry - Use cases in E-commerce Industry - Generative AI and Chatgpt help india G20 Summit - Future Scope of ChatGPT.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the concepts of Generative AI and list its legal aspects.
CO2: Make use of use cases to integrate Generative AI with application such as ChatGPT.
CO3: Illustrate various security aspects in generated content.
CO4: Illustrate examples for problem solving abilities in ChatGPT.
CO5: Prepare use cases for various applications of Generative AI.

TEXT BOOKS:

1. Utpal Chakraborty, Soumyadeep Roy, Sumit Kumar, Rise of Generative AI and ChatGPT, 1st Edition, BPB Publications,2023.
2. Maula, D. B., Generative AI: The Beginner's Guide. (n.p.): Amazon Digital Services LLC – Kdp, 2023.

3. Patel, D. M., Artificial Intelligence & Generative AI for Beginners: The Complete Guide. United States, 2023.

REFERENCES:

1. Joseph Babcock,Raghav Bali,Generative AI with Python and Tensorflow 2, 1st Edition, Packt Publishing Ltd.,2021.
2. Emerson, J., Ripples of Generative AI: How Generative AI Impacts, Informs, and Transforms Our Lives. (n.p.): Artificial Intelligence.,2023.
3. Valentina Alto, Modern Generative AI with ChatGPT and Open AI, Packt Publishing Ltd.,2023.

21PAD08	FOG COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the basics of Edge and Fog Computing.
- To conceptualize the communication standards.
- To familiarize with integration of edge with data analytics.
- To understand the importance of security infrastructures and management.
- To explore the applications of edge Computing.

UNIT-I	FOG COMPUTING AND ITS MODELS	9

Introduction to Fog Computing: Fog Computing, Characteristics, Application Scenarios, Issues andchallenges. Fog Computing Architecture: Communication and Network Model, Programming Models, Fog Architecture for smart cities, healthcare and vehicles.

UNIT-II	COMMUNICATION TECHNOLOGIES	9

Fog Computing Communication Technologies: Introduction, IEEE 802.11, 4G, 5G standards, WPAN, Short-Range Technologies, LPWAN and other medium and Long-Range Technologies.

UNIT-III	EDGE, FOG & CLOUD	9

Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds: Introduction, Background, Network Slicing in 5G, Network Slicing in Software-Defined Clouds, Network Slicing Management in Edge and Fog, Middleware for Fog and Edge Computing, Need for Fog and Edge Computing Middleware, Clusters for Lightweight Edge Clouds, IoT Integration, Security Management for Edge Cloud Architectures. Fog Computing Realization for Big Data Analytics: Introduction to Big Data Analytics, Data Analytics in the Fog, Prototypes and Evaluation.

UNIT-IV	IoT & SECURITY INFRASTRUCTURE	9

Fog computing requirements when applied to IoT: Scalability, Interoperability, Fog-IoT Architectural model, Challenges on IoT Stack Model via TCP/IP Architecture, Data Management, filtering, Event Management, Device Management, cloudification, virualization, security and privacy issues. Integrating IoT, Fog, Cloud Infrastructures: Methodology, Integrated C2F2T Literature by Modeling Technique by Use-Case Scenarios, Integrated C2F2T Literature by Metrics.

UNIT-V	APPLICATIONS	9

Exploiting Fog Computing in Health Monitoring: An Architecture of a Health Monitoring IoT Based System with Fog Computing, Fog Computing Services in Smart E-Health Gateways, Discussion of Connected Components. Fog Computing Model for Evolving Smart Transportation Applications: Introduction, Data-Driven Intelligent Transportation Systems, Fog Computing for Smart Transportation, Applications Case Study: Intelligent Traffic Lights Management (ITLM) System.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Explain the basic concepts in Edge computing.
CO2: Understand the architecture, its components and working of components and its performance.
CO3: Explore Fog on security, multimedia and smart data.
CO4: Explore the integration of fog computing with IoT.
CO5: Model the fog computing scenario.

TEXT BOOKS:

1. Fog Computing: Theory and Practice by Assad Abbas, Samee U. Khan, Albert Y., 2020

2. Fog and Edge Computing: Principles and Paradigms (Wiley Series on Parallel and Distributed Computing) by Rajkumar Buyya and Satish Narayana Srirama, John Wiley & Sons, 2019
3. Amir Vahid Dastjerdi and Rajkumar Buyya, ―Fog Computing: Helping the Internet of Things Realize its Potential, University of Melbourne, IEEE Computer Soc, 2016

REFERENCES:

1. Amir M. Rahmani, Pasi Liljeberg, Preden, Axel Jantsch, ―Fog Computing in the Internet of Things - Intelligence at the Edge‖, Springer International Publishing, 2018.
2. Flavio Bonomi, Rodolfo Milito, Jiang Zhu, Sateesh Addepalli, ―Fog Computing and Its Role in the Internet of Things, MCC' 12, 2012.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

VERTICAL – II

21PAD17	CYBER THREAT ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To Understand the security problems and defend the cyberspace.
- To gain knowledge for protecting against attacks, threats and intrusion.
- To Understand how to leverage intelligence.
- To explore adversary behaviour and make use of indicators of compromise to detect and stop malware.
- To explore knowledge on intelligence reports.

UNIT-I	**CYBER ATTACKS, INTRUSIONS, THREATS**	**9**
Introduction to cyber-attacks, attack model, Adversary Types, Vulnerability Types, Threat Types, Attacks vs. Intrusion, DDoS, Types, Malware, malware Types, Introduction to Dark net, Cybercrimes.		
UNIT-II	**CYBER THREATS AND INTRUSION KILL CHAIN**	**9**
Introduction to Advanced Persistent Threats, Intrusion Kill Chain, Zero days, Attack surface, Attack vectors, Evasion techniques – Host and Network level evasions, Covert Communication: Infiltration and Exfiltration, Advanced Evasion techniques.		
UNIT-III	**THREAT INTELLIGENCE**	**9**
Cyber Threat Intelligence (CTI), Overview of Threat Intelligence Lifecycle and Frameworks, CTI types, generic threat actor, Indicators of Compromise (IoCs).		
UNIT-IV	**THREATINTELLIGENCE MODEL**	**9**
Campaign analysis, Diamond model, Threat intel methodologies, Intrusion reconstruction, OSINT, Challenges with detection intrusions.		
UNIT-V	**SECURITYOPERATION CENTRE (SOC)**	**9**
Introduction to SIEM, Threat Intelligence Data Collection, Threat Intelligence Collection Management, Threat Intelligence Data Feeds and Sources, Data Processing and analysis, building your own SOC, Visualizing the threat intelligence data. Threat Intelligence Reports: Baseline and Diff, Blacklists and Whitelists, Tracking, Integration.		
		TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Develop incident response skills to combat network and system.
CO2: Classify various types of attacks and learn the tools to launch the attacks.
CO3: Explain the security of network and system.
CO4: Review and analyze threat intelligence logs and reports.
CO5: Classify and Respond to the threats.

TEXT BOOKS:

1. Wilson Bautista, Practical Cyber Intelligence: How Action-based Intelligence Can be an Effective Response to Incidents, Packt publisher, 2018.
2. Arun E Thomas, Security Operations Center - SIEM Use Cases and Cyber Threat Intelligence, 2018.

3. Jocelyn O. Padallan, “Cyber Security”, Arcler press, 2019

REFERENCES:

1. Eoghan Casey, Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet, Elsevier, 2011.
2. John Sammons, The Basics of Digital Forensics: The Primer for Getting Started in Digital Forensics, Syngress publisher, 2013

21PAD18	IoT SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To Understand the security practices of IoT.
- To gain knowledge about attacks and threats.
- To explore about secure and smart IoT applications.
- To acquire knowledge on executing security algorithms on IoT devices.
- To explore societal impact on IoT security.

UNIT-I	INTRODUCTION: SECURING THE INTERNET OF THINGS	9

Introduction – Security Requirements in IoT architectures – Security in Enabling Technologies – IoT Security Life Cycle – Cryptographic Fundamentals for IoT Security Engineering - Security Concerns in IoT Applications – Basic Security Practices.

UNIT-II	SECURITY ARCHITECTURE IN THE INTERNET OF THINGS	9

Introduction – Security Requirements in IoT – Insufficient Authentication/Authorization – Insecure Access Control – Threads to Access Control, Privacy, and Availability – Attacks Specific to IoT – Malware Propagation and Control in Internet of Things.

UNIT-III	PRIVACY PRESERVATION	9

Privacy Preservation Data Dissemination - Privacy Preservation for IoT used in Smart Building – Exploiting Mobility Social Features for Location Privacy Enhancement in Internet of Vehicles – Lightweight and Robust Schemes for Privacy Protection in Key personal IoT Applications: Mobile WBSN and Participatory Sensing.

UNIT-IV	TRUST, AUTHENTICATION AND DATA SECURITY	9

Trust and Trust Models for IoT – Emerging Architecture Model for IoT Security and Privacy – preventing Unauthorized Access to Sensor Data – Authentication in IoT – Computational Security for the IoT – Secure Path Generation Scheme for real-Time Green IoT – Security Protocols for IoT Access Networks.

UNIT-V	SOCIAL AWARENESS AND CASE STUDIES	9

User Centric Decentralized Governance Framework for Privacy and Trust in IoT – Policy Based Approach for Informed Consent in IoT - Security and Impact of the IoT on Mobile Networks – Security Concerns in Social IoT – Security for IoT Based Healthcare – Smart cities.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Describe the basics of securing Internet of Things.
CO2: Explain architecture and threats in IoT.
CO3: Analyze various privacy schemes related to IoT
CO4: Describe the authentication mechanisms for IoT security and privacy.
CO5: Explain security issues for various applications using case studies.

TEXT BOOKS:

1. Shancang Li, Li Da Xu, “Securing the Internet of Things,” Syngress (Elsevier) publication, 2017.
2. Fei Hu, “Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations,” CRC Press (Taylor & Francis Group), 2016.
3. Arshdeep Bahga, Vijay Madisetti, “Internet of Things – A Hands-on approach,” VPT Publishers, 2014.

REFERENCES:

1. Alasdair Gilchris, “Iot Security Issues,” Walter de Gruyter GmbH & Co, 2017.

2. Sridipta Misra, Muthucumaru Maheswaran, Salman Hashmi, “Security Challenges and Approaches in Internet of Things,” Springer, 2016.
3. Brian Russell, Drew Van Duren,“Practical Internet of Things Security,” Packet Publishing Ltd, 2016.

21PAD19	MALWARE ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- Understand the fundamentals of malware, types and its effects.
- Identify and analyze various malware types by static and dynamic analysis.
- To deal with detection, analysis, understanding, controlling, and eradication of malware.
- To acquire knowledge about various functions of malware.
- To deal with malware analysis in android.

UNIT-I	**FIUNDATION OF MALWARE ANALYSIS**	**9**
Introduction to Malware - Malware threats - Malware types: Viruses, Worms, Rootkits, Trojans, Bots, Spyware, Adware, Logic Bombs - Goals of Malware Analysis - AV Scanning – Hashing - Finding Strings -Packing and Obfuscation - PE file format – Static - Linked Libraries and Functions - Static Analysis tools -Virtual Machines and their usage in Malware analysis – Sandboxing - Basic dynamic analysis - Malware execution - Process Monitoring -Viewing processes - Registry snapshots.		
UNIT-II	**STATIC ANALYSIS**	**9**
The Stack – Conditionals – Branching - Rep Instructions – Disassembly - Global and local variables - Arithmetic operations – Loops - Function Call Conventions - C Main Method and Offsets. Portable Executable File Format - The PE File Headers and Sections - IDA Pro - Function analysis – Graphing – The Structure of a Virtual Machine - Analyzing Windows programs - Anti-static analysis techniques – obfuscation – packing – metamorphism - polymorphism.		
UNIT-III	**DYNAMIC ANALYSIS**	**9**
Live malware analysis - dead malware analysis - analyzing traces of malware - system calls - api calls – registries - network activities. Anti-dynamic analysis techniques - VM detection techniques- Evasion techniques - Malware Sandbox - Monitoring with Process Monitor - Packet Sniffing with Wireshark – Kernel vs. User-Mode Debugging – OllyDbg – Breakpoints – Tracing - Exception Handling – Patching.		
UNIT-IV	**MALWARE FUNCTIONS**	**9**
Downloaders and Launchers – Backdoors - Credential Stealers - Persistence Mechanisms- Handles – Mutexes - Privilege Escalation - Covert malware launching- Launchers - Process Injection- Process Replacement - Hook Injection – Detours - APC injection.		
UNIT-V	**ANDROID MALWARE ANALYSIS**	**9**
Android Malware Analysis: Android architecture - App development cycle – APKTool- APKInspector - Dex2Jar - JD-GUI - Static and Dynamic Analysis - Case Study: Smartphone (Apps) Security.		
		TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Understand the various concepts of malware analysis and their technologies used.
CO2: Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques.
CO3: Understand the methods and techniques used by professional malware analysts.
CO4: Analyze, debug, and disassemble any malicious software by malware analysis.
CO5: Understand the concept of Android malware analysis their architecture, and App development.

TEXT BOOKS:

1. Michael Sikorski and Andrew Honig, “Practical Malware Analysis” by No Starch Press, 2012.
2. Bill Blunden, “The Rootkit Arsenal: Escape and Evasion in the Dark Corners of the System”, Second Edition, Jones & Bartlett Publishers, 2009.
3. Victor Marak, "Windows Malware Analysis Essentials" Packt Publishing, O’Reilly, 2015.

REFERENCES:

1. Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, "Android Malware and Analysis", CRC Press, Taylor & Francis Group, 2015.
2. Jamie Butler and Greg Hoglund, “Rootkits: Subverting the Windows Kernel”, Addison-Wesley Professional,2005.

21PAD20	STEGANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To learn the basics of steganography to understand.
- To detect and analyze hidden information through steganalysis.
- To master different steganography frameworks and algorithms.
- To analyze practical Application of Steganography Techniques
- To use of Detection and Distortion Techniques.

UNIT-I	INTRODUCTION TO STEGANOGRAPHY	9

Overview, History, Methods for hiding (text, images, audio, video, speech etc.), Issues: Security, Capacity and Imperceptibility, Steganalysis: Active and Malicious Attackers, Active and passive steganalysis.

UNIT-II	STEGANOGRAPHY FRAMEWORK	9

Frameworks for secret communication (pure Steganography, secret key, public key steganography), Steganography algorithms (adaptive and non-adaptive).

UNIT-III	STEGANOGRAPHY TECHNIQUES	9

Substitution system and biplane tools, Transform domain techniques, Spread spectrum and information hiding, Statistical Steganography, Distortion and code generation techniques, Automated generation of English text.

UNIT-IV	STEGANALYSIS	9

Detecting hidden information, Extracting hidden information, Disabling hidden Information, Watermarking techniques, History, Basic Principles, applications, Requirements of algorithmic design issues, Evaluation and benchmarking of watermarking system.

UNIT-V	DETECTION & DISTORTION TECHNIQUES	9

Applications of Steganography, Steganography for Dissidents, Steganography for Criminals. Detection, Distortion, Techniques: LSB Embedding, LSB Steganalysis using primary sets, Texture based.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Learn various ways to hide information, including text, images, audio, video, and speech.

CO2: Understand and use different methods for secret communication, such as pure steganography, secret key, and public key steganography.

CO3: Apply practical techniques for hiding information, like substitution systems, biplane tools, and statistical steganography.

CO4: Develop skills in finding, extracting, and disabling hidden information through steganalysis**.**

CO5: Understand techniques like LSB Embedding and Texture-based methods for detection and distortion.

TEXT BOOKS:

1. Stefan Katzenbelsser and Fabien A. P. Petitcolas, “Information hiding techniques for Steganography and Digital Watermarking”, ARTECH House Publishers,2011.

2. Peter Wayner, “Disappearing Cryptography–Information Hiding: Steganography & Watermarking”, Morgan Kaufmann Publishers, New York, 2002.
3. Hang Zhou, Kejiang Chen, Zehua Ma, Feng Wang,” Triangle Mesh Watermarking and Steganography”, Springer, 2023.

REFERENCES:

1. Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, TonKalker,“Digital Watermarking and Steganography”, Margan Kaufmann Publishers, New York,2011.
2. Jessica Fridrich, “Steganography in Digital Media: Principles, Algorithms, and Applications”,Cambridge university press, 2010.

21PAD21	BIOMETRIC SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To learn various biometric technologies.
- To learn the biometric recognition systems.
- To gain knowledge on iris recognition.
- To know about hand geometry and voice biometrics.
- To learn methods for security in biometric systems.

UNIT-I	INTRODUCTION	9

Introduction – Operation of a biometric system – Verification versus identification – Performance of a biometric system – Applications of biometrics – Biometric characteristics.

UNIT-II	FINGERPRINT AND FACE RECOGNITION	9

Introduction – Fingerprint Sensing– Feature extraction – Matching – Performance evaluation– Introduction to Face Recognition – Face Recognition Techniques – Databases – Advanced Correlation Filters – Tensor faces– Active Appearance Models for Face Recognition – Face Super-resolution using Locality Preserving Projections.

UNIT-III	IRIS RECOGNITION	9

History of Iris Recognition – Active Contours – Flexible Generalized Embedded Coordinates – Fourier-based Trigonometry – Correction for Off-Axis Gaze – Detecting Eyelashes by Statistical Inference – Excluding Eyelashes by Statistical Inference Alternative Score Normalization Rules – Adapting for Large-Scale Applications.

UNIT-IV	HAND GEOMETRY GAIT RECOGNITION AND VOICE BIOMETRICS	9

History of Hand Geometry – Applications – Technology – Performance – Standardization – Introduction to Gait Recognition – HumanID Gait Challenge Problem – Recognition Approaches – Introduction to Voice Biometrics – Identity information in the speech signal – Feature Extraction – Tokenization – Text-dependent speaker recognition – Text-independent speaker recognition.

UNIT-V	BIOMETRIC AUTHENTICATION	9

Introduction to Palmprint Authentication System – System Framework – Recognition Engine – On-Line Signature Verification – Resources for On-Line Signature Verification – Biometrics Security Overview – Vulnerabilities in Biometric Systems – Biometric Template Security – Encoded Biometric Schemes.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Identify the various Biometric technologies.
CO2: Design of various biometric recognition systems for the organization.
CO3: Familiarize with concepts of iris recognition.
CO4: Apply hand geometry and voice biometrics in various applications.
CO5: Examine the need for security in biometric systems.

TEXT BOOKS:

1. A.K. Jain, P. Flynn, A.A. Ross, Handbook of Biometrics, Springer, 2008.

2. Samir Nanavati, Michael Thieme, Raj Nanavati, "Biometrics - Identity Verification in a Networked World", WILEY- Dream Tech, 2009.
3. Paul Reid "Biometrics for Network Security", Pearson Education, 2004.

REFERENCES:

1. John D. Woodward, Jr. "Biometrics- The Ultimate Reference"-Wiley Dreamtech.1st edition, 2003.
2. John R. Vacca, “Biometric Technologies and Verification Systems”, Elsevier Inc, 2007.

21PAD22	BLOCKCHAIN AND CRYPTOCURRENCY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the mechanism of Blockchain and Cryptocurrency.
- To understand the functionality of current implementation of blockchain technology.
- To understand the required cryptographic background.
- To explore the applications of Blockchain to cryptocurrencies and understanding limitations of current Blockchain.
- An exposure towards cryptocurrency ecosystem.

UNIT-I	INTRODUCTION TO CRYPTOGRAPHY AND CRYPTOCURRENCIES	9

Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency- Decentralization-Centralization vs. Decentralization-Distributed consensus, Consensus with- out identity using a blockchain, Incentives and proof of work. Simple Local Storage, Hot and Cold Storage, Splitting and Sharing Keys, Online Wallets and Exchanges, Payment Services, Transaction Fees, Currency Exchange Markets.

UNIT-II	MECHANICS OF BITCOIN	9

Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bit- coin network, Limitations and improvements.

UNIT-III	BITCOIN MINING AND ANONYMITY	9

The task of Bitcoin miners, Mining Hardware, Energy consumption and ecology, Mining pools, Mining incentives and strategies - Anonymity Basics, How to De-anonymize Bitcoin, Mixing, Decentralized Mixing, Zerocoin and Zerocash.

UNIT-IV	COMMUNITY, POLITICS, AND REGULATION	9

Consensus in Bitcoin, Bitcoin Core Software, Stakeholders: Who‟s in Charge, Roots of Bitcoin, Governments Notice on Bitcoin, Anti Money Laundering Regulation, New York‟s Bit LicenseProposal. Bitcoin as a Platform: Bitcoin as an Append only Log, Bitcoins as Smart Property, Secure Multi Party Lotteries in Bitcoin, Bitcoin as Public Randomness, Source-PredictionMarkets, and Real World Data Feeds.

UNIT-V	ALTCOINS AND THE CRYPTOCURRENCY ECOSYSTEM	9

Altcoins: History and Motivation, A Few Altcoins in Detail, Relationship Between Bitcoin and Altcoins, Merge Mining-Atomic Crosschain Swaps-6 Bitcoin Backed Altcoins, Side Chains, Ethereum and Smart Contracts.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Understand and apply the fundamentals of Cryptography in Cryptocurrency.
CO2: Summarize about various operations associated with the life cycle of Block chain and Cryptocurrency.
CO3: Describe the methods for verification and validation of Bitcoin transactions.
CO4: Demonstrate the general ecosystem of several Cryptocurrency.
CO5: Summarize the principles, practices and policies associated Bitcoin business.

TEXT BOOKS:

1. Narayanan, A., Bonneau, J., Felten, E., Miller, A., and Goldfeder, S. “Bitcoin and cryptocurrency technologies: a comprehensive introduction”,Princeton University Press, 2016.
2. Antonopoulos, A. M. “Mastering Bitcoin: unlocking digital cryptocurrencies. Oreilly Media, Inc.”, 2014.
3. Makoto Yono, “Blockchain and Crypto Currency”, Economic, Law and Institutions in Asia Pacific, 1^{st} Edition, 2020.

REFERENCES:

1. Franco, P. “Understanding Bitcoin: Cryptography, engineering and economics”, John Wiley and Sons, 2014.
2. Yadav Satya Prakash, “Blockchain And Cryptocurrency”, I K International, 2022.

21PAD23	INFORMATION SECURITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To acquire knowledge about system security related incidents and insight on potential defences.
- To counter measures against common threat/vulnerabilities.
- To provide the knowledge of installation, configuration and troubleshooting of information security devices.
- To make familiarize on the tools and common processes in information security audits.
- To explore about data management.

UNIT-I	INFORMATION SECURITY DEVICES	9

Identify And Access Management (IdAM), Networks (Wired And Wireless) Devices, Endpoints/Edge Devices, Storage Devices, Servers, Infrastructure Devices (e.g. Routers, Firewall Services) , Computer Assets, Servers And Storage Networks, Content management, IDS/IPS.

UNIT-II	SECURITY DEVICE MANAGEMENT	9

Different types of information security devices and their functions, Technical and configuration specifications, architecture concepts and design patterns and how these contribute to the security of design and devices.

UNIT-III	DEVICE CONFIGURATION	9

Common issues in installing or configuring information security devices, Methods to resolve these issues, Methods of testing installed/configured information security devices.

UNIT-IV	INFORMATION SECURITY AUDIT PREPARATION	9

Establish the nature and scope of information security audits, Roles and responsibilities, Identify the procedures/guidelines/checklists, Identify the requirements of information security, audits and prepare for audits in advance, Liaise with appropriate people to gather data/information required for information security audits. Security Audit Review - Organize data/information required for information security audits using standard templates and tools, Audit tasks, Reviews, Comply with the organization's policies, standards, procedures, guidelines and checklists, Disaster Recovery Plan.

UNIT-V	DATA AND INFORMATION MANAGEMENT	9

Fetching the data/information from reliable sources, Checking that the data/information is accurate, complete and up-to-date, Rule-based analysis of the data/information, Insert the data/information into the agreed formats, Reporting unresolved anomalies in the data/information.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Classify security devices and summarize the functions of it.
CO2: Understand the configuration of network devices.
CO3: Identify the procedure for security audit and generate reports.
CO4: Understand policies, standards of audit process.
CO5: Analyze data and prepare reports.

TEXT BOOKS:

1. Information Systems Security: Security Management, Metrics, Frameworks and Best Practices, Nina Godbole, Wiley, 2017.
2. Rhodes-Ousley, Mark. Information Security: The Complete Reference, Second Edition, Information Security Management: Concepts and Practice. New York, McGraw-Hill, 2013.
3. Christopher J. Alberts, Audrey J. Dorofee, Managing Information Security Risks, Addison-Wesley Professional, 2004.

REFERENCES:

1. Andrew Vladimirov Michajlowski, Konstantin, Andrew A. Vladimirov, Konstantin V.Gavrilenko, Assessing Information Security: Strategies, Tactics, Logic and Framework, IT Governance Ltd, O'Reilly 2010.
2. Christopher J. Alberts, Audrey J. Dorofee, Managing Information Security Risks, Addison-Wesley Professional, 2004.

21PAD24	DIGITAL FORENSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To learn the fundamentals of Cyber forensics and Data Acquisition.
- To understand the procedure for processing, analysis and validation of digital evidence.
- To learn the principles of network forensics.
- To gain knowledge on email investigation, mobile device forensics and cloud forensics.
- To study the Indian and International cyber laws.

UNIT-I	INTRODUCTION	9

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues. Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.

UNIT-II	DATA ACQUISITION	9

Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.

UNIT-III	FORENSIC PROCESSING	9

Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.

UNIT-IV	EMAIL, MOBILE AND CLOUD FORENSICS	9

E-mail and Social Media Investigations: Exploring the Role of E-mail in Investigations- Exploring the Roles of the Client and Server in E-mail- Investigating E-mail Crimes and Violation- Understanding E-mail Servers- Using Specialized E-mail Forensics Tools- Applying Digital Forensics to Social Media. Mobile Device Forensics and the Internet of Anything: Understanding Mobile Device Forensics- Understanding Acquisition Procedures for Mobile Devices- Understanding Forensics in the Internet of Anything. Cloud Forensics: An Overview of Cloud Computing Legal Challenges in Cloud Forensics- Technical Challenges in Cloud Forensics- Acquisitions in the Cloud- Conducting a Cloud Investigation- Tools for Cloud Forensics.

UNIT-V	CYBER LAWS AND CASE STUDIES	9

Cybercrime Case Studies: Cybercrime against individuals- Cybercrime against property- Cybercrime against Nation. Introduction to Cyber Laws- Cyber Laws in India and case studies-International Cyber laws and case studies: Cybercrime Legislation in the Netherlands - Cyber laws in Malaysia - Cybercrime laws in the UK - Cybercrime laws of the USA - Australian laws related to privacy.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Explain the benefits and procedure for cybercrimes.
CO2: Determine how to perform data acquisition.
CO3: Analyse and validate evidences collected from various sources.
CO4: Identify issues in email investigation, mobile device forensics and cloud forensics.
CO5: Apply cyber law for different case studies.

TEXT BOOKS:

1. Nelson, Phillips, Steuart, "Computer Forensics and Investigations", Cengage Learning, Sixth Edition, 2018.
2. Dejey, Murugan, "Cyber Forensics", Oxford University Press, 2018.
3. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., "Guide to Computer Forensics and Investigations, 2nd ed., Thomson Course Technology, 2006,

REFERENCES:

1. John R. Vacca, "Computer Forensics", Firewall Media, New Delhi, 2009.
2. Keith J. Jones, Richard Bejtlich, Curtis W. Rose, "Real Digital Forensics", Addison Wesley Pearson Education, 2005.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

VERTICAL- III

21PAD25	BUSINESS ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES: 21PAD25

The main objectives of this course are:

- To understand the Analytics Life Cycle.
- To comprehend the process of acquiring Business Intelligence.
- To understand various types of analytics for Business Forecasting.
- To model the supply chain management for Analytics.
- To apply analytics for different functions of a business.

UNIT-I	INTRODUCTION TO BUSINESS ANALYTICS	9

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling –Validating and verifying analytical results, Communicating and presenting results to clients and Driving organizational change and assessing impact– Interpretation – Deployment and Iteration.

UNIT-II	BUSINESS INTELLIGENCE	9

Data Warehouses and Data Mart - Knowledge Management – Types of Decisions – Decision Making Process - Decision Support Systems – Business Intelligence – OLAP – Analytic functions.

UNIT-III	BUSINESS FORECASTING	9

Introduction to Business Forecasting and Predictive analytics - Data Mining and Predictive Analysis Modeling -Linear Regression, Cluster, CART and Neural Network model– Data Visualization and Analytics- Charts(Bars-Pie-Line-Scatter-Map-Bubble-Box & Whisker-Tree map - Heat map-Circle and Area) - Worksheet, Dashboard and Story Board creation.

UNIT-IV	HR & SUPPLY CHAIN ANALYTICS	9

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain.

UNIT-V	MARKETING & SALES ANALYTICS	9

Marketing Strategy, Marketing Mix, Customer Behavior – selling Process – Sales Planning – Analytics applications in Marketing and Sales.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Explain the real world business problems and model with analytical solutions.
CO2: Identify the business processes for extracting Business Intelligence.
CO3: Apply predictive analytics for business fore-casting.
CO4: Apply analytics for supply chain and logistics management.
CO5: Use analytics for marketing and sales.

TEXT BOOKS:

1. James H. Stock and Mark W. Watson ,"Introduction to Econometrics",Third Edition,Addison-Wesley, 2017.
2. Marc J. Schniederjans, Dara G. Schniederjans and Christopher M. Starkey, " Business Analytics Principles, Concepts, and Applications - What, Why, and How" , 1st Edition,Pearson Ed, 2014.
3. Christian Albright S and Wayne L. Winston, "Business Analytics - Data Analysis and Decision Making", 5th edition, Cengage Learning, 2015,

REFERENCES:

1. R. Evans James, "Business Analytics", 2nd Edition, Pearson Education**,**2017.
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics,1st Edition, Wiley,2011
3. Philip Kotler and Kevin Keller, "Marketing Management", 15th edition, PHI, 2016.

21PAD26	PREDICTIVE ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To explain terminology, technology and applications of predictive analysis.
- To apply data preparation techniques and generate appropriate association rules.
- To discuss various descriptive models, their merits, demerits and application.
- To describe various predictive modelling methods.
- To learn about advanced text visualization techniques.

UNIT-I	**INTRODUCTION TO PREDICTIVE ANALYTICS**	**9**

Overview of Predictive Analytics- Setting Up the Problem - Data Understanding- Single Variable- Data Visualization in One Dimension- Data Visualization, Two or Higher Dimensions-The Value of Statistical Significance- Pulling It All Together into a Data Audit – Case study: Churn prevention.

UNIT-II	**DATA PREPARATION AND ASSOCIATION RULES**	**9**

Data Preparation- Variable Cleaning- Feature Creation- Item sets and Association Rules – Terminology- Parameter Settings- How the Data Is Organized- Measures of Interesting Rules - Deploying Association Rules- Problems with Association Rules- Building Classification Rules from Association Rules- Hospital Readmission.

UNIT-III	**MODELLING**	**9**

Descriptive Modeling- Data Preparation Issues with Descriptive Modeling- Principal Component Analysis- Clustering Algorithms- Interpreting Descriptive Models- Standard Cluster Model Interpretation.

UNIT-IV	**PREDICTIVE MODELLING**	**9**

Decision Trees- Logistic Regression -Neural Network Model – K-Nearest Neighbours – Naive Bayes – Regression Models - Linear Regression - Other Regression Algorithms- Case study: predictive web Analytics.

UNIT-V	**TEXT MINING**	**9**

Motivation for Text Mining- A Predictive Modeling Approach to Text Mining- Structured vs.Unstructured Data- Why Text Mining Is Hard- Data Preparation Steps- Text Mining Features Modeling with Text Mining Features- Regular Expressions- Case Studies:- Survey Analysis.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Explain terminology, technology and applications of predictive analysis.
CO2: Apply data preparation techniques to effectively interpret big data.
CO3: Discuss various descriptive models, their merits, demerits and application.
CO4: Describe principles of predictive analytics and apply them to achieve real, pragmatic solutions.
CO5: Illustrate the features and applications of text mining.

TEXT BOOKS:

1. Dean Abbott, "Applied Predictive Analytics-Principles and Techniques for the Professional in Data Analyst", Wiley, 2014
2. Jiawei Han and Micheline Kamber, Data Mining Concepts and Techniques, 3rd Edition ,Elsevier, 2012
3. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning-Data Mining, Inference, and Prediction, 2nd Edition, Springer Verlag, 2009.

REFERENCES:

1. Conrad Carlberg, "Predictive Analytics: Microsoft Excel", First Edition, Que Publishing,2012.
2. Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani " An Introduction to Statistical Learning with Applications in R", Springer,2013.
3. Alberto Cordoba, "Understanding the Predictive Analytics Lifecycle", 1st Edition, Wiley, 2014.

21PAD27	BIG DATA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the fundamental concepts of big data and its importance in the modern world.
- To learn about data discovery techniques and open source technologies for big data analytics.
- To understand the basics of Hadoop and the Hadoop ecosystem.
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig and Hive for bigdata analytics.
- To understand the concept of data mining and its role in big data analytics.

UNIT-I	INTRODUCTION TO BIG DATA	9

Big Data and its Importance – Four Vs of Big Data – Drivers for Big Data –Introduction to Big Data Analytics – Big Data Analytics applications.

UNIT-II	BIG DATA TECHNOLOGIES	9

Hadoop's Parallel World – Data discovery – Open-source technology for Big Data Analytics – cloud and Big Data –Predictive Analytics – Mobile Business Intelligence and Big Data.

UNIT-III	INTRODUCTION HADOOP	9

Big Data – Apache Hadoop & Hadoop Eco System – Moving Data in and out of Hadoop – Understanding inputs and outputs of MapReduce - Data Serialization.

UNIT-IV	HADOOP ARCHITECTURE	9

RDBMS Vs Hadoop, Hadoop Overview, Hadoop distributors, HDFS, HDFS Daemons, Anatomy of File Write and Read., Name Node, Secondary Name Node, and Data Node, HDFS Architecture, Hadoop Configuration, Map Reduce Framework, Role of HBase in Big Data processing, HIVE, PIG.

UNIT-V	DATA ANALYTICS WITH R	9

Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering, Social Media Analytics, Mobile Analytics, Big Data Analytics with BigR.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Analyze the drivers for big data and the applications of big data analytics.
CO2: Explore data discovery techniques and open source technologies for big data analytics.
CO3: Grasp the fundamentals of Hadoop and the Hadoop ecosystem, a collection of tools and technologies for big data management.
CO4: Explore HDFS architecture, Hadoop configuration, MapReduce framework, and the role of HBase in Big Data processing.
CO5: Gain hands-on experience with data mining techniques and tools, encompassing data preprocessing, feature selection, and model evaluation.

TEXT BOOKS:

1. Seema Acharya, Subhasini Chellappan,"Big Data Analytics", First Edition, Wiley 2015.
2. Michael Minelli, Michehe Chambers,"Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Business", First Edition, Ambiga Dhiraj, Wiely CIO Series, 2013.
3. "Hadoop: The Definitive Guide", Tom White, Third Edition, O‟Reilly Media, 2012.

REFERENCES:

1. Arvind Sathi," Big Data Analytics: Disruptive Technologies for Changing the Game", First Edition,IBM Corporation, 2012.
2. Jay Liebowitz ,"Big Data and Business Analytics", , Auerbach Publications, First Edition, CRC press ,2013.
3. Tom Plunkett, Mark Hornic,"Using R to Unlock the Value of Big Data: Big Data Analytics with Oracle R Enterprise and Oracle R Connector for Hadoop", First Edition, McGraw-Hill/Osborne Media, Oracle press,2013.

21PAD28	IoT DOMAIN ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To identify and analyze the various challenges faced in implementing IoT analytics solutions.
- To gain a foundational understanding of networking basics, including network topologies, protocols, and communication models.
- To understand the key components of IoT analytics systems to achieve modularity and maintainability.
- To apprehend data quality, assessing the accuracy, completeness, and consistency of IoT data.
- To relate feature engineering techniques to prepare IoT data for machine learning algorithms.

UNIT-I	IOT ANALYTICS AND CHALLENGES	9

Introduction to IoT, applications, IoT architectures, introduction to analytics, IoT analytics challenges.

UNIT-II	IOT DEVICES AND NETWORKING PROTOCOLS	9

IoT devices, Networking basics, IoT networking connectivity protocols, IoT networking data messaging protocols, Analyzing data to infer protocol and device characteristics.

UNIT-III	IOT ANALYTICS FOR THE CLOUD	9

Introduction to elastic analytics, Decouple key components, Cloud security and analytics, Designing data processing for analytics, Applying big data technology to storage.

UNIT-IV	EXPLORING IOT DATA	9

Exploring and visualizing data, Techniques to understand data quality, Basic time series analysis, Statistical analysis.

UNIT-V	DATA SCIENCE FOR IOT ANALYTICS	9

Introduction to Machine Learning, Feature engineering with IoT data, Validation methods, Understanding the bias–variance tradeoff, Use cases for deep learning with IoT data.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Identify and analyze the various challenges faced in implementing IoT analytics solutions.

CO2: Analyze IoT data to infer protocol and device characteristics, enabling network optimization and device management.

CO3: Explore cloud security considerations for IoT analytics, ensuring data privacy and protection against cyberattacks.

CO4: Employ techniques to understand data quality, assessing the accuracy, completeness, and consistency of IoT data**.**

CO5: Implement validation methods to evaluate the performance and generalization ability of machine learning models in IoT analytics.

TEXT BOOKS:

1. Minteer, Andrew, “Analytics for the Internet of Things (IoT)”,1st Edition, Packt Publishing Ltd. 2017.
2. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, “IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things”, First Edition, CISCO Press, 2017.
3. Kai Hwang, Min Chen,” Big-Data Analytics for Cloud, IoT and Cognitive Computing”, First Edition ,Wiley,2017.

REFERENCES:

1. Hwaiyu Geng, Internet of Things and Data Analytics Handbook, 1st Edition, Wiley,2016.
2. John Soldatos, Building Blocks for IoT Analytics Internet-of-Things Analytics, 1st Edition ,River Publishers Gerardus Blokdyk,2017.
3. Gerardus Blokdyk,” IoT Analytics A Complete Guide”, 1st Edition, 5starcooks,2019.

21PAD29	ANALYTICS IN CLOUD COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the principles of cloud architecture, models and infrastructure.
- To understand the concepts of virtualization and virtual machines.
- To gain knowledge about virtualization Infrastructure.
- To explore and experiment with various Cloud deployment environments.
- To learn about the security issues in the cloud environment.

UNIT-I	CLOUD ARCHITECTURE MODELS AND INFRASTRUCTURE	9

Cloud Architecture: System Models for Distributed and Cloud Computing – NIST Cloud Computing Reference Architecture – Cloud deployment models – Cloud service models; Cloud Infrastructure: Architectural Design of Compute and Storage Clouds – Design Challenges.

UNIT-II	VIRTUALIZATION BASICS	9

Virtual Machine Basics – Taxonomy of Virtual Machines – Hypervisor – Key Concepts –Virtualization structure – Implementation levels of virtualization – Virtualization Types: Full Virtualization – Para Virtualization – Hardware Virtualization – Virtualization of CPU, Memory and I/O devices.

UNIT-III	VIRTUALIZATION INFRASTRUCTURE AND DOCKER	9

Desktop Virtualization – Network Virtualization – Storage Virtualization – System-level of Operating Virtualization – Application Virtualization – Virtual clusters and Resource Management –Containers vs. Virtual Machines – Introduction to Docker – Docker Components – Docker Container – Docker Images and Repositories.

UNIT-IV	CLOUD DEPLOYMENT ENVIRONMENT	9

Google App Engine – Amazon AWS – Microsoft Azure; Cloud Software Environments –Eucalyptus – OpenStack.

UNIT-V	CLOUD SECURITY	9

Virtualization System-Specific Attacks: Guest hopping – VM migration attack – hyperjacking. Data Security and Storage; Identity and Access Management (IAM) - IAM Challenges - IAM Architecture and Practice.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Understand the design challenges in the cloud.

CO2: Apply the concept of virtualization and its types**.**

CO3: Experiment with virtualization of hardware resources and Docker.

CO4: Develop and deploy services on the cloud and set up a cloud environment.

CO5: Explain security challenges in the cloud environment.

TEXT BOOKS:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers,1st Edition, 2013.
2. James Turnbull, "The Docker Book", O'Reilly Publishers, 1st Edition, 2014.
3. Krutz, R. L., Vines, R. D, "Cloud security. A Comprehensive Guide to Secure Cloud Computing", Wiley Publishing, 1st Edition, 2010.

REFERENCES:

1. Rajkumar Buyya, James Broberg, Andrez M Goscinski, "Cloud Computing: Principles and Paradigms", Wiley International, 1st Edition,2013
2. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 1st Edition, 2005.
3. Tim Mather, Subra Kumaraswamy, and Shahed Latif, "Cloud Security and Privacy: an enterprise perspective on risks and compliance", O'Reilly Media, Inc.,1st Edition ,2009.

21PAD30	MULTIVARIATE DATA ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the fundamental concepts of univariate, bivariate, and multivariate techniques.
- To conceptualize research models with variables and engage in effective data collection practices.
- To explore different approaches to factor analysis and interpret the results obtained.
- To apprehend the application of moderation models and their role in understanding complex relationships.
- To gain proficiency in multiple discriminant analysis and its applications in group classification.

UNIT-I	INTRODUCTION	9

Uni-variate, Bi-variate and Multi-variate techniques – Classification of multivariate techniques –Guidelines for multivariate analysis and interpretation.

UNIT-II	PREPARING FOR MULTIVARIATE ANALYSIS	9

Conceptualization of research model with variables, collection of data –-Approaches for dealing with missing data – Testing the assumptions of multivariate analysis.

UNIT-III	MULTIPLE LINEAR REGRESSION ANALYSIS, FACTOR ANALYSIS	9

Multiple Linear Regression Analysis – Inferences from the estimated regression function -Validation of the model. -Approaches to factor analysis – interpretation of results.

UNIT-IV	LATENT VARIABLE TECHNIQUES	9

Confirmatory Factor Analysis, Structural equation modelling, Mediation models, Moderation models, Longitudinal studies.

UNIT-V	ADVANCED MULTIVARIATE TECHNIQUES	9

Multiple Discriminant Analysis, Logistic Regression, Cluster Analysis, Conjoint Analysis, multidimensional scaling.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Demonstrate a deep understanding of the concepts and methods used in multivariate data analysis, including their strengths and limitations.

CO2: Use advanced techniques to conduct thorough and insightful analysis of multivariate data, and interpret the results accurately and effectively.

CO3: Show a strong understanding of real-world problems, and conduct deep analysis using appropriate methods to draw reasonable conclusions.

CO4: Write a clear and insightful report for a real-world case study, including well-supported and convincing details.

CO5: Make better business decisions by effectively using advanced techniques in data analytics.

TEXT BOOKS:

1. Joseph F Hair, Rolph E Anderson, Ronald L. Tatham & William C. Black, “Multivariate Data
2. Analysis”, Pearson Education, 7th Edition,New Delhi, 2009.
3. Barbara G. Tabachnick, Linda S.Fidell, “Using Multivariate Statistics”, 6th Edition, Pearson, 2012.
4. Richard A Johnson and Dean W.Wichern,” Applied Multivariate Statistical Analysis”, 6th Edition, Prentice Hall, New Delhi, 2012.

REFERENCES:

1. David R Anderson, Dennis J Seveency, and Thomas A Williams, Statistics for Business and Economics, Thompson, 13th Edition,Singapore, 2019,
2. Michael Jambu, “Exploratory and multivariate data analysis”, 1st Edition, Academic Press Inc., 1990,
3. T.W. Anderson ,“An Introduction to Multivariate Statistical Analysis”,3rd Edition, Wiley,2009,

21PAD31	GEOSPATIAL DATA ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the fundamentals of Geo Spatial technology.
- To design geographic information science database.
- To familiar with the modeling techniques.
- To Learn spatial, raster and terrain analysis.
- To get exposed to spatial modeling and estimation.

UNIT-I INTRODUCTION TO GIS — 9

Introduction – GIS Components – GIS in Organizations – Data Models : Introduction – Common Spatial Data Models – Raster Data Models – Other Data Models – Data File and Structures - Geodesy – Datums.

UNIT-II DESIGNING GIS DATABASE WITH DIGITAL DATA — 9

Projections and Coordinate Systems – Building GIS Database – Digitizing Coordinate capture – Coordinate Transformation – Output : Maps – Data – Meta Data - Digital Data: Introduction – Global Digital Data – Attribute Data and Tables.

UNIT-III GEOSPATIAL NAVIGATION SYSTEM AND DATA MODEL — 9

Global Satellite Navigation System : Introduction – Differential Correction – Optical and Laser Coordinate Surveying – GNSS Applications – Aerial and Satellite Images : Basic Principles – Aerial Images – Satellite Images – Air born LiDAR.

UNIT-IV SPATIAL AND RASTER ANALYSIS — 9

Introduction – Selection and Classification – Dissolve – Proximity Functions and Buffering – Overlay – Map Algebra – Local Functions – Neighborhood, Zonal and Global Functions – Terrain Analysis.

UNIT-V SPATIAL MODELING AND ESTIMATION — 9

Sampling – Spatial Interpolation Methods –Spatial Prediction –Core Area Mapping–Cartographic Modeling– Saptio–Temporal Models–Data Standards and Data Quality – GNSS – Datum Modernization–Improved Remote Sensing–Cloud Based GIS–Open GIS.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Use the fundamental concepts of Geographic Information Science and Technology.

CO2: Design Geo Spatial Database.

CO3: Describe the geospatial system and represents various data model.

CO4: Analyze Geospatial data using spatial and raster analysis techniques.

CO5: Create and design principles, including thematic map display, map projections, and cartographic Design.

TEXT BOOKS:

1. Paul Bolstad, “GIS Fundamentals: A First Text on Geographic Information Systems”, XanEdu Publishing Inc , 6th edition, 2019.
2. Robert Haining, “Spatial Data Analysis Theory and Practice”, Cambridge University, 1st Edition, 2010.
3. O’Sullivan, D and Unwin, D.J.,” Geographic Information Analysis”, Wiley,2nd edition,2010.

REFERENCES:

1. Lo.C.P., Albert K.W. Yeung, Concepts and Techniques of Geographic Information Systems, Prentice-Hall India Publishers, 2nd Edition, 2016
2. Kang - Tsung Chang, Introduction to Geographic Information Systems, McGraw Hill Publishing, 2nd Edition, 2011.
3. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, “An Introduction Geographical Information Systems, Pearson Education, 2nd Edition, 2007.

21PAD32	TIME SERIES ANALYSIS AND FORECASTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the graphical and numerical description of time series data.
- To apply regression models to general time series data.
- To use exponential smoothing methods to forecast future values.
- To apply ARIMA models to model stationary time series data.
- To be familiar with multivariate time series models and forecasting.

UNIT-I	STATISTICS BACKGROUND FOR FORECASTING	9

Introduction- Graphical Displays- Numerical Description of Time Series Data (stationarity, autocovariance, autocorrelation)- Use of Data Transformations and Adjustments- General Approach to Time Series Modeling and Forecasting-Evaluation and Monitoring Forecasting Model Performance.

UNIT-II	REGRESSION ANALYSIS AND FORECASTING	9

Introduction-Least Squares Estimation in Linear Regression- Statistical Inference In Linear Regression- Prediction of New Observations- Variable Selection Methods in Regression- Generalized and Weighted Least Squares- Regression Models for General Time Series Data.

UNIT-III	EXPONENTIAL SMOOTHING METHODS	9

Introduction- First-Order Smoothing- Modeling Time Series Data- Second-Order Exponential Smoothing-Higher-Order Exponential Smoothing- Forecasting.

UNIT-IV	AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) MODELS	9

Introduction- Linear Models for Stationary Time Series- Finite Order Moving Average Processes- Finite Order Autoregressive Processes- Mixed Autoregressive – Moving Average (ARMA)-Nonstationary Processes- Time Series Model Building.

UNIT-V	SURVEY OF OTHER FORECASTING METHODS	9

Multivariate Time Series Models and Forecasting- State Space Models- Combining Forecasts to Improve Prediction Performance- Neural Networks and Forecasting.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Evaluate and monitor forecasting model performance using appropriate metrics.

CO2: Understand and apply least squares estimation to fit linear regression models.

CO3: Interpret and evaluate the performance of exponential smoothing models.

CO4: Fit ARIMA models using maximum likelihood estimation**.**

CO5: Combine forecasts from different methods to improve predictive accuracy.

TEXT BOOKS:

1. Douglas C. Montgomery, Cheryl L. Jennings, and Murat Kulachi , "Introduction to Time Series Analysis and Forecasting",2nd Edition,Wiley,2015.
2. George E. P. Box , Gwilym M. Jenkins , Gregory C. Reinsel , Greta M. Ljung, "Time Series Analysis: Forecasting and Control", 5th Edition,Wiley,2015.

REFERENCES:

1. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulahci , James R. Broyles , Christopher J. Rigdon , Rachel T. Johnson, "Student Solutions Manual to Accompany Introduction to Time Series Analysis and Forecasting" **,** 1st Edition, Wiley,2009.
2. Rob Hyndman, George Athanasopoulos, "Forecasting: principles and practice", 1st Edition, Kindle Edition,2018.
3. Galit Shmueli, Kenneth C. Lichtendahl Jr, "Practical Time Series Forecasting with R: A Hands-On Guide", 2nd Edition, Kindle Edition,2016.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
VERTICAL - IV

21PAD33	ROBOTIC PROCESS AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the basic concepts of Robotic Process Automation.
- To expose to the key RPA design and development strategies and methodologies.
- To learn the fundamental RPA logic and structure.
- To explore the Exception Handling, Debugging and Logging operations in RPA.
- To learn to deploy and maintain the software bot.

UNIT-I — INTRODUCTION TO ROBOTIC PROCESS AUTOMATION — 9

Emergence of Robotic Process Automation (RPA), Evolution of RPA, Differentiating RPA from Automation - Benefits of RPA - Application areas of RPA, Components of RPA, RPA Platforms. Robotic Process Automation Tools - Templates, User Interface, Domains in Activities, Workflow Files.

UNIT-II — AUTOMATION PROCESS ACTIVITIES — 9

Sequence, Flowchart & Control Flow: Sequencing the Workflow, Activities, Flowchart, Control Flow for Decision making. Data Manipulation: Variables, Collection, Arguments, Data Table, Clipboard management, File operations Controls: Finding the control, waiting for a control, Act on a control, UiExplorer, Handling Events.

UNIT-III — APP INTEGRATION, RECORDING AND SCRAPING — 9

App Integration, Recording, Scraping, Selector, Workflow Activities. Recording mouse and keyboard actions to perform operation, Scraping data from website and writing to CSV. Process Mining.

UNIT-IV — EXCEPTION HANDLING AND CODE MANAGEMENT — 9

Exception handling, Common exceptions, Logging- Debugging techniques, Collecting crash dumps, Error reporting. Code management and maintenance: Project organization, Nesting workflows, Reusability, Templates, Commenting techniques, State Machine.

UNIT-V — DEPLOYMENT AND MAINTENANCE — 9

Publishing using publish utility, Orchestration Server, Control bots, Orchestration Server to deploy bots, License management, Publishing and managing updates. RPA Vendors - Open Source RPA, Future of RPA.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Enunciate the key distinctions between RPA and existing automation techniques and platforms.
CO2: Use UiPath to design control flows and work flows for the target process
CO3: Implement recording, web scraping and process mining by automation
CO4: Use UiPath Studio to detect, and handle exceptions in automation processes
CO5: Implement and use Orchestrator for creation, monitoring, scheduling, and controlling of automated bots and processes.

TEXT BOOKS:

1. Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool – UiPath by Alok Mani Tripathi, Packt Publishing, 2018.
2. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems, Apress publications, 2020.
3. A Gerardus Blokdyk, “Robotic Process Automation Rpa A Complete Guide “, 2020.

REFERENCES:

1. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, “Introduction to Robotic Process Automation: a Primer”, Institute of Robotic Process Automation, Amazon Asia-Pacific Holdings Private Limited, 2018.
2. Richard Murdoch, “Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant”, Amazon Asia-Pacific Holdings Private Limited, 2018.

21PAD34	REINFORCEMENT LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the fundamental concepts of reinforcement learning.
- To learn the principles of Monte Carlo prediction.
- To define R-Learning framework and its application in reinforcement learning problems.
- To explore linear methods for function approximation in reinforcement learning.
- To utilize heuristic search algorithms in reinforcement learning.

UNIT-I	**INTRODUCTION**	**9**

Introduction - Elements of RL, History of RL- Evaluative feedback -Goals and rewards – Returns – Markovian Decision Problem (MDP) – Value functions - Optimality Criterion in MDPs. Policy Evaluation-Policy Improvement- Value Iteration, asynchronous DP- Efficiency of DP.

UNIT-II	**MONTE CARLO METHODS**	**9**

Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Monte Carlo Control- Policy Evaluation - Policy Improvement - On-policy and off - policy Monte Carlo controls -Incremental implementation.

UNIT-III	**LEARNING**	**9**

Temporal-Difference prediction - Optimality of TD – Sarsa – Q Learning – Off-Policy TD Control - R Learning -ActorCritic Model- Unifying Monte Carlo and TD –Traces - Games.

UNIT-IV	**FUNCTION**	**9**

Approximation - Value prediction and control – Gradient Descent methods - Linear methods – Control with Function Approximation - Artificial Neural Network based approximation.

UNIT-V	**PLANNING AND LEARNING**	**9**

Model based learning and planning - Integrating Planning, Acting, and Learning - prioritized sweeping - Trajectory Sampling - Monte Carlo Tree Search - Heuristic search - Case Studies.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Implement and apply policy iteration and value iteration reinforcement learning algorithms.
CO2: Implement and apply Monte Carlo reinforcement learning algorithms.
CO3: Implement and apply temporal-difference reinforcement learning algorithms.
CO4: Construct and apply on/off - policy reinforcement learning algorithms with function approximation.
CO5: Implementation and testing of complete decision making systems.

TEXT BOOKS:

1. Sutton R. S. and Barto A. G., "Reinforcement Learning: An Introduction",2nd Edition MIT Press,2018.
2. Reinforcement Learning', Richard.S.Sutton and Andrew G.Barto, 2nd edition, MIT Press, 2018.
3. CsabaSzepesvári, "Algorithms for Reinforcement Learning", 2nd Edition, Morgan & Claypool, 2013.

REFERENCES:

1. Belousov, B., Abdulsamad, H., Klink, P., Parisi, S., Peters, J. (Eds.), “Reinforcement Learning Algorithms: Analysis and Applications”,1^{st} Edition, Springer 2021.
2. Kevin Murphy , “Machine Learning - A Probabilistic Perspective” ,1^{st} Edition, MIT press, 2012.
3. Christopher Bishop, “Pattern Recognition and Machine Learning”, 1^{st} Edition, Springer, 2006.

21PAD35	FOUNDATIONS OF GAME DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and tool kits.
- To learn and develop simple games using Pygame environment.

UNIT-I	3D GRAPHICS FOR GAME DESIGN	9

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components – 2D and 3D Transformations – Projections – Color Models – Illumination and Shader Models – Animation –Controller Based Animation.

UNIT-II	GAME DESIGN PRINCIPLES	9

Character Development, Storyboard Development for Gaming – Script Design – Script Narration, Game Balancing, Core Mechanics, Principles of Level Design – Proposals – Writing for Preproduction, Production and Post – Production.

UNIT-III	GAME ENGINE DESIGN	9

Rendering Concept – Software Rendering – Hardware Rendering – Spatial Sorting Algorithms –Algorithms for Game Engine– Collision Detection – Game Logic – Game AI – Pathfinding.

UNIT-IV	OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS	9

Pygame Game development – Unity – Unity Scripts –Mobile Gaming, Game Studio, Unity Single player and Multi-Player games.

UNIT-V	GAME DEVELOPMENT USING PYGAME	9

Developing 2D and 3D interactive games using Pygame – Avatar Creation – 2D and 3D Graphics Programming – Incorporating music and sound – Asset Creations – Game Physics algorithms Development – Device Handling in Pygame – Overview of Isometric and Tile Based arcade Games – Puzzle Games.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Explain the concepts of 2D and 3d Graphics.
CO2: Design game design documents**.**
CO3: Implementation of gaming engines.
CO4: Survey gaming environments and frameworks.
CO5: Implement a simple game in Pygame**.**

TEXT BOOKS:

1. Sanjay Madhav, “Game Programming Algorithms and Techniques: A Platform Agnostic Approach”, 1st Edition, Addison Wesley,2013.
2. Will McGugan, “Beginning Game Development with Python and Pygame: From Novice to Professional”, 1st Edition, Apress, 2007.

3. Paul Craven, “Python Arcade games”, 1st Edition, Apress Publishers,2016.
REFERENCES: 1. David H. Eberly, “3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics”, 2nd Edition, CRC Press,2006. 2. Jung Hyun Han, “3D Graphics for Game Programming”, 1st Edition, Chapman and Hall/CRC, 2011. 3. Jason Gregory ,”Game Engine Architecture” 3rd Edition, A K Peters, 2019.

21PAD36	HUMAN COMPUTER INTERACTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To learn the foundations of Human Computer Interaction.
- To become familiar with the design technologies for individuals and persons with disabilities.
- To understand the different models of HCI.
- To be aware of mobile HCI.
- To learn the guidelines for user interface.

UNIT-I	**FOUNDATIONS OF HCI**	**9**

The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity- Paradigms.

UNIT-II	**DESIGN & SOFTWARE PROCESS**	**9**

Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules.

UNIT-III	**MODELS AND THEORIES**	**9**

HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

UNIT-IV	**MOBILE HCI**	**9**

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools.

UNIT-V	**WEB INTERFACE DESIGN**	**9**

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Design effective dialog for HCI.
CO2: Demonstrate the software process and design rules.
CO3: Design effective HCI for individuals and persons with disabilities.
CO4: Identify the importance of user feedback.
CO5: Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Websites.

TEXT BOOKS:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, "Human Computer Interaction", 3rd Edition, Pearson Education, 2004
2. Brian Fling, "Mobile Design and Development", 1st Edition, O'Reilly Media Inc., 2009.
3. Bill Scott and Theresa Neil, "Designing Web Interfaces", 1st Edition, O'Reilly, 2009

REFERENCES:

1. Julie A. Jacko and Andrew Sears, The human-computer interaction handbook: fundamentals, evolving Technologies, and emerging applications, Lawrence Erlbaum Associates, 1st Edition, Inc.,Publishers, 2003.
2. Lloyd P. Rieber, Computers, Graphics, & Learning, 1st Edition, Brown & Benchmark publishers, 2005.
3. Yvonne Rogers, Helen Sharp, Jenny Preece, Interaction Design: beyond human-computer interaction, 2nd Edition, John-Wiley and Sons Inc., 2009.

21PAD37	GPU ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the basics of GPU architectures.
- To write programs for massively parallel processors.
- To understand the issues in mapping algorithms for GPUs.
- To introduce different GPU programming models.
- To study different algorithms for GPUs.

UNIT-I	GPU ARCHITECTURE	9

Evolution of GPU architectures - Understanding Parallelism with GPU –Typical GPU Architecture -CUDA Hardware Overview - Threads, Blocks, Grids, Warps, Scheduling.

UNIT-II	CUDA PROGRAMMING	9

Using CUDA - Multi GPU - Multi GPU Solutions - Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.

UNIT-III	PROGRAMMING ISSUES	9

Common Problems: CUDA Error Handling, Parallel Programming Issues, Synchronization, Algorithmic Issues, Finding and Avoiding Errors.

UNIT-IV	OPENCL BASICS	9

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.

UNIT-V	ALGORITHMS ON GPU	9

Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix - Matrix Multiplication – Programming Heterogeneous Cluster.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Describe GPU Architecture.
CO2: Write programs using CUDA, identify issues and debug them.
CO3: Implement efficient algorithms in GPUs for common application kernels, such as matrix multiplication.
CO4: Write simple programs using OpenCL.
CO5: Identify efficient parallel programming patterns to solve problems.

TEXT BOOKS:

1. Shane Cook, CUDA Programming: A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), 1st Edition, Morgan Kaufmann, 2012.
2. David R. Kaeli, Perhaad Mistry, Dana Schaa, Dong Ping Zhang, “Heterogeneous computing with OpenCL”, 3rd Edition, Morgan Kauffman, 2015.
3. Nicholas Wilt, CUDA Handbook: A Comprehensive Guide to GPU Programming, 1st Edition, Addison -Wesley, 2013.

REFERENCES:

1. Jason Sanders, Edward Kandrot, CUDA by Example: An Introduction to General Purpose GPU Programming, 1st Edition, Addison - Wesley, 2010.
2. David B. Kirk, Wen-mei W. Hwu, Programming Massively Parallel Processors - A Hands-on Approach, 3rd Edition, Morgan Kaufmann, 2016.

21PAD38	WEB AND SOCIAL MEDIA ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the basic issues and types of web and social media mining.
- To familiarize the learners with the concept of web and social media analytics and understand its significance.
- To familiarize the learners with the tools of web and social media analytics.
- To Enable the learners to develop skills required for analyzing the effectiveness of web and social media for business purposes.
- To know the applications in real time systems.

UNIT-I	INTRODUCTION TO SOCIAL MEDIA ANALYSIS	9

Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations, Application of SMA in different areas. Network fundamentals and models: The social networks perspective - nodes, ties and influencers, Social network and web data and methods.

UNIT-II	COMMUNITY BUILDING AND MANAGEMENT	9

History and Evolution of Social Media-Understanding Science of Social Media –Goals for using Social Media- Social Media Audience and Influencers - Digital PR- Promoting Social Media Pages- Linking Social Media Accounts.

UNIT-III	SOCIAL MEDIA POLICIES AND MEASUREMENTS	9

Social Media Policies-Etiquette, Privacy- ethical problems posed by emerging social media technologies - The Basics of Tracking Social Media.

UNIT-IV	WEB ANALYTICS	9

Data Collection, Overview of Qualitative Analysis, Business Analysis, KPI and Planning, Critical Components of a Successful Web Analytics Strategy, Proposals & Reports, Web Data Analysis.

UNIT-V	SOCIAL MEDIA ANALYTICS	9

Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post- performance on FB. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Understand about web, social media mining.
CO2: Understand the significance of web and social media analytics.
CO3: Learn tools of web and social media analytics.
CO4: Develop skills required for analyzing the effectiveness of web and social media for business purposes.
CO5: Know the applications in real time systems.

TEXT BOOKS:

1. Matthew Ganis, Avinash Kohirkar, Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media, Pearson, 2016.

2. K. M. Shrivastava, Social Media in Business and Governance, Sterling Publishers Private Limited, 2013
3. Christian Fuchs, Social Media a critical introduction, SAGE Publications Ltd, 2014.

REFERENCES:

1. Bittu Kumar, Social Networking, V & S Publishers, 2013.
2. Avinash Kaushik, Web Analytics - An Hour a Day, Wiley Publishing, 2007.

21PAD39	AI IN FINANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To explore the concepts of machine intelligence.
- To understand the types of Finance, and Concepts of AI in Finance.
- To discuss the neural networks and reinforcement learning.
- To learn algorithmic trading and test it in python environment.
- To understand the role of AI in finance and its applications.

UNIT-I	MACHINE INTELLIGENCE	9

Artificial Intelligence: Algorithms, Neural Networks— Importance of Data. Super Intelligence : Forms of Intelligence – Paths to Super intelligence – Intelligence Explosion.

UNIT-II	FINANCE AND MACHINE LEARNING	9

Normative Finance: Uncertainty and Risk – Expected Utility Theory – Mean – Variance Portfolio Theory – Capital Asset Pricing Model – Arbitrage Pricing Theory. Data-Driven Finance: Scientific Method – Financial Econometrics and Regression – Data Availability, Normative Theories Revisited – Debunking Central Assumptions. Machine Learning. AI– First Finance.

UNIT-III	STATISTICAL INEFFICIENCIES	9

Dense Neural Networks: Baseline prediction – Normalization – Dropout – Regularization – Bagging – Optimizers .Recurrent Neural Networks: Second Example – Financial Price Series – Financial Return Series – Financial Features. Reinforcement Learning : Fundamental Notations – OpenAI Gym - Monte Carlo Agent – Neural Network Agent – DQL Agent – Simple Finance Gym - Better Finance Gym – FQL Agent.

UNIT-IV	ALGORITHMIC TRADING	9

Vectorized Back testing: Back testing an SMA-Based Strategy – Back testing a Daily DNN-Based Strategy – Back testing an Intraday DNN-Based Strategy. Risk Management: Trading Bot, Vectorized Back testing Event-Based Back testing – Assessing Risk – Back testing Risk Measures. Execution and Deployment: Oando Account – Data Retrieval – Order Execution – Trading Bot.

UNIT-V	OUTLOOK	9

AI-Based Competition: AI and Finance – Lack of Standardization – Education and Training Fight for Resources – Market Impact – Competitive Scenarios – Risks – Regulation and Oversight. Financial Singularity.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Explore the main concepts of AI and machine learning.
CO2: Use financial types, metrics and machine learning techniques in AI.
CO3: Apply neural networks in Finance.
CO4: Explore algorithmic trading that AI and machine learning techniques can add to various portfolio and risk management strategies.
CO5: Apply the concepts of AI in financial applications.

TEXT BOOKS:

1. Yves Hilpisch, “Artificial Intelligence in Finance – A Python-Based Guide”, O’Reilly Media, Inc. 1st Edition, 2020.
2. Nydia Remolina, Aurelio Gurrea-Martinez, "Artificial Intelligence in Finance: Challenges, Opportunities and Regulatory Developments", Edward Elgar Publishing ,1st Edition, Ltd,2023.
3. Jeffrey Ng, “Hands-On Artificial Intelligence for Banking: A practical guide to building intelligent financial applications using machine learning techniques”, Packt, 2020.

REFERENCES:

1. Oliver Wyman, "Artificial Intelligence Applications in Financial Services”, Marsh & McLennan, 1st Edition, 2019.
2. Ivana Bartoletti, Anne Leslie, Shân M. Millie ,"The AI Book: The Artificial Intelligence Handbook for Investors, Entrepreneurs and FinTech Visionaries", 1st Edition, Wiley,2020.

21PAD40	ARTIFICIAL NEURAL NETWORKS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To explore the architecture and learning principles of Neural Networks.
- To develop various hybrid algorithms involved in Neural Networks.
- To provide adequate knowledge of application of Neural Networks in real time systems.
- To understand the architecture of Adaptive Resonance theory.
- To define the Neocognitron and its process.

UNIT-I	NEURAL NETWORKS ARCHITECTURES	9

Neurophysiology – General Processing Element – Perceptron representation – Learning – Linear separability–Problems with the perceptron training algorithms – Multilayer perceptron Learning rules – Supervised learning –ADALINE Architecture – LMS learning rule – Applications.

UNIT-II	BACK PROPAGATION NETWORK AND SIMULATED ANNEALING	9

Back Propagation Network – operation, generalized delta rule, Training algorithm – updating of output and hidden layer weights – Practical difficulties and considerations – Application of BPN – Annealing – Boltzmann machine – Learning – Application.

UNIT-III	COUNTER PROPAGATION NETWORK AND SELF ORGANIZING MAP	9

Counter Propagation network concept – Architecture –Training – Practical consideration – Applications- Self organizing map – learning algorithm, feature map classifier, Applications.

UNIT-IV	ASSOCIATIVE MEMORY AND ADAPTIVE RESONANCE THEORY	9

Associative Memory concept – Bi–directional Associative Memory – Hopfield memory – traveling salesman problem – Architecture of Adaptive Resonance Theory – Pattern matching in ART network.

UNIT-V	NEOCOGNITRON	9

Architecture of Neocognitron– Data processing and performance of architecture of spatio temporal networks for speech recognition.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Apply the concept of neural networks in practical applications.

CO2: Design, implement and analyze the performance of Back Propagation Neural Network.

CO3: Apply Counter Propagation Network and Self Organizing Map for solving various problems.

CO4: Solve real world problems using Associative and Adaptive Neural Network Techniques.

CO5: Implement Neocognitron architecture for practical applications.

TEXT BOOKS:

1. J.A. Freeman and B.M.Skapura, "Neural Networks, Algorithms Applications and Programming Techniques", Addison–Wesely, 2003.
2. Laurene V. Fausett “Fundamentals of Neural Networks: Architectures, Algorithms and Applications”, Prentice Hall, 2013.

REFERENCES:

1. Jang J.S.R., Sun C.T and Mizutani E, "Neuro Fuzzy and Soft computing", Pearson education, Reprint 2010.
2. S.Rajasekaran and G.A.VijayalakshmiPai "Neural networks, Fuzzy logics, and Genetic algorithms", Prentice Hall of India, 2013.

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY
(Autonomous)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
VERTICAL- V

21PAD41	VIDEO CREATION AND EDITING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
The main objectives of this course are:
- To introduce the broad perspective of linear and nonlinear editing concepts.
- To understand the concept of Storytelling styles.
- To be familiar with audio and video recording.
- To apply different media tools.
- To learn and understand the concepts of AVID XPRESS DV 4.

UNIT-I	FUNDAMENTALS	9
Evolution of filmmaking - linear editing - non-linear digital video - Economy of Expression - risks associated with altering reality through editing.		
UNIT-II	**STORYTELLING**	**9**
Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits - Consumer and pro NLE systems - digitizing images - managing resolutions - mechanics of digital editing - pointer files - media management.		
UNIT-III	**USING AUDIO AND VIDEO**	**9**
Capturing digital and analog video importing audio putting video on exporting digital video to tape recording to CDs and VCDs.		
UNIT-IV	**WORKING WITH FINAL CUT PRO**	**9**
Working with clips and the Viewer - working with sequences, the Timeline, and the canvas - Basic Editing - Adding and Editing Testing Effects - Advanced Editing and Training Techniques - Working with Audio - Using Media Tools - Viewing and Setting Preferences.		
UNIT-V	**WORKING WITH AVID XPRESS DV 4**	**9**
Starting Projects and Working with Project Window - Using Basic Tools and Logging - Preparing to Record and Recording - Importing Files - Organizing with Bins - Viewing and Making Footage - Using Timeline and Working in Trim Mode - Working with Audio - Output Options.		
		TOTAL:45 PERIODS

COURSE OUTCOMES:
At end of the course, learners will be able to
CO1: Compare the strengths and limitations of Nonlinear editing.
CO2: Identify the infrastructure and significance of storytelling.
CO3: Apply suitable methods for recording to CDs and VCDs.
CO4: Address the core issues of advanced editing and training techniques.
CO5: Design and develop projects using AVID XPRESS DV 4.

TEXT BOOKS:

1. Avid Xpress DV 4 User Guide, 2007.
2. Robert M. Goodman and Partick McGarth, “Editing Digital Video: The Complete Creative and Technical Guide”, Digital Video and Audio, McGraw – Hill 2003.
3. Andrei Besedin, “Digital Video And Photo Editing Software With Adobe Photoshop Software Creating Cloud Classroom Book! : Classroom in a Book”, Kindle Edition, 2021.

REFERENCES:

1. Final Cut Pro 6 User Manual, 2004.
2. Keith Underdahl, “Digital Video for Dummies”, Third Edition, Dummy Series, 2001.

21PAD42	ESSENTIALS OF UI AND UX DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To provide a sound knowledge in UI & UX.
- To understand the need for UI and UX.
- To understand the various Research Methods used in Design.
- To explore the various Tools used in UI & UX.
- Creating a wireframe and prototype.

UNIT-I	FOUNDATIONS OF DESIGN	9

UI vs. UX Design - Core Stages of Design Thinking - Divergent and Convergent Thinking -Brainstorming and Game storming - Observational Empathy.

UNIT-II	FOUNDATIONS OF UI DESIGN	9

Visual and UI Principles - UI Elements and Patterns - Interaction Behaviors and Principles –Branding - Style Guides.

UNIT-III	FOUNDATIONS OF UX DESIGN	9

Introduction to User Experience - Why You Should Care about User Experience - Understanding User Experience - Defining the UX Design Process and its Methodology - Research in User Experience Design - Tools and Method used for Research - User Needs and its Goals - Know about Business Goals.

UNIT-IV	WIREFRAMING, PROTOTYPING AND TESTING	9

Sketching Principles - Sketching Red Routes - Responsive Design – Wireframing - Creating Wireflows - Building a Prototype - Building High-Fidelity Mockups - Designing Efficiently with Tools- Interaction Patterns - Conducting Usability Tests - Other Evaluative User Research Methods - Synthesizing Test Findings - Prototype Iteration.

UNIT-V	RESEARCH, DESIGNING, IDEATING, & INFORMATION ARCHITECTURE	9

Identifying and Writing Problem Statements - Identifying Appropriate Research Methods – Creating Personas - Solution Ideation - Creating User Stories - Creating Scenarios - Flow Diagrams - Flow Mapping - Information Architecture.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Build UI for user Applications.
CO2: Evaluate UX design of any product or application.
CO3: Demonstrate UX Skills in product development.
CO4: Implement Sketching principles.
CO5: Create Wireframe and Prototype.

TEXT BOOKS:

1. Joel Marsh, “UX for Beginners”, O’Reilly , 2022.
2. Jon Yablonski, “Laws of UX using Psychology to Design Better Product & Services” O’Reilly 2021.
3. Jenifer Tidwell, Charles Brewer, Aynne Valencia, “Designing Interface” 3rd Edition , O’Reilly 2020.

REFERENCES:

1. Steve Schoger, Adam Wathan “Refactoring UI”, 2018.
2. Steve Krug, “Don't Make Me Think, Revisited: A Commonsense Approach to Web &Mobile”, 3rd Edition, 2015.
3. https://www.nngroup.com/articles/

21PAD43	DIGITAL MARKETING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the process of online market.
- To acquire the knowledge on search engine optimization.
- To Explore the role and importance of digital marketing in today's rapidly changing business environment.
- To learn about social media marketing.
- To focuses on how digital transformation can be utilized by organizations and how its effectiveness can be measured.

UNIT-I	INTRODUCTION TO ONLINE MARKET	9

Online Market space- Digital Marketing Strategy- Components - Opportunities for building Brand Website - Planning and Creation - Content Marketing.

UNIT-II	SEARCH ENGINE OPTIMISATION	9

Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement.

UNIT-III	E- MAIL MARKETING	9

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing- Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting.

UNIT-IV	SOCIAL MEDIA MARKETING	9

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing.

UNIT-V	DIGITAL TRANSFORMATION	9

Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, Social Media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

TOTAL: 45PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: To examine and explore the role and importance of digital marketing in today's rapidly changing business environment.

CO2: To focuses on how digital marketing can be utilized by organizations and how its effectiveness can be measured.

CO3: To know the key elements of a digital marketing strategy.

CO4: To study how the effectiveness of a digital marketing campaign can be measured.

CO5: To demonstrate advanced practical skills in common digital marketing tools such as SEO, SEM, Social media and Blogs.

TEXT BOOKS:

1. Puneet Singh Bhatia,"Fundamentals of Digital Marketing",1st edition, Pearson Education,2017.
2. Vandana Ahuja,"Digital Marketing" Oxford University Press,2015.
3. Barker, Barker, Bormann and Neher, Social Media Marketing: A Strategic Approach, 2E South-Western ,Cengage Learning,2017.

REFERENCES:

1. Philip Kotler, “Marketing 4.0: Moving from Traditional to Digital” Wiley, 1st edition,2017.
2. Ryan, D., "Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation, Kogan Page Limited,2014.
3. Pulizzi,J Beginner's Guide to Digital Marketing , Mcgraw Hill Education,2019.

21PAD44	VISUAL EFFECTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To get a basic idea on animation principles and techniques.
- To get exposure to CGI, color and light elements of VFX.
- To have a better understanding of basic special effects techniques.
- To have a knowledge of state of the art vfx techniques.
- To become familiar with popular compositing techniques.

UNIT-I	ANIMATION BASICS	9

VFX production pipeline, Principles of animation, Techniques: Keyframe, kinematics, Full animation, limited animation, Rotoscoping, stop motion, object animation, pixilation, rigging, shape keys, motion paths.

UNIT-II	CGI, COLOR, LIGHT	9

CGI – virtual worlds, Photorealism, physical realism, function realism, 3D Modeling and Rendering: color - Color spaces, color depth, Color grading, color effects, HDRI, Light – Area and mesh lights, image based lights, PBR lights, photometric light, BRDF shading model.

UNIT-III	SPECIAL EFFECTS	9

Special Effects – props, scaled models, animatronics, pyrotechniques, Schüfftan process, Particle effects – wind, rain, fog, fire.

UNIT-IV	VISUAL EFFECTS TECHNIQUES	9

Motion Capture, Matt Painting, Rigging, Front Projection.Rotoscoping, Match Moving – Tracking, camera reconstruction, planar tracking, Calibration, Point Cloud Projection, Ground plane determination, 3D Match Moving.

UNIT-V	COMPOSITING	9

Compositing – chroma key, blue screen/green screen, background projection, alpha compositing, deep image compositing, multiple exposure, matting, VFX tools - Blender, Natron, GIMP.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: To implement animation in 2D / 3D following the principles and techniques.
CO2: To use CGI, color and light elements in VFX applications.
CO3: To create special effects using any of the state of the art tools.
CO4: To apply popular visual effects techniques using advanced tools.
CO5: To use compositing tools for creating VFX for a variety of applications.

TEXT BOOKS:

1. Chris Roda, "Real Time Visual Effects for the Technical Artist", CRC Press, 1st Edition, 2022.
2. Steve Wright, "Digital Compositing for film and video, Routledge", 4th Edition, 2017.
3. John Gress, "Digital Visual Effects and Compositing", New Riders Press, 1st Edition, 2014.

REFERENCES:

1. Jon Gress, "Digital Visual Effects and Compositing", New Riders Press, 1st Edition, 2014.
2. Robin Brinkman, "The Art and Science of Digital Compositing: Techniques for Visual Effects, Animation and Motion Graphics", Morgan Kauffman, 2008.
3. Luiz Velho, Bruno Madeira, "Introduction to Visual Effects A Computational Approach", Routledge, 2023.

4. Jasmine Katatikarn, Michael Tanzillo, “Lighting for Animation: The art of visual storytelling , Routledge, 1st Edition, 2016.
5. Eran Dinur, “The Complete guide to Photorealism, for Visual Effects, Visualization and Games”, Routledge, 1st Edition, 2021.

21PAD45	APP DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To understand the basics of web and mobile app development.
- To learn development of native applications with basic GUI Components.
- To develop cross-platform applications with event handling.
- To implement applications with location and data storage capabilities.
- To demonstrate web applications with database access.

UNIT-I	**FUNDAMENTALS OF MOBILE & WEB APPLICATION DEVELOPMENT**	**9**

Basics of Web and Mobile application development, Native App, Hybrid App, Cross-platform App, What is Progressive Web App, Responsive Web design.

UNIT-II	**NATIVE APP DEVELOPMENT USING JAVA**	**9**

Native Web App, Benefits of Native App, Scenarios to create Native App, Tools for creating Native App, Cons of Native App, Popular Native App Dev elopment Frameworks, Java & Kotlin for Android, Swift & Objective- C for iOS, Basics of React Native, Native Components, JSX, State, Props.

UNIT-III	**HYBRID APP DEVELOPMENT**	**9**

Hybrid Web App, Benefits of Hybrid App, Criteria for creating Native App, Tools for creating Hybrid App, Cons of Hybrid App, Popular Hybrid App Development Frameworks, Ionic, Apache Cordova.

UNIT-IV	**CROSS-PLATFORM APP DEVELOPMENT USING REACT-NATIVE**	**9**

What is Cross-platform App, Benefits of Cross-platform App, Criteria for creating Cross-platform App, Tools for creating Cross-platform App, Cons of Cross-platform App, Popular Cross- platform App Development Frameworks, Flutter, Xamarin, React-Native, Basics of React Native, Native Components, JSX, State, Props.

UNIT-V	**NON-FUNCTIONAL CHARACTERISTICS OF APP FRAMEWORKS**	**9**

Comparison of different App frameworks, Build Performance, App Performance, Debugging capabilities, Time to Market, Maintainability, Ease of Development, UI/UX and Reusability.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Develop Native applications with GUI Components.
CO2: Enhance hybrid applications with basic event handling.
CO3: Implement cross-platform applications with location and data storage capabilities.
CO4: Exhibit cross platform applications with basic GUI and event handling.
CO5: Develop web applications with cloud database access.

TEXT BOOKS:

1. Dawn Griffiths, Head First Android Development, , O'Reilly, 3rd edition, November 2021.
2. Raymond K. Camden, "Apache Cordova in Action" , Manning. 2015.
3. Anthony Accomazzo, Houssein Djirdeh, Sophia Shoemaker, Devin Abbott , "Full Stack React Native: Create beautiful mobile apps with JavaScript and React Native", FullStack publishing, 2019.

REFERENCES:

1. John Horton, "Android Programming for Beginners", Packt Publishing, 2nd Edition, 2018.
2. Shaun Lewis, Mike Dunn, "Native Mobile Development", 2019.
3. Pawan Lingras, Matt Triff, Rucha Lingras, "Building Cross-Platform Mobile and Web Apps for Engineers and Scientists: An Active Learning Approach" 2015.

21PAD46	DEVOPS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To introduce DevOps terminology, definition & concepts.
- To understand the different Version control tools like Git, Mercurial etc.
- To understand the concepts of Continuous Integration, Continuous Testing and Continuous Deployment.
- To understand Configuration management using Ansible.
- Illustrate the benefits and drive the adoption of cloud-based Devops tools to solve real world problems.

UNIT-I	INTRODUCTION TO DEVOPS	9

Devops Essentials - Introduction to AWS, GCP, Azure - Version control systems: Git and Github - Gerrit Code review.

UNIT-II	COMPILE AND BUILD USING MAVEN , GRADLE & ANT	9

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases(compile build, test, package) Maven Profiles, Maven repositories(local, central, global),Maven plugins, Maven create and build Artificats, Dependency management, Installation of Gradle, Understand build using Gradle – Introduction to ANT- Installation of ANT – Understand and Build using ANT.

UNIT-III	CONTINUOUS INTEGRATION USING JENKINS	9

Install & Configure Jenkins, Jenkins Architecture Overview, Creating a Jenkins Job, Configuring a Jenkins job, Introduction to Plugins, Adding Plugins to Jenkins, Commonly used plugins (Git Plugin, Parameter Plugin, HTML Publisher, Copy Artifact and Extended choice parameters). Configuring Jenkins to work with java, Git and Maven, Creating a Jenkins Build and Jenkins workspace.

UNIT-IV	CONFIGURATION MANAGEMENT USING ANSIBLE	9

Ansible Introduction, Installation, Ansible master/slave configuration, YAML basics, Ansible modules, Ansible Inventory files, Ansible playbooks, Ansible Roles, adhoc commands in ansible.

UNIT-V	BUILDING DEVOPS PIPELINES USING AZURE	9

Create Github Account, Create Repository, Create Azure Organization, Create a new pipeline, Builda sample code, Modify azure-pipelines.yaml file - Testing and Monitoring - Selenium, Jira, and ELK.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Understand different actions performed through Version control tools like Git.

CO2: Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.

CO3: Ability to Perform Automated Continuous Deployment.

CO4: Ability to do configuration management using Ansible.

CO5: Understand to leverage Cloud-based DevOps tools using Azure DevOps.

TEXT BOOKS:

1. Roberto Vormittag, “A Practical Guide to Git and GitHub for Windows Users: From Beginnerto Expert in Easy Step-By-Step Exercises”, 2nd Edition, Kindle Edition, 2016.
2. Jason Cannon, “Linux for Beginners: An Introduction to the Linux Operating System and Command Line”, Kindle Edition, 2014.

3. Mitesh Soni , Hands-On Azure Devops: Cicd Implementation For Mobile, Hybrid, And Web Applications Using Azure Devops And Microsoft Azure: CICD Implementation for DevOps and Microsoft Azure , Paperback ,2020 .

REFERENCES:

1. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, 1st Edition, 2015.
2. David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, 2nd Edition, 2016.
3. Mariot Tsitoara, “Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, 2nd Edition, 2019.
4. https://www.jenkins.io/user-handbook.pdf
5. https://maven.apache.org/guides/getting-started/

<table>
<tr><td rowspan="2">21PAD47</td><td rowspan="2">OPEN SOURCE TECHNOLOGIES</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:
The main objectives of this course are:
• Understand the difference between open-source software and commercial software.
• Understand the policies, licensing procedures and ethics of FOSS.
• Understand open-source philosophy, methodology and ecosystem.
• Awareness with Open-Source Technologies.
• Knowledge to start, manage open-source projects.</td></tr>
<tr><td>UNIT-I</td><td colspan="4">INTRODUCTION</td><td>9</td></tr>
<tr><td colspan="6">Introduction to Open-Source: Open Source, Need and Principles of OSS, Open-Source Standards, Requirements for Software, OSS success, Free Software, Examples, Licensing, Free Vs. Proprietary Software, Free Software Vs. Open-Source Software, Public Domain. History of free software, Proprietary Vs Open-Source Licensing Model, use of Open- Source Software, FOSS does not mean no cost. History: BSD, The Free Software Foundation and the GNU Project.</td></tr>
<tr><td>UNIT-II</td><td colspan="4">OPEN-SOURCE PRINCIPLES AND METHODOLOGY</td><td>9</td></tr>
<tr><td colspan="6">Open-Source History, OpenSource Initiatives, Open Standards Principles, Methodologies, Philosophy, Software freedom, Open-Source Software Development, Licenses, Copyright vs. Copy left, Patents, Zero marginal cost, Income-generation Opportunities, Internationalization - Licensing: What is a License, How to create your own Licenses, Important FOSS Licenses (Apache, BSD, PL, LGPL), copyrights and copy lefts, Patent.</td></tr>
<tr><td>UNIT-III</td><td colspan="4">OPEN SOURCE PROJECT</td><td>9</td></tr>
<tr><td colspan="6">Starting and maintaining own Open-Source Project, Open-Source Hardware, Open-Source Design, Open-source Teaching, Open-source media.Collaboration: Community and Communication, Contributing to OpenSource Projects Introduction to GitHub, interacting with the community on GitHub, Communication and etiquette, testing open-source code, reporting issues, contributing code. Introduction to Wikipedia, contributing to Wikipedia or contributing to any prominent open-source project of student's choice.</td></tr>
<tr><td>UNIT-IV</td><td colspan="4">UNDERSTANDING OPEN-SOURCE ECOSYSTEM</td><td>9</td></tr>
<tr><td colspan="6">Open-Source Operating Systems: GNU/Linux, Android, Free BSD, Open Solaris. Open-Source Hardware, Virtualization Technologies, Containerization Technologies: Docker, Development tools, IDEs, Debuggers, Programming languages, LAMP, Open-Source Database technologies.</td></tr>
<tr><td>UNIT-V</td><td colspan="4">OPEN SOURCE ETHICS & CASE STUDIES</td><td>9</td></tr>
<tr><td colspan="6">Open Source Ethics – Open Vs Closed Source – Government – Ethics – Impact of Open source Technology – Shared Software – Shared Source.Example Projects: Apache web server, GNU/Linux, Android, Mozilla (Firefox), Wikipedia, Drupal, wordpress, GCC, GDB, github, Free BSD, Open Solaris, Open Office. Open Source Hardware, Virtualization Technologies, Containerization Technologies: Docker, Development tools, IDEs, debuggers, Programming languages, LAMP, Open Source database technologies. Study: Understanding the developmental models, licensing, mode of funding, commercial/non-commercial use.</td></tr>
<tr><td colspan="6" align="right">TOTAL:45 PERIODS</td></tr>
</table>

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Differentiate between Open Source and Proprietary software and Licensing.
CO2: Understand the policies, licensing procedures and ethics of FOSS.
CO3: Build and modify one or more Free and Open Source Software packages.
CO4: Recognize the applications, benefits and features of Open-Source Technologies.
CO5: Contribute software to and interact with Free and Open Source Software development projects.
CO6: Gain knowledge to start, manage open-source projects.

TEXT BOOKS:

1. Kailash Vadera, Bhavyesh Gandhi, "Open Source Technology", Laxmi Publications Pvt Ltd, 1st Edition,2012.
2. P.Rizwan Ahmed, Open Source Software, Margham Publication, 2015.
3. Fadi P. Deek and James A. M. McHugh, "Open Source: Technology and Policy", Cambridge Universities Press 2009.

REFERENCES:

1. Kailash Vadera & Bhavyesh, "Open-Source Technology",Gandhi, University Science Press, Laxmi Publications, 2009.
2. Sumitabha Das, "Unix Concepts and Applications" Tata McGraw Hill Education, 2006.
3. "Perspectives on Free and Open-Source Software", Clay Shirky and Michael Cusumano, MIT press, 2007.

21PAD48	ENTERPRISE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

The main objectives of this course are:

- To Understand the basics and configuration of MongoDB.
- To acquire knowledge on web frameworks, develop server side web applications like Node.js and To develop innovative web applications using various technologies.
- To build application on Express Web.
- To provide good understanding of latest web technologies on client side components like ReactJS and Angular2.

UNIT-I	MongoDB	9

Basics, Configuring Server and Client, MongoDB Compass, Creating Database, MongoDB Commands, MongoDB CRUD Operations. Introduction to REST and API, REST Constraints, Representations, Resource Identifier, REST Actions, Status Codes.

UNIT-II	NodeJs	9

Introduction, NodeJS Features and Drawbacks, setup Environment for NodeJs, NodeJS Program architecture, NodeJS Web Server, NodeJS Global Objects, NodeJS OS Objects, NodeJS Error Handling, Node JS Event Loop, NodeJS File System, Async and Sync, Connecting with Database, Handling CRUD Operations.

UNIT-III	Building an Express web application	9

Introduction to Express, Installation of Express, Create first Express application, the application request and response objects, configuring an Express application, rendering views, Authentication, Authorization.

UNIT-IV	Introduction to ReactJS	9

React Components, React State and Props Component intercommunication: Component Composition, pass data from parent to child, pass data from child to parent, Fetching data API using axioms, Types of forms, Form Validations, Posting Data, React Router, and Building & Deploying React App.

UNIT-V	Introduction to Angular2	9

Angular2 Architecture (Component-Based Architecture), Consuming API, State Management, Validation, Routing. Passing data from parent to child and Passing data between siblings. Angular2 Specific: Directives, Modules, Components, Observables, Binding, Pipes, Dependency Injection.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

- Understand the database connectivity and application servers.
- Explore the type of forms with validations using ReactJS.
- Utilize Express framework to develop responsive web applications.
- Demonstrate the architecture and file system of NodeJs.
- Identify the significance of component intercommunication with Angular2.

TEXT BOOKS:

1. Amos Q. Haviv, MEAN Web Development, 2nd Edition, Packt Publications, 2016.
2. Vasan Subramanian, “Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node”, 2nd Edition, APress. 2019

3. Fernando Doglio, “REST API Development with Node.js”, 2nd Edition, APress, 2018

REFERENCES:

1. Shelly Powers, “Learning Node: Moving to the Server-Side”, 2nd Edition, O‟REILLY, 2016.
2. Simon D. Holmes and Clive Harber, “Getting MEAN with Mongo, Express, Angular, and Node”, Second Edition, Manning Publications, 2019.
3. Brad Dayley, “Node.js, MongoDB and Angular Web Development”, 2nd Edition, Addison-Wesley Professional, 2017.

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

OPEN ELECTIVES

21OAD01	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING FUNDAMENTALS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Understand intelligent agents and discuss the different types of agents.
- Solve problems using uninformed and informed search techniques.
- Explain the different types of machine learning models and their applications.
- Train and evaluate neural networks for classification tasks.
- Implement unsupervised learning algorithms for clustering and dimensionality reduction.

UNIT-I | INTELLIGENT AGENT | 6

Introduction - Foundations of AI - History of AI - The state of the art - Risks and Benefits of AI - Intelligent Agents - Nature of Environment - Structure of Agent - Problem Solving Agents - Formulating Problems.

UNIT-II | PROBLEM SOLVING WITH SEARCH TECHNIQUES | 6

Uninformed Search - Breadth First Search- Depth First Search - Depth Limited Search- Informed Search - Greedy Best First- Constraint Satisfaction Problems (CSP)- Examples - Map Coloring-- Backtracking Search for CSP.

UNIT-III | LEARNING | 6

Machine Learning: Definitions – Classification - Regression - approaches of machine learning models - Types of learning - Probability - Basics - Linear Algebra – Hypothesis space and inductive bias, Evaluation.

UNIT-IV | SUPERVISED LEARNING | 6

Neural Network: Introduction, Perceptron Networks - Back propagation networks - Decision Tree: Entropy – classification algorithm - Rule based Classification- Naïve Bayesian classification - Support Vector Machines (SVM).

UNIT-V | UNSUPERVISED LEARNING | 6

Unsupervised Learning- Kohonen Self-Organizing Feature Maps - Learning Vector Quantization – Clustering- Types of Clustering – Hierarchical clustering algorithms – k-means algorithm.

30 PERIODS

PRACTICAL EXERCISES: 30 PERIODS

1. Implementing breadth first search.
2. Implementing depth first search.
3. Implementing Greedy Best Search.
4. Implementing a regression model.
5. Implementing a decision tree classifier.
6. Implementing Naïve Bayesian classification.
7. Implementing neural network using self-organizing maps.
8. Implementing k-Means algorithm to cluster a set of data.
9. Implementing hierarchical clustering algorithm.
10. Implementing Learning Vector Quantization.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the fundamental concepts of intelligent agents, including their definition, nature, structure, and problem-solving capabilities.

CO2: Apply uninformed and informed search techniques to solve various types of problems.

CO3: Analyze the different approaches to machine learning, including classification, regression.

CO4: Implement supervised learning algorithms, such as neural networks, decision trees, and support vector machines

CO5: Evaluate unsupervised learning algorithms, such as self-organizing maps and clustering algorithms, for their effectiveness in data analysis.

TEXTBOOKS:

1. S. Russell and P. Norvig, "Artificial Intelligence: A Modern Approach", Prentice Hall, Fourth Edition, 2021
2. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, Fourth Edition, 2020.
3. Tom Mitchell, "Machine Learning", McGraw Hill, 3rd Edition, 2017

REFERENCES:

1. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, "Foundations of Machine Learning", Second Edition, MIT Press, 2018
2. Saikat Dull, S. Chandramouli, Das, "Machine Learning", 1st Edition, Pearson, 2018.
3. Deepak Khemani, "Artificial Intelligence", 2ndEdition, Tata McGraw Hill Education,2013

21OAD02	IoT CONCEPTS AND APPLICATIONS	L	T	P	C
		2	0	2	3

OBJECTIVES:

At the end of the course, learners will be able to

- To apprise students with basic knowledge of IoT that paves a platform to understand physical and logical design of IoT
- To analyze requirements of various communication models and protocols for cost-effective design of IoT applications on different IoT platforms.
- To introduce the technologies behind Internet of Things (IoT).
- To explain the students how to code for an IoT application using Arduino/Raspberry Pi open platform.
- To apply the concept of Internet of Things in real world scenario.

UNIT-I	INTRODUCTION TO INTERNET OF THINGS	5

Evolution of Internet of Things – Enabling Technologies – IoT Architectures: oneM2M, IoT World Forum (IoTWF) and Alternative IoT Models – Simplified IoT Architecture and Core IoT Functional Stack – Fog, Edge and Cloud in IoT

UNIT-II	COMPONENTS IN INTERNET OF THINGS	5

Functional Blocks of an IoT Ecosystem – Sensors, Actuators, and Smart Objects – Control Units - Communication modules (Bluetooth, Zigbee, Wifi, GPS, GSM Modules)

UNIT-III	PROTOCOLS AND TECHNOLOGIES BEHIND IOT	6

IOT Protocols - IPv6, 6LoWPAN, MQTT, CoAP - RFID, Wireless Sensor Networks, BigData Analytics, Cloud Computing, Embedded Systems.

UNIT-IV	OPEN PLATFORMS AND PROGRAMMING	7

IOT deployment for Raspberry Pi /Arduino platform -Architecture –Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT-V	IoT APPLICATIONS	7

Business models for the internet of things, Smart city, Smart mobility and transport, Industrial IoT, Smart health, Environment monitoring and surveillance – Home Automation – Smart Agriculture

30 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Introduction to Arduino platform and programming
2. Interfacing Arduino to Zigbee module
3. Interfacing Arduino to GSM module
4. Interfacing Arduino to Bluetooth Module
5. Introduction to Raspberry PI platform and python programming
6. Interfacing sensors to Raspberry PI
7. Communicate between Arduino and Raspberry PI using any wireless medium
8. Setup a cloud platform to log the data
9. Log Data using Raspberry PI and upload to the cloud platform
10. Design an IoT based system.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO 1: Explain the concept of IoT and compare the stack of different technologies.

CO 2: Understand the communication modules, various protocols and able to integrate with

Arduino/Raspbery.
CO 3: Design portable IoT using Arduino/Raspberry Pi /open platform
CO 4: Apply data analytics and use cloud offerings related to IoT.
CO 5: Analyze applications of IoT in real time scenario.

TEXTBOOKS:

1. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017
2. Samuel Greengard, The Internet of Things, The MIT Press, 2015
3. Perry Lea, "Internet of things for architects", Packt, 2018

REFERENCES:

1. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012
2. IOT (Internet of Things) Programming: A Simple and Fast Way of Learning, IOT Kindle Edition.
3. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
4. ArshdeepBahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 2015
5. https://www.arduino.cc/
   https://www.ibm.com/smarterplanet/us/en/?ca=v_smarterplanet

21OAD03	DATA SCIENCE FUNDAMENTALS	L	T	P	C
		2	0	2	3

OBJECTIVES:

At the end of the course, learners will be able to

- To Explore the need of Data Science.
- To Understand the life cycle of Data Analytics.
- To gain the insights from the data through statistical analysis.
- To visualize the data by applying visualization techniques.
- To solve real world data analysis using R programming.

UNIT-I	INTRODUCTION TO DATA SCIENCE	5

What is Data - Need for Data Science - Data Science Process – Taxonomy of Data Analytics – History on Methodologies on Data Analytics – KDD Process – State of Practice in Analytics – Key Roles for The New Big Data Ecosystem.

UNIT-II	DATA ANALYTICS LIFE CYCLE	5

Data Analytics Life Cycle Overview – Discovery – Data Preparation – Model Planning – Model Building – Communicate Results – Operationalize – Case Study on Global Innovation Network and Analysis (GINA).

UNIT-III	INSIGHTS FROM DATA	6

Descriptive statistics – Descriptive Univariate Analysis – Univariate Frequencies – Data Visualization – Statistics - Descriptive Bivariate Analysis - Descriptive Multivariate Analysis.

UNIT-IV	DATA VISUALIZATION	7

Data Visualization: Pixel-Oriented Visualization Techniques, Geometric Projection Visualization Techniques, Icon-Based Visualization Techniques, Hierarchical Visualization Techniques, Visualizing Complex Data and Relations.

UNIT-V	DATA ANALYTICS USING EXCEL AND R	7

R – Programming - Key concepts – Basic features of R -Data Exploration and analysis with R – Excel - Statistical methods for evaluation - Presentation and analysis of Quantitative Data - Presentation and analysis of Qualitative Data- Inferential Statistical analysis of data.

Data Wrangling: Hierarchical Indexing, Combining and Merging Data Sets Reshaping and Pivoting. Data Visualization matplotlib: Basics of matplotlib, plotting with pandas, Data Visualization using Excel.

30 PERIODS

PRACTICAL EXERCISES:	30 PERIODS

1. Practical based on NumPy ndarray using R.
2. Working with Pandas Data Frame using R
3. Handling Missing values and Duplicate Values using R.
4. Data Integration in R.
5. Data Entry and Calculate Summary Statistics in Excel.
6. Generate Comparitive Statistics in Excel.
7. Use Diabetes data set from UCI and perform the following operations
   a. Univariate Analysis: Frequency, Mean, Median, Mode, Variance, Standard Deviation and Skewness.
8. Data Cleansing using Excel.
9. Simple Linear Regression Model in Microsoft Excel.
10. Data Visualization using R and Excel.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of the course, learners will be able to
CO 1: Explain the concept of data science and role of data analytics.
CO 2: Understand the overview of life cycle of data analytics.
CO 3: Apply data analytics on data and use different analytics method related to data.
CO 4: Create informative visualization and summarize data sets.
CO 5: Analyze applications using data analysis.

TEXTBOOKS:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, Introducing Data Sciencell, Manning Publications, 2016.
2. Moreira, J., Carvalho, A., Carvalho, A. C. P. d. L. F., Horvath, T. (2018). AGeneral Introduction to Data Analytics. United Kingdom: Wiley.
3. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data. (2015). Germany: Wiley.

REFERENCES:

1. Thomas Mailund, "Beginning Data Science in R – Data Analysis, Visualization and Modelling for the Data Scientist", Apress Publication, 2017.
2. O'Neil, C., & Schutt, R., Doing Data Science: Straight Talk from the Frontline O'Reilly Media,2013.
3. McKinney, W., Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython. 2nd edition. O'Reilly Media,2017.

21OAD04	AUGMENTED REALITY/VIRTUAL REALITY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- Explain the fundamental concepts of virtual reality (VR).
- Understand and apply geometric modeling techniques in VR development
- Explore the capabilities of World ToolKit and Java 3D for VR development.
- Understand the software development process for AR applications.
- Develop a comprehensive understanding of various AR applications and their real-world impact.

UNIT-I	INTRODUCTION	6

The Three I's of Virtual Reality-The Five Classic Components of a VR System-Input Devices-Three-dimensional position trackers, navigation and manipulation-interfaces and gesture interfaces-Output Devices: Graphics displays-sound displays & haptic feedback.

UNIT-II	VR DEVELOPMENT PROCESS	6

Geometric modeling - kinematics modeling- physical modeling - behaviour modeling - model Management.

UNIT-III	VR PROGRAMMING	6

VR Programming – Toolkits and Scene Graphs – World ToolKit – Java 3D – Comparison of World ToolKit and Java 3D

UNIT-IV	AUGMENTED REALITY	6

Introduction to Augmented Reality-Augmented Reality Hardware-Augmented Reality Software-Augmented Reality Content

UNIT-V	APPLICATIONS	6

Mobile Augmented Reality-Augmented Reality Applications-The Future of Augmented Reality

30 PERIODS

PRACTICAL EXERCISES:	30 PERIODS

1. Study of different game engines.
2. Implementation on Video/ Feature Viewing.
3. Implementation on Virtual tour.
4. Implementation on material animation.
5. Implementation to show portal planets.
6. Explore projects in Unity 2D and 3D.
7. Developing architecture of a house using Virtual Reality.
8. Perform CRO based experiment using Virtual Reality.
9. Undertaking qualitative analysis in Chemistry using Virtual Reality.
10. Carry out assembly/disassembly of an engine using Virtual Reality.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explore the different types of input and output devices used in VR.
CO2: Implement physical modeling techniques to enhance the realism of VR simulations.
CO3: Develop practical VR applications using chosen VR programming tools.
CO4: Create and utilize AR content for various applications.
CO5: Analyze the future prospects and trends of AR technology.

TEXTBOOKS:

1. C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc.,2008
2. Alan B. Craig"Understanding Augmented Reality Concepts and Applications",First Edition ,

Morgan Kaufmann,2013

3. Jason Jerald,"The VR Book: Human-Centred Design for Virtual Reality", First Edition, Association for Computing Machinery and Morgan & Claypool, New York, NY, USA. 2015.

REFERENCES:

1. Grigore C. Burdea, Philippe Coiffet , "Virtual Reality Technology", Wiley Inter Science, 2nd Edition, 2006.
2. Steve Aukstakalnis ,"Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)", First Edi, Addison-Wesley Professional, 2016.
3. Robert Scoble & Shel Israel "The Fourth Transformation: How Augmented Reality & Artificial Intelligence Will Change Everything" , First edition, Patrick Brewster Press; 2016.

ONE CREDIT COURSES

21OCAD01	PRACTICAL MACHINE LEARNING WITH TENSORFLOW	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are:

- To work with Tensor Flow.
- To execute prediction and monitoring models.
- To work with large dataset.

CONTENT

1. Getting started with Tensorflow
2. Overview of Machine Learning (Process and Techniques, Demonstration of ML concepts with Deep Playground)
3. Data Input and Preprocessing with Tensorflow
4. Machine Learning Model Building
5. Prediction with Tensorflow
6. Monitoring and evaluating models using Tensorboard
7. Advance Tensorflow (Building custom models - CNNs, Scaling up for large datasets)
8. Distributed training with hardware accelerators

TOTAL:15 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Understand the concepts of Tensor Flow and able to implement sample models
CO2: Demonstrate preprocessing of data and to design in sensor board
CO3: Develop custom models by building simple dataset

TEXT BOOKS:

1. Learn Tensorflow 2.0, Pramod Singh, 1st edition, Apress
2. Natural Language Processing with TensorFlow, Thushan Ganegedara, 1st edition, Packt Publishing

REFERENCES:

1. Advanced Deep Learning with TensorFlow 2 and Keras, Rowel Atienza, 2nd edition, Packt Publishing Limited
2. TinyML, Pete Warden, 1st edition, O′Reilly

21OCAD02	PRACTICAL TABLEAU	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:
The main objectives of this course are:

- Connect to the data and customize a data source.
- Create a data extract, edit metadata, create groups and hierarchies in field data.
- Use sets to compare data subsets.
- Build a range of essential chart types for analysis.
- Use the Tableau workspace to create visualizations.

CONTENT

1. Introduction To Tableau
2. Data Connections in Tableau Interface
3. Organizing And Simplifying Data
4. Building Chart Types
5. Advanced Chart Types
6. Calculations
7. Logic Statements
8. Mapping
9. Statistics
10. Data Visualization Using Tableau

TOTAL:15 PERIODS

COURSE OUTCOMES:
At end of the course, learners will be able to
CO1: To apply and comprehend commonly used data analytics techniques with Tableau Desktop.
CO2: Understand the advantages of multiple data analytics techniques through learning practices.
CO3: Understand and produce effective data visualizations.
CO4: Understand good data practices and apply them to different types of real-world data.
CO5: Develop analytics that yield insights for different stakeholders through Tableau sheets, stories, and dashboards.

TEXTBOOK:

1. Ryan Sleeper*, Practical Tableau,* O'Reilly Media, Inc.*,*
2. Joshua N. Milligan, Learning Tableau 2019: Tools for Business Intelligence, data prep, and visual analytics, 3rd Edition, Packt Publishing Ltd, 2019

REFERENCES:

1. Chandresh Sinha, Tableau 10 for Beginners: Version 10.x, Ohio Computer Academy, 2017

21OCAD03	MASTERING POWER BI	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are:

- Identify the primary components of the Power BI interface: reports, data, and model views.
- Import Excel data and build basic visuals.
- Publish a desktop report to the Power BI Service.
- Identify common challenges in Power BI data models, implement smart solutions, and avoid common mistakes.
- Enables to learn about Data Analysis Expressions (DAX) and Data Visualization with Power BI Desktop.

CONTENT

1. Concepts of Business Intelligence
2. Power BI installation
3. Traditional BI vs. Power BI
4. Power BI vs. Tableau vs. QlikView
5. Uses of Power B
6. The Flow of Work in Power BI
7. Working with Power BI
8. Basic Components of Power BI
9. Comparison of Power BI Version
10. Introduction to Building Blocks of Power BI
11. Data model and importance of Data Modelling
12. Creating Calculated Columns and Measures
13. Performing Data Analysis using Data Analysis Expression (DAX)

TOTAL:15 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Understand relationships and how to create and manage them.
CO2: Understanding different Data Types.
CO3: Create interactive Data Visualizations and format them.
CO4: Build the Data models for the applications.
CO5: Create calculated columns and measures using DAX Functions.

TEXTBOOK:

1. Raviv, Gil. Collect, Combine, and Transform Data Using Power Query in Excel and Power BI. Redmond: Microsoft Press, 2019.
2. Knight, Devin, Pearson, Michael, Schacht, Bradley, Ostrowsky, Erin. Microsoft Power BI Quick Start Guide. 2nd. Birmingham, UK: PocketPublishing, 2020

REFERENCES:

1. The Definitive Guide to DAX: Business intelligence for Microsoft Power BI, Alberto Ferrari Marco Russo – 15 September 2020
2. Learn Power BI: Step by Step Guide to Building Your Own Reports (2022), by Derek Wilson | 7 March 2022
3. Mastering Power BI,Chandraish Sinha, 30 September 2022
4. Microsoft Power Bi Dashboards Step By Step, 1e, by Errin O'Connor , 6 March 2020

21OCAD01	INTRODUCTION TO INNOVATIVE PROJECTS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

The main objectives of this course are:

- To make students confident enough to handle the day-to-day issues.
- To develop the ―Thinking Skill‖ of the students, especially Creative Thinking Skills
- To train the students to be innovative in all their activities
- To prepare a project report on a socially relevant theme as a solution to the existing issues

CONTENT

1. Innovation
   - Difference between Creativity and Innovation
   - Examples of innovation
   - Being innovative.
   - Project: A literature searches on prototyping of your solution finalized. Prepare a prototype model or process and upload.
2. Innovation Process
   - Steps for Innovation
   - Right climate for innovation
   - Project: Refining the project, based on the review report and uploading the text
3. Innovation Project Proposal Presentation
   - Project proposal contents
   - Economic input
   - ROI – Template
   - Project: Presentation of the innovative project proposal and upload.

TOTAL:15 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Understand the various types of thinking skills.

CO2: Enhance the innovative and creative ideas.

CO3: Find out a suitable solution for socially relevant issues- J component

TEXT BOOKS:

1. How to have Creative Ideas, Edward debone, Vermilon publication, UK, 2007

2. The Art of Innovation, Tom Kelley & Jonathan Littman, Profile Books Ltd, UK, 2008

REFERENCES:

1. Creating Confidence, Meribeth Bonct, Kogan Page India Ltd, New Delhi, 2000
2. Lateral Thinking Skills, Paul Sloane, Keogan Page India Ltd, New Delhi, 2008
3. Indian Innovators, Akhat Agrawal, Jaico Books, Mumbai, 2015
4. JUGAAD Innovation, Navi Radjou, Jaideep Prabhu, Simone Ahuja Random house India, Noida, 2012

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
MANDATORY COURSES

21MCC01	CONSTITUTION OF INDIA	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:
The main objectives of this course are:

- To explain the basic features and fundamental principles of Constitution of India.
- To explain the salient features and characteristics of the Constitution of India.
- To explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers.
- To explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India.
- To explain the Local Self Government–Constitutional Scheme in India.

SYLLABUS

1. Meaning of the constitution law and constitutionalism.
2. Historical perspective of the Constitution of India.
3. Salient features and characteristics of the Constitution of India.
4. Scheme of the fundamental rights.
5. The scheme of the Fundamental Duties and its legal status.
6. The Directive Principles of State Policy–Its importance and implementation.
7. Federal structure and distribution of legislative and financial powers between the Union and the States.
8. Parliamentary Form of Government in India–The constitution powers and status of the President of India.
9. Amendment of the Constitutional Powers and Procedure.
10. The historical perspectives of the constitutional amendments in India.
11. Emergency Provisions: National Emergency, President Rule, Financial Emergency.
12. Local Self Government–Constitutional Scheme in India.
13. Scheme of the Fundamental Right to Equality.
14. Scheme of the Fundamental Right to certain FreedomunderArticle19
15. Scope of the Right to Life and Personal Liberty under Article21

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of the course, learners will be able to

CO1: Explain the meaning of the constitution law and constitutionalism and Historical perspective of the Constitution of India.
CO2: Explain the salient features and characteristics of the Constitution of India, scheme of the fundamental rights and the scheme of the Fundamental Duties and its legal status.
CO3: Explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers between the Union and the States, and Parliamentary Form of Government in India.

CO4: Explain the amendment of the Constitutional Powers and Procedure, the historical Perspectives of the constitutional amendments in India, and Emergency Provisions.

CO5: Explain the Local Self Government –Constitutional Scheme in India, Scheme of the Fundamental Right to Equality.

TEXT BOOKS:

1. DurgaDasBasu, "Introduction to the Constitution of India",Lexis Nexis Butterworths Wadhwa,20th edition, Reprint 2011.
   Weblink :https://www.india.gov.in/my-government/constitution-india.

21MCC02	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

The main objectives of this course are:

- To explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge.
- To explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.
- To explain about the use of Traditional Knowledge to meet the basic needs of human being.
- To explain the rich biodiversity material sand knowledge preserved for practicing traditional lifestyle.

  To explain the use of Traditional Knowledge in Manufacturing and Industry.

UNIT-I	TRADITIONAL AND MODERN KNOWLEDGE	3

Two Worlds of Knowledge - Phase of Explorers, Sir Arthur Cotton and Irrigation, Small pox Vaccination, Late Nineteenth Century, Voelcker, Howard and Agriculture, Havell and Indian Art; Indians at the Encounter - Gaekwad of Baroda and Technical Education, Science Education and Modern Industries, Hakim Ajmal Khan and Ayurveda, R. N. Chopra and Indigenous Drugs,Gauhar Jaan and Indian Classical Music; Linking Science and the Rural - Tagore's Sriniketan Experiment, Marthandam, the YMCA Model, Gandhi's Thoughts on Development, Nehru'sViewofGrowth;Post-IndependenceEra-ModernizationandTraditionalKnowledge,Social Roots of Traditional Knowledge Activism, Global Recognition for Traditional Knowledge.

UNIT-II	PROTECTION AND SHARING	3

For Recognition and Protection-United Nations Educational, Scientific and Cultural Organization (UNESCO), World Health Organization (WHO), International Labour Organization (ILO), UNWorking Group on Indigenous Populations, Evolution of Other Organizations; Norms of Sharing - United Nations Environment Programme (UNEP), World Intellectual Property Organization (WIPO), World Trade Organization (WTO); IPR and Traditional Knowledge-Theoretical Background, Positive Protections of TK, Defensive Strategies, IPR Facilitation for TK.

UNIT-III	TRADITIONAL KNOWLEDGE FOR BASIC NEEDS	3

Indian Mid wifery Tradition—The Dai System, Surface Flow Irrigation Tanks, Housing-A Human Right, Changing Priorities—Niyamgiri. **Biodiversity and Genetic Resources:** Jeevani The Wonder Herb of Kanis, A Holistic Approach -FRLHT, Basmati – In the New Millennium, AYUSH-Based Cosmetics.

UNIT-IV	TRADITIONAL KNOWLEDGE IN MANUFACTURING	3

Drug Discovery, A Sweetener of Bengal, The Sacred Ring of Payyanur, Channapatna Toys

UNIT-V	TRADITIONAL CULTURAL EXPRESSIONS	3

Banarasi Saree, Music, Built and Tangible Heritage, Modern Yoga, Sanskrit and Artificial Intelligence, Climate Change and Traditional Knowledge.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge.

CO2: Explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.

CO3: Explain about the use of Traditional Knowledge to meet the basic needs of human being.

CO4: Explain the rich biodiversity material sand knowledge preserved for practicing traditional lifestyle.

CO5: Explain the use of Traditional Knowledge in Manufacturing and Industry.

TEXT BOOKS:

1. Nirmal Sengupta“Traditional Knowledge in Modern India Preservation, Promotion, Ethical Access and Benefit Sharing Mechanisms”Springer,2019.
2. AmitJha,”Traditional Knowledge System in India”,Atlantic Publishers and Distributors PvtLtd, 2009.
3. Basanta Kumar Mohanta,Vipin Kumar Singh “Traditional Knowledge System and Technology in India”, Pratibha Prakashan, 2012.
4. Kapil Kapoor, Michel Danino"Knowledge Traditions and Practices of India", Central Board of Secondary Education,2012.

REFERENCES:

1. NPTEL video lecture on “Ayurvedic Inheritance of India”, Video link:https://nptel.ac.in/courses/121/106/121106003/#.
2. Youtube video on “Introduction to Indian Knowledge Systems”, Video link:https://www.youtube.com/watch?v=LZP1StpYEPM.
3. Youtube video on “12 Great achievements of Indian Civilization”, Video link:https://www.youtube.com/watch?v=xmogKGCmclE.

VELAMMAL

COLLEGE OF ENGINEERING AND TECHNOLOGY

MADURAI-625009

(Autonomous)

B.E COMPUTER SCIENCE AND ENGINEERING
REGULATIONS-2021

CHOICE BASED CREDIT SYSTEM (CBCS)
SYLLABUS FOR SEMESTERS I TO VIII

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY, MADURAI-625009

(Autonomous)

REGULATIONS - 2021

B.E. COMPUTER SCIENCE AND ENGINEERING (CBCS)

CURRICULUM FOR SEMESTERS I TO VIII

SEMESTER – I

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21IP101	Induction Programme *(Common to all B.E./B.Tech. Programmes)*	-	0	0	0	0
		THEORY					
2.	21EN101	Professional English – I *(Common to all B.E./B.Tech. Programmes)*	HS	3	2	0	4
3.	21MA101	Matrices and Calculus *(Common to all B.E./B.Tech. Programmes)*	BS	3	2	0	4
4.	21PH101	Engineering Physics *(Common to all B.E./B.Tech. Programmes)*	BS	3	0	0	3
5.	21CH101	Engineering Chemistry *(Common to all B.E./B.Tech. Programmes)*	BS	3	0	0	3
6.	21CS101	Problem Solving and Python Programming. *(Common to all B.E./B.Tech. Programmes)*	ES	3	0	0	3
7.	21XXXXX	Cambridge Course* *(Common to all B.E./B.Tech. Programmes)*	EE	1	0	0	1
		PRACTICAL COURSES					
8.	21CS102	Problem Solving and Python Programming Laboratory *(Common to all B.E./B.Tech. Programmes)*	ES	0	0	4	2
9.	21PC101	Physics and Chemistry Laboratory *(Common to all B.E./B.Tech. Programmes)*	BS	0	0	4	2
		Total Credits					**22**

**Naan Mudhalvan Scheme Course*

SEMESTER – II

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21EN102	English – II *(Common to all B.E./B.Tech. Programmes)*	HS	3	0	0	3
2.	21MA103	Sampling Techniques and Numerical Methods *(Common to B.E.CSE/B.Tech.IT/B.E.ECE)*	BS	3	2	0	4
3.	21PH103	Physics for Information Science *(Common to B.E.CSE/B.Tech.IT)*	BS	3	0	0	3
4.	21ME101	Engineering Graphics *(Common to all B.E./B.Tech. Programmes)*	ES	2	0	2	3
5.	21EE104	Basic Electrical and Electronics Engineering for Information Science *(Common to B.E CSE/B.Tech.IT)*	ES	3	0	0	3
6.	21CS103	Programming in C *(Common to B.E.CSE/B.Tech.IT)*	PC	3	0	0	3
7.	21CH103	Environmental Science *(Common to all B.E./B.Tech. Programmes)*	BS	2	0	0	2
		PRACTICAL COURSES					
8.	21EM101	Engineering Practices Laboratory *(Common to all B.E./B.Tech. Programmes)*	ES	0	0	4	2
9.	21CS104	Programming in C Laboratory *(Common to B.E. CSE/B.Tech.IT)*	PC	0	0	4	2
		Total Credits					**25**

SEMESTER-III

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21MA203	Discrete Mathematics *(Common to B.E.CSE/B.Tech.IT)*	BS	3	2	0	4
2.	21EC201	Digital Principles and System Design *(Common to B.E.CSE/B.Tech.IT/B.E.ECE)*	PC	3	0	0	3
3.	21CS201	Computer Organization and Architecture *(Common to B.E.CSE/B.Tech.IT)*	PC	3	0	0	3
4.	21CS202	Data Structures *(Common to B.E.CSE/B.Tech.IT)*	PC	3	0	0	3
5.	21CS203	Object Oriented Programming *(Common to B.E.CSE/B.Tech.IT)*	PC	3	0	0	3
6.	21XXXX	Microsoft Office Fundamentals* *(Common to all B.E./B.Tech. Programmes)*	EE	1	0	0	1
		PRACTICAL COURSES					
7.	21EC212	Digital Systems Laboratory *(Common to B.E.CSE/B.Tech.IT/B.E.ECE)*	PC	0	0	4	2
8.	21CS204	Data Structures Laboratory *(Common to B.E.CSE/B.Tech. IT)*	PC	0	0	4	2
9.	21CS205	Object Oriented Programming Laboratory *(Common to B.E.CSE/B.Tech.IT)*	PC	0	0	4	2
		Total Credits					**23**

**Naan Mudhalvan Scheme Course*

SEMESTER-IV

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1.	21MA205	Stochastic Process and its Applications *(Common to B.E.CSE/B.Tech.IT)*	BS	3	2	0	4
2.	21CS206	Database Management Systems *(Common to B.E.CSE/B.Tech.IT)*	PC	3	0	0	3
3.	21CS207	Design and Analysis of Algorithm *(Common to B.E.CSE/B.Tech.IT)*	PC	3	0	0	3
4.	21CS208	Operating Systems *(Common to B.E.CSE/B.Tech.IT)*	PC	3	0	0	3
5.	21CS209	Internet Programming	PC	3	0	0	3
PRACTICAL COURSES							
6.	21CS210	Database Management Systems Laboratory *(Common to B.E.CSE/B.Tech.IT)*	PC	0	0	4	2
7.	21CS211	Operating Systems Laboratory *(Common to B.E.CSE/B.Tech.IT)*	PC	0	0	4	2
8.	21CS212	Internet Programming Laboratory	PC	0	0	4	2
Total Credits							**22**

SEMESTER-V

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1	21CS301	Theory of Computation	PC	3	0	0	3
2	21XXXXX	Professional Elective-I	PE	2	0	2	3
3	21XXXXX	Professional Elective-II	PE	2	0	2	3
4		Naan Mudhalvan Scheme Course*	EE	2	0	0	2#
5	21MCCS01	Constitution of India	MC	1	0	0	0
6		Internship#	EE	0	0	0	1
		THEORY WITH PRACTICAL COURSES					
7	21CS302	Computer Networks	PC	3	0	2	4
8.	21CS303	Artificial Intelligence and Machine Learning	PC	3	0	2	4
9.	21CS304	Object Oriented Software Engineering	PC	3	0	2	4
		Total Credits					**22**

* *Augmented Reality/Virtual Reality/Full Stack/Big Data Analytics/Cloud Essentials/Machine Learning*

 # Two Weeks Internship

SEMESTER-VI

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21CS305	Compiler Design	PC	3	2	0	4
2.	21CS306	Distributed Systems	PC	3	0	0	3
3.	21XXXXX	Professional Elective-III	PE	2	0	2	3
4.	21XXXXX	Professional Elective-IV	PE	2	0	2	3
5.	21XXXX	Open Elective-I	OE	3	0	0	3
6.		Naan Mudhalvan Scheme Course*	EE	2	0	0	2#
7.	21MCCS02	Essence of Indian Traditional Knowledge	MC	1	0	0	0
8.	21OCCSXX	One Credit Course	EE	0	0	2	1
		THEORY WITH PRACTICAL COURSE					
9.	21CS307	Embedded Systems and IoT	PC	3	0	2	4
		PRACTICAL COURSE					
10.	21EN301	Professional Communication Laboratory *(Common to all B.E./B.Tech. Programmes)*	HS	0	0	2	1
		Total Credits					**22**

SEMESTER- VII

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21CS401	Cryptography and Network Security	PC	3	0	0	3
2.	21IT401	Big Data Engineering *(Common to B.E.CSE/B.Tech.IT)*	PC	3	0	0	3
3.	21XXXX	Open Elective – II	OE	3	0	0	3
4.	21XXXX	Open Elective – III	OE	3	0	0	3
5.	21XXXX	Open Elective – IV	OE	3	0	0	3
6.		Naan Mudhalvan Scheme Course*	EE	2	0	0	2#
		THEORY WITH PRACTICAL COURSE					
7.	21CS402	Data Science	PC	3	0	2	4
		PRACTICAL COURSE					
8.	21CS403	Project Work-I	EE	0	0	4	2
		Total Credits					**21**

* *Augmented Reality/Virtual Reality/Full Stack/Big Data Analytics/Cloud Essentials/Machine Learning*

SEMESTER-VIII

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21XXXXX	Professional Elective-V	PE	2	0	2	3
2.	21XXXXX	Professional Elective-VI	PE	2	0	2	3
		PRACTICAL COURSE					
3.	21CS404	Project Work-II	EE	0	0	20	10
		Total Credits					**16**

Total Credits: 173

SEMESTER-WISE CREDIT DISTRIBUTION

	I SEM	II SEM	III SEM	IV SEM	V SEM	VI SEM	VII SEM	VIII SEM	Total Credits
HS	4	3	-	-	-	1	-	-	8
BS	12	9	4	4	-	-	-	-	29
ES	5	8	-	-	-	-	-	-	13
PC	-	5	18	18	15	11	10	-	77
PE	-	-	-	-	6	6	-	6	18
OE	-	-	-	-	-	3	9	-	12
EE	1	-	1	-	$(1+2^{\#})$	$(1+2^{\#})$	$(2+2^{\#})$	10	16
MC	-	-	-	-	$0^{\#}$	$0^{\#}$	-	-	-
Total	**22**	**25**	**23**	**22**	**22**	**22**	**21**	**16**	**173**

#Naan Mudhalvan Scheme Courses

S.No	Topic
1.	Humanities and Social Sciences including Management (HS)
2.	Basic Sciences (BS)
3.	Engineering Sciences including Workshop, Drawing, Basics of Civil / Electrical / Mechanical / Computer etc. (ES)
4.	Professional Core Courses (PC)
5.	Professional Electives : Courses relevant to chosen specialization / branch (PE)
6.	Open Electives: Electives from other Technical and / or emerging Courses (OE)
7.	Project Work, Seminar and Internship in Industry – Employability Enhancement Courses (EE)
8.	Mandatory Course(MC)
9.	One Credit Course (OC)

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: DATA SCIENCE

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PCS01	Data Science and Big Data Analytics	PE	2	0	2	3
2.	21PCS02	Exploratory Data Analysis	PE	2	0	2	3
3.	21PCS03	Neural Networks and Deep Learning	PE	2	0	2	3
4.	21PCS04	Information Recommender Systems	PE	2	0	2	3
5.	21PCS05	Computer Vision Algorithms and Applications	PE	2	0	2	3
6.	21PCS06	Image and Video Analytics	PE	2	0	2	3
7.	21PCS07	Text and Speech Analysis	PE	2	0	2	3
8.	21PCS08	Essentials of Business Analytics	PE	2	0	2	3

VERTICAL 2: FULL STACK DEVELOPMENT

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PCS09	Principles of Programming Languages	PE	2	0	2	3
2.	21PCS10	Web Technology and Design	PE	2	0	2	3
3.	21PCS11	Cloud Services Management	PE	2	0	2	3
4.	21PCS12	Android App Development	PE	2	0	2	3
5.	21PCS13	Web Application Security	PE	2	0	2	3
6.	21PCS14	Software Testing and Automation	PE	2	0	2	3
7.	21PCS15	Introduction to Dev-Ops	PE	2	0	2	3
8.	21PCS16	Python Application Programming Interface Development	PE	2	0	2	3

VERTICAL 3: DATA CENTRE TECHNOLOGIES

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PCS17	Data Warehousing Concepts and Implementation	PE	2	0	2	3
2.	21PCS18	Data Storage Technologies	PE	2	0	2	3
3.	21PCS19	Software Defined Networks	PE	2	0	2	3
4.	21PCS20	Cloud Computing and Virtualization	PE	2	0	2	3
5.	21PCS21	Information Storage and Management	PE	3	0	0	3
6.	21PCS22	Stream Processing Framework	PE	2	0	2	3
7.	21PCS23	Fog and Edge Computing	PE	3	0	0	3
8.	21PCS24	Cloud Data Center Network Architectures	PE	2	0	2	3

VERTICAL 4: CYBER SECURITY AND DATA PRIVACY

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PIT01	Cryptographic Techniques	PE	3	0	0	3
2.	21PIT02	Paradigms of Network Security	PE	2	0	2	3
3.	21PIT03	Engineering Secure Software Systems	PE	3	0	0	3
4.	21PIT04	Digital and Mobile Forensics	PE	3	0	0	3
5.	21PIT05	Ethical Hacking Exploit Development	PE	2	0	2	3
6.	21PIT06	Social Network Security	PE	3	0	0	3
7.	21PIT07	Security and Privacy in Cloud	PE	3	0	0	3
8.	21PIT08	Crypto currency and Block chain Technologies	PE	2	0	2	3

VERTICAL 5: CREATIVE MEDIA

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PIT09	Multimedia and Animation	PE	2	0	2	3
2.	21PIT10	Multimedia Data Compression and Storage	PE	3	0	0	3
3.	21PIT11	UI and UX Design	PE	2	0	2	3
4.	21PIT12	Video Processing and Analytics	PE	3	0	0	3
5.	21PIT13	Techniques for Visual Effects	PE	3	0	0	3
6.	21PIT14	Game Design and Development	PE	2	0	2	3
7.	21PIT15	Concepts of Augmented Reality and Virtual Reality	PE	3	0	0	3
8.	21PIT16	Strategies of Digital Marketing	PE	3	0	0	3

VERTICAL 6: PROGRESSIVE TECHNOLOGIES

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PIT17	Techniques of Robotic Process Automation	PE	3	0	0	3
2.	21PIT18	Cyber security Essentials	PE	3	0	0	3
3.	21PIT19	3D Printing and Design	PE	3	0	0	3
4.	21PIT20	Embedded System Design	PE	2	0	2	3
5.	21PIT21	Principles of Quantum Computing	PE	3	0	0	3
6.	21PIT22	Autonomous Ground Vehicle Systems	PE	3	0	0	3
7.	21PIT23	E-Learning Techniques	PE	3	0	0	3
8.	21PIT24	Next Generation Networks	PE	3	0	0	3

VERTICAL 7: COGNITIVE COMPUTING

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PCS25	Ethics and Artificial Intelligence	PE	3	0	0	3
2.	21PCS26	Introduction to Knowledge Engineering	PE	2	0	2	3
3.	21PCS27	Principles of Soft Computing	PE	2	0	2	3
4.	21PCS28	Optimization Techniques and Applications	PE	2	0	2	3
5.	21OMA01	Graph Theory and its Applications	PE	3	0	0	3
6.	21PCS29	Introduction to Game Theory	PE	2	0	2	3
7.	21PCS30	Cognitive Science Theory and Applications	PE	2	0	2	3
8.	21PCS31	Statistical Natural Language Processing	PE	2	0	2	3

VERTICAL 8: COMPUTING SCIENCES

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PCS32	Introduction to C	PE	2	0	2	3
2.	21PCS33	Fundamentals of Data Structures	PE	2	0	2	3
3.	21PCS34	Database Programming with PL/SQL	PE	2	0	2	3
4.	21PCS35	Java Programming	PE	2	0	2	3
5.	21PCS36	Fundamentals of Computer Networks	PE	2	0	2	3
6.	21PCS37	Software Testing and Tools	PE	2	0	2	3
7.	21PCS38	Web Programming	PE	2	0	2	3
8.	21PCS39	Machine Learning using Python	PE	2	0	2	3

ONE CREDIT COURSE

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21OCCS01	Angular JS (LyncSpace,Chennai)	EE	0	0	2	1
2.	21OCCS02	Machine Learning Using Python (Cadence Design Systems,Bengaluru)	EE	0	0	2	1
3.	21OCCS03	Practical Approach to Data warehousing using Informatica (Zetspire Technologies Pvt,Madurai)	EE	0	0	2	1
4.	21OCCS04	Healthcare Automation using Machine Learning (Novitech R&D Private Limited, Coimbatore)	EE	0	0	2	1
5.	21OCCS05	Foundations of NoSQL Database (Wipro R&D ,Chennai)	EE	0	0	2	1
6.	21OCCS06	Introduction to Mainframe Systems (Megam Solutions, Madurai)	EE	0	0	2	1
7.	21OCCS07	Embedded Software Development (Embien Technologies, Madurai)	EE	0	0	2	1
8.	21OCCS08	Innovation and Design Thinking (Glorious Web Tech,Pudukottai)	EE	0	0	2	1

COURSE OFFERED TO OTHER DEPARTMENTS

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1	21CS105	C Programming	PC	2	0	0	2
2	21CS214	Object Oriented Programming And Data Structures	PC	3	0	0	3
3	21CS215	Object Oriented Programming Laboratory	PC	0	0	4	2
4	21CS308	C and Data Structures	PC	2	0	2	3

SEMESTER - I

21IP101	INDUCTION PROGRAMME *(Common to all B.E./ B.Tech. programmes)*	L	T	P	C
		0	0	0	0

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfil his/her responsibility as an engineer, as a citizen and as a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. "

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don'ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and **therefore there shall be no tests / assessments** during this programme.

REFERENCE: Guide to Induction program from AICTE

21EN101	PROFESSIONAL ENGLISH-1 *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

1. To develop learners skills in listening and responding effectively
2. To improve basic grammar for better communication
3. To practice reading exercise for understanding vocabulary
4. To initiate and participate in pair presentation, extempore
5. To strengthen writing skills for various compositions

UNIT I	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	12

Listening – Listening for general information - Specific details - Conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form; **Speaking -** Self Introduction; Introducing a friend; Conversation - Politeness strategies; Telephone conversation; Leave a voicemail; Leave a message with another person; asking for information to fill details in a form; **Reading -** Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails; **Writing -** Writing emails / letters introducing oneself; **Grammar -** Present Tense (simple, continuous); Question types: Wh/ Yes or No/ and Tags **Vocabulary -** Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II	NARRATION AND SUMMATION	12

Listening - Listening to podcast, anecdotes / stories / event narration; documentaries and interviews with celebrities; **Speaking** - Narrating personal experiences / events; Interviewing a celebrity; Reporting / and summarizing of documentaries / podcasts/ interviews; **Reading** - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs; **Writing** - Guided writing - Paragraph writing Short Report on an event (field trip etc.); **Grammar** - Past tense (Simple, continuous); Subject-Verb Agreement; and Prepositions; **Vocabulary** - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III	DESCRIPTION OF A PROCESS / PRODUCT	12

Listening - Listen to a product and process descriptions; a classroom lecture; and advertisements about a products; **Speaking** - Picture description; Giving instruction to use the product; Presenting a product; and Summarizing a lecture; **Reading** - Reading advertisements, gadget reviews; user manuals; **Writing** - Writing definitions; instructions; and Product /Process description; **Grammar** - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect, Present and past perfect continuous tenses; **Vocabulary** - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words)

UNIT IV	CLASSIFICATION AND RECOMMENDATIONS	12

Listening - Listening to TED Talks; Scientific lectures; and educational videos; **Speaking** – Small Talk; Mini presentations and making recommendations; **Reading** - Newspaper articles; Journal reports - Non Verbal Communication (tables, pie charts etc,) **Writing** - Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode) **Grammar** - Articles; Pronouns - Possessive & Relative pronouns; **Vocabulary** - Collocations; Fixed / Semi fixed expressions

UNIT V	**EXPRESSIONS**	**12**

Listening - Listening to debates/ discussions; different viewpoints on an issue; and panel discussions; **Speaking** - Group discussions, Debates, and Expressing opinions through Simulations & Role-play; **Reading** - Reading editorials; and Opinion Blogs; **Writing** - Essay Writing (Descriptive or narrative); **Grammar** - Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences; **Vocabulary** - Cause & Effect Expressions - Content vs. Function words.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Listen and comprehend complex academic texts

CO2: Read and infer the denotative and connotative meanings of technical texts

CO3: Write definitions, descriptions, narrations and essays on various topics

CO4: Speak fluently and accurately in formal and informal communicative contexts

CO5: Express their opinions effectively in both oral and written medium of communication

TEXT BOOKS:

1. Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University. English for Science & Technology. Cambridge University Press, 2021
2. Board of Editors, Department of English, Anna University. English for Engineers & Technologists. Orient Blackswan Private Ltd, 2020.
3. Board of Editors, Department of English, Anna University. Using English Orient Blackswan Private Ltd, 2017

REFERENCES:

1. Meenakshi Raman & Sangeeta Sharma. Technical Communication – Principles And Practices Oxford University Press, New Delhi, 2016
2. Lakshminarayanan K.R. A Course Book On Technical English. SciTech Publications (India) Pvt. Ltd., 2012
3. Ayesha Viswamohan. English For Technical Communication (With CD). McGraw Hill Education, ISBN: 0070264244. 2008.
4. Kulbhusan Kumar, RS Salaria, Effective Communication Skill. Khanna Publishing House. First Edition, 2018.
5. Dr. V. Chellammal. Learning to Communicate. Allied Publishing House, New Delhi, 2003.

21MA101	MATRICES AND CALCULUS *(Common to all B.E. / B.Tech. Programmes)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To explain the students about differential calculus.
- To demonstrate the functions of several variables technique to solve problems in many engineering branches.
- To demonstrate the various techniques of integration.
- To prepare the student to use mathematical tools in evaluating multiple integrals and their applications.

UNIT I	MATRICES	12

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II	DIFFERENTIAL CALCULUS	12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.

UNIT III	FUNCTIONS OF SEVERAL VARIABLES	12

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV	INTEGRAL CALCULUS	12

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centre of mass.

UNIT V	MULTIPLE INTEGRALS	12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centre of mass, moment of inertia.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use the matrix algebra methods for solving engineering problems.

CO2: Apply differential calculus tools in solving various application problems.

CO3: Make use of differential calculus ideas on several variable functions.

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CO4: Identify suitable methods of integration in solving practical problems.

CO5: Solve practical problems of areas, volumes using multiple integrals.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
3. James Stewart, "Calculus: Early Transcendentals", 8th Edition, Cengage Learning, New Delhi, 2015.

REFERENCES:

1. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", 7th Edition, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 2009.
2. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", 5th Edition, Narosa Publications, New Delhi, 2016.
3. Ramana. B.V., "Higher Engineering Mathematics", 6th Edition, McGraw Hill Education Pvt. Ltd, New Delhi, 2010.
4. Thomas. G. B., Hass. J and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

21PH101	ENGINEERING PHYSICS *(Common to all B.E. / B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To illustrate the students effectively to achieve an understanding of mechanics.
- To infer the students to gain knowledge of electromagnetic waves and its applications.
- To explain the basics of oscillations, optics and lasers.
- To outline the importance of quantum physics.
- To relate the students towards the applications of quantum mechanics.

UNIT I — MECHANICS — 9

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum– double pendulum –Introduction to nonlinear oscillations.

UNIT II — ELECTROMAGNETIC WAVES — 9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.

UNIT III — OSCILLATIONS, OPTICS AND LASERS — 9

A. P. Pushpalai

Jaiminmin

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave – sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference– Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.		
UNIT IV	**BASIC QUANTUM MECHANICS**	**9**
Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in an infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.		
UNIT V	**APPLIED QUANTUM MECHANICS**	**9**
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the importance of mechanics.

CO2: Extend their knowledge in electromagnetic waves.

CO3: Illustrate a strong foundational knowledge in oscillations, optics and lasers.

CO4: Interpret the importance of quantum physics.

CO5: Summarize quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow, "An Introduction to Mechanics", 1st Edition, McGraw Hill Education, 2017.
2. E.M.Purcell and D.J.Morin, "Electricity and Magnetism", 3rd Edition, Cambridge University Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", 7th Edition, McGraw-Hill, 2017.

REFERENCES

1. R.Wolfson. "Essential University Physics", Volume 1 & 2. , 1st Edition (Indian Edition) Pearson Education, 2009.
2. Paul A. Tipler, "Physics" - Volume 1 & 2, 1st Edition (Indian Edition), CBS Publishers & Distributors, 2004.
3. K.Thyagarajan and A.Ghatak. "Lasers: Fundamentals and Applications", 2nd Edition, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R. Resnick and J. Walker, "Principles of Physics", 10th Edition (Indian Edition), Wiley, 2015.
5. N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students", 1st Edition , Springer Verlag, 2012.

21CH101	ENGINEERING CHEMISTRY *(Common to all B.E. / B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe water quality parameters and water treatment techniques.
- To discuss basic principles and preparatory methods of nanomaterials.
- To demonstrate the basic concepts and applications of phase rule and composites.
- To identify different types of fuels, their preparation, properties and combustion characteristics.
- To illustrate the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I	WATER AND ITS TREATMENT	9

Water: Sources and impurities, **Water quality parameters:** Definition and significance of-colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination).**Desalination of brackish water**: Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. **Treatment of boiler feed water**: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II	NANOCHEMISTRY	9

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials**: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. **Applications** of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III	PHASE RULE AND COMPOSITES	9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). **Properties and applications of**: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. **Hybrid composites** - definition and examples.

UNIT IV	FUELS AND COMBUSTION	9

Fuels: Introduction: Classification of fuels; **Coal and coke**: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:** Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Power alcohol and biodiesel.**

Combustion of fuels: **Introduction**: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; **Ignition temperature**: spontaneous ignition temperature, Explosive range; **Flue gas analysis** - ORSAT Method. **CO_2 emission and carbon foot print.**

UNIT V	ENERGY SOURCES AND STORAGE DEVICES	9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. **Solar energy conversion:** Principle, working and applications of solar cells; **Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H_2-O_2 fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2: Describe the basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3: Apply the knowledge of phase rule and composites for material selection requirements.

CO4: Identify suitable fuels for engineering processes and applications.

CO5: Demonstrate different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", 12th Edition, S. Chand Publishing, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B.B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-II M Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" 2nd Edition, McGraw Hill Education (India) Private Limited, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", 2nd Edition, Cambridge University Press, Delhi, 2019
5. O.V. Roussak and H.D. Gesser, "Applied Chemistry-A Text Book for Engineers and Technologists", 2nd Edition, Springer Science Business Media, New York, 2013.

21CS101	PROBLEM SOLVING AND PYTHON PROGRAMMING *(Common to all B.E./B.Tech Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

UNIT-I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.

UNIT-II	DATA TYPES, EXPRESSIONS, STATEMENTS	9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT-III	CONTROL FLOW, FUNCTIONS, STRINGS	9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-else-if-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT-IV	LISTS, TUPLES, DICTIONARIES	9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT-V	FILES, MODULES, PACKAGES	9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of design approaches to solve computational problems.

CO2: Develop and execute basic Python programs using expressions and input/output statements.

CO3: Utilize strings, functions and control statements to develop real world problems.

CO4: Construct programs using Python data types like lists, tuples and dictionaries.

CO5:Prepare a Python application by incorporating files and exceptions
TEXT BOOKS: 1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016. 2. Karl Beecher,"Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017. 3. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc- Graw Hill, 2018.
REFERENCES: 1. Paul Deitel and Harvey Deitel, "Python for Programmers", 1st Edition, Pearson Education, 2021. 2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021. 3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", 3rd Edition, MIT Press, 2021 4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019

21CS102	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY *(Common to all B.E./B.Tech Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To describe the problem solving approaches.
- To solve the basic programming constructs in Python.
- To illustrate various computing strategies for Python-based solutions to real world problems.
- To make use of Python data structures - lists, tuples, and dictionaries.
- To explain input/output with files in Python.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.,)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.,- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)

8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error,voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.,

COURSE OUTCOMES: **TOTAL:60 PERIODS**

At the end of the course, learners will be able to

CO1:Develop algorithmic solutions to simple computational Problems

CO2: Illustrate and execute basic Python programs using simple statements.

CO3: Build program for scientific problems using strings, functions and control statements.

CO4: Utilize compound data types lists, tuples and dictionaries for real-time applications.

CO5: Experiment the python packages, files and exceptions for developing software applications

21PC101	PHYSICS AND CHEMISTRY LABORATORY *(Common to all B.E. / B.Tech., Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To explain the proper use of various kinds of physics laboratory equipment.
- To extend how data can be collected, presented and interpreted in a clear and concise manner.
- To infer problem solving skills related to physics principles and interpretation of experimental data.
- To summarize error in experimental measurements and techniques used to minimize such error.
- To translate the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 7 Experiments)

1 Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – Determination of the velocity of sound and compressibility of liquids
10. Post office box - Determination of Band gap of a semiconductor.
11. Photoelectric effect

12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1:.Explain the functioning of various physics laboratory equipment

CO2: Relate the graphical models to analyze laboratory data

CO3: Interpret mathematical models as a medium for quantitative reasoning and describing physical reality.

CO4: Explain Access, process and analyze scientific information.

CO5: Translate students to solve problems individually and collaboratively

REFERENCES :

1. "Physics Laboratory Manual", Department of Physics, Velammal College of Engineering & Technology, Madurai (2021)
2. P. Mani, "Physics Laboratory", Dhanam Publications, 2021

*Each class is divided in to two batches (30 students / batch) and each batch will perform their experiments alternatively per week in physics and chemistry laboratory

21PC101	PHYSICS AND CHEMISTRY LABORATORY	L	T	P	C
	(Common to all B.E / B.Tech. Programmes)	0	0	4	2

CHEMISTRY LABORATORY

COURSE OBJECTIVES:

- To identify the required glass wares and instruments for chemical analysis.
- To estimate water quality parameters such as hardness, dissolved oxygen and chloride content.
- To relate electrochemical techniques such as pH metry, conductometry and potentiometry.
- To interpret the data collected from the analysis.
- To express the skills to get accurate results

List of Experiments (Any 7 experiments)

1. Preparation of Na2CO3 as a primary standard and estimation of acidity of a water sample using the primary standard.
2. Determination of types and amount of alkalinity in water sample.
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate. (precipitation titration)

11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel.
15. Proximate analysis of Coal.

COURSE OUTCOMES :

At the end of the course, learners will be able to

CO1: Extent the skills to choose and handle appropriate glass wares.

CO2: Interpret the water quality parameters using volumetric method.

CO3: Estimate the conductivity, pH & emf by electro chemical methods.

CO4: Infer the collected data for appropriate chemical analysis.

CO5: Demonstrate systematic approach to obtain accurate results

TEXT BOOK:

J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, "Vogel's Textbook of Quantitative Chemical Analysis" 2009.

SEMESTER-II

21EN102	ENGLISH-II *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- Foster their ability to write convincing job applications and effective reports.
- Develop their speaking skills to make technical presentations and participate in group discussions.
- Strengthen their Listening skill which will help them comprehend lectures and talks in their areas of specialization.
- Create awareness about the soft skills

UNIT I	INTRODUCTION TO TECHNICAL ENGLISH	9

Listening - Factual and Academic speeches; **Speaking** - Asking for and giving directions - **Reading** - Technical texts from - Newspapers /websites; **Writing** - Statements - Definitions - issue based writing instructions - Checklists - Recommendations; **Vocabulary Development**- technical vocabulary; **Grammar** Error spotting - Compound words; **Soft skills** - Leadership Skills

UNIT II	READING AND STUDY SKILLS	9

Listening - Listening to longer technical talks and completing exercises based on them; **Speaking** - Describing a general process; **Reading** - Reading longer technical texts - Identifying the various transitions in a text - Paragraphing; **Writing** - Interpreting charts, graphs; **Vocabulary Development** - Vocabulary used in formal letters/emails and reports **Grammar** - Impersonal passive voice, numerical adjectives - **Soft skills** - Teamwork

UNIT III	TECHNICAL WRITING AND GRAMMAR	9

Listening - Listening to classroom lectures, talks on engineering /technology; **Speaking** - introduction to technical presentations; **Reading** - longer texts both general and technical, practice in speed reading; **Writing** - Describing a technical process; **Vocabulary Development** - Sequence words - Misspelled words; **Grammar** - Embedded sentences ; **Soft skills** - Decision making

UNIT IV	JOB APPLICATIONS	9

Listening - Listening to Documentaries and Making Notes; **Speaking** - Mechanics of Presentations; **Reading** - Reading for Detailed Comprehension; **Writing** - Email Etiquette, Job Application, Cover Letter, Resume Preparation(softcopy and hard copy), Analytical Essay Writing; **Vocabulary Development** - Finding Suitable Synonyms, Paraphrasing; **Grammar** – Clauses, 'If' Conditionals; **Soft Skills** - Time Management.

UNIT V	GROUP DISCUSSION AND REPORT WRITING	9

Listening - TED Talks; **Speaking** - Participating in a Group Discussion; **Reading** - Reading and Understanding Technical Articles; **Writing** - Writing Reports, Survey Report, Accident Report, Minutes of a Meeting; **Vocabulary Development** - Verbal Analogies; **Grammar** - Reported Speech; **Soft Skills** - Conflict Resolution.

TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able to

CO1: Critically read and interpret information in technical texts

CO2: Write convincing job applications, resume and effective reports

CO3: Present the technical ideas effectively in spoken and written forms

CO4: Understand spoken language in lectures and talks

CO5: Demonstrate basic soft skills in life

TEXT BOOKS:

1. Board of Editors, Fluency in English-A Course book for Undergraduate Engineers and Technologist. Orient Blackswan Pvt Ltd, Hyderabad: 2018
2. Jawahar, Jewelcy & Rathna.P. Communicative English Workbook. VRB Publishers Pvt Ltd. Chennai. 2018.
3. Board of Editors, Department of English, Anna University, Chennai. Mindscapes-English for Technologists and Engineers. Orient Black Swan Pvt Ltd, Chennai, 2012.

REFERENCES:

1. Verma, Shalini. Technical Communication for Engineers. Vikas Publishing House Pvt Ltd. New Delhi. 2015

2. Raman, Meenakshi & Sharma, Sangeeta. Technical Communication English Skills for Engineers. Oxford University Press. 2008.
3. Rizvi, Ashraf.M. Effective Technical Communication. MC Graw Hill Education Pvt Ltd. New Delhi. 2016.

21MA103	SAMPLING TECHNIQUES AND NUMERICAL METHODS *(Common to B.E. CSE/ B.Tech. IT/B.E.ECE)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To describe the necessary basic concepts in probability
- To explain the concept of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To use the basic concepts of classification of design of experiments.
- To choose the method for solving algebraic and transcendental equations using numerical techniques.
- To discuss the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines..

UNIT I	PROBABILITY	15
Introduction-Sample Spaces and Events-Axioms of Probability-Interpretations and Properties of Probabilities-Conditional Probabilities-Baye's theorem- Independence.		
UNIT II	TESTING OF HYPOTHESIS	15
Large sample test based on Normal distribution for single mean and difference of means – Tests based on t, $\chi 2$ and F distributions for testing means and variances – Contingency table (Test for Independency) – Goodness of fit.		
UNIT III	DESIGN OF EXPERIMENTS	15
Introduction, aim, basic designs of experiments, one way and two way classifications - Completely randomized design – Randomized block design – Latin square design.		
UNIT IV	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	15
Newton Raphson method –Method of False position- pivoting – Gauss Jordan methods – Iterative method: Gauss Seidel – Matrix inversion by Gauss Jordan method – Eigen values of a matrix by power method.		
UNIT V	INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION	15
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's $1/3^{rd}$ rules, $3/8^{th}$ rule.		

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Apply the concepts of Probability in Engineering problems.

CO2:Explain the test of hypothesis for small and large samples by using various test like t-test, F-test, Z-test and $\chi 2$ test.

CO3: Apply the basic concepts of classifications of design of experiments.

CO4: Solve the system of equations and the eigen value problems using iterative procedure.

CO5:Interpret the value of an unknown function at any interpolated point of the given tabulated values.

TEXT BOOKS:

1. JAY.L. Devore, "Probability and Statistics for Engineering and the Science", 9th Edition, Cengage Learning, 2021.
2. Johnson. R.A., and Irwin Miller, John Freund, "Miller and Freund's Probability and Statistics for Engineers", 12th Edition, Pearson Education, Asia, 2011.
3. Gerald. C.F., and Wheatley. P.O. "Applied Numerical Analysis", 7th Edition, Pearson Education, Asia, New Delhi, 2008.

REFERENCES:

1. Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8th Edition, Pearson Education, Asia, 2007.
2. Spiegel. M.R., Schiller. J., and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", 3rd Edition, Tata McGraw Hill, 2012.
3. Chapra. S.C., and Canale. R.P, "Numerical Methods for Engineers", 5th Edition, Tata McGraw Hill, New Delhi, 2007.

21PH103	**PHYSICS FOR INFORMATION SCIENCE** *(Common to B. E. CSE / B. Tech. IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the importance in studying electrical properties of materials.
- To extend the students knowledge in semiconductor physics.
- To illustrate knowledge on magnetic properties of materials.
- To summarize different optical properties of materials, optical displays and applications.
- To translate an idea of significance of nano structures, quantum confinement, ensuing nano device applications and quantum computing

UNIT I	ELECTRICAL PROPERTIES OF MATERIALS	9

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Wiedemann-Franz law - Success and failures - Electrons in metals - Particle in a three dimensional box - Degenerate states - Fermi- Dirac statistics - Density of energy states - Electron effective mass - Concept of hole.

UNIT II	SEMICONDUCTOR PHYSICS	9

A.P. Pushpalai
Jaiindran

Intrinsic Semiconductors - Energy band diagram - Direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - extrinsic semiconductors - Carrier concentration in n-type & p-type semiconductors - Variation of carrier concentration with temperature - Variation of Fermi level with temperature and impurity concentration - Carrier transport in Semiconductor: random motion, drift, mobility and diffusion - Hall effect and devices - Ohmic contacts - Schottky diode.

UNIT III	MAGNETIC PROPERTIES OF MATERIALS	9

Magnetic dipole moment - Atomic magnetic moments - Magnetic permeability and susceptibility - Magnetic material classification: diamagnetism - Paramagnetism - Ferromagnetism - Antiferromagnetism - Ferrimagnetism - Ferromagnetism: origin and exchange interaction saturation magnetization and Curie temperature - Domain Theory- M versus H behaviour - Hard and soft magnetic materials - Examples and uses - Magnetic principle in computer data storage - Magnetic hard disc (GMR sensor).

UNIT IV	OPTICAL PROPERTIES OF MATERIALS	9

Classification of optical materials - carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode - solar cell - LED - Organic LED - Laser diodes - Optical data storage techniques.

UNIT V	NANODEVICES AND QUANTUM COMPUTING	9

Introduction - Quantum confinement - Quantum structures: quantum wells, wires and dots - Band gap of nanomaterials. Tunneling - Single electron phenomena: Coulomb blockade - Resonant- tunneling diode - single electron transistor - quantum cellular automata - Quantum system for information processing - quantum states - classical bits - quantum bits or qubits - CNOT gate - multiple qubits - quantum gates - advantage of quantum computing over classical computing (qualitative).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Demonstrate the classical and quantum electron theories, and energy band structures.

CO2: Infer knowledge on basics of semiconductor physics and its applications in various devices.

CO3: Summarize magnetic properties of materials and their applications in data storage.

CO4: Extend the functioning of optical materials for optoelectronics

CO5: Translate the basics of quantum structures towards quantum computing.

TEXT BOOKS:

1. Jasprit Singh, "Semiconductor Devices Basic Principles", First Edition (Indian Edition), Wiley, 2007.
2. S.O. Kasap, "Principles of Electronic Materials and Devices", Fourth Edition (Indian Edition), McGraw-Hill Education, 2020.
3. Parag K. Lala, "Quantum Computing: A Beginner's Introduction", First Edition (Indian Edition) McGraw-Hill Education, 2020.

REFERENCES

1. 1. Charles Kittel, "Introduction to Solid State Physics", Indian Edition Wiley, 2019.
2. Y.B.Band and Y.Avishai, "Quantum Mechanics with Applications to Nanotechnology and Information Science", First Edition, Academic Press, 2013.
3. V.V.Mitin, V.A. Kochelap and M.A.Stroscio, "Introduction to Nanoelectronics", First Edition, Cambridge University.Press, 2008.
4. G.W. Hanson, "Fundamentals of Nanoelectronics", Indian Edition, Pearson Education 2009.
5. B.Rogers, J.Adams and S.Pennathur, "Nanotechnology: Understanding Small Systems", CRC Press, 2014.

21ME101	**ENGINEERING GRAPHICS** *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To sketch the projection of points, lines and planes.
- To sketch the projection of simple solids
- To sketch the projection of sectioned solids and development of lateral surfaces
- To sketch the isometric and perspective views of simple solids.
- To sketch the orthographic projection of various objects freehand.

UNIT I	PROJECTIONS OF POINTS, LINES AND PLANE SURFACE	12

Importance of graphics in engineering applications – Use of drafting instruments - Lettering and dimensioning.

Introduction to Orthographic projections - Principles -Principal planes-First angle projection. Projection of points located in all quadrants. Projection of straight lines inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.

Projection of planes (regular polygonal and circular surfaces) inclined to both the principal planes by rotating object method. (Not for Examination)

UNIT II	PROJECTION OF SOLIDS	12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT III	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT IV	ISOMETRIC AND PERSPECTIVE PROJECTIONS	12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .		
UNIT V	FREEHAND SKETCHING	12
Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects. Introduction to drafting packages and demonstration. (Not for examination).		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Construct the orthographic projections of points, straight lines and plane surfaces.

CO2: Sketch the orthographic projections of simple solids

CO3: Sketch the orthographic projections of sectional solids and lateral surfaces of the solids.

CO4: Construct the isometric projections and perspective projections of simple solids.

CO5: Sketch the orthographic projection of objects using freehand.

TEXT BOOKS:

1. Natarajan K.V., "A text book of Engineering Graphics", 31st Edition, Dhanalakshmi Publishers, Chennai, 2018.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", 15th Edition, New Age International (P) Limited, 2018.
3. Bhatt N.D. and Panchal V.M., "Engineering Drawing", 53rd Edition, Charotar Publishing House, 2014.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", 2nd Edition, Tata McGraw Hill Publishing Company Limited, 2013.
2. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", 2nd Edition, Oxford University, Press, New Delhi, 2015.
3. Shah M.B., and Rana B.C., "Engineering Drawing", 2nd Edition, Pearson, 2009.

21EE104	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING FOR INFORMATION SCIENCE *(Common to B.E. CSE / B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basics of electric circuits and analysis.
- To summarize the basics of working principles and application of AC and DC machines.
- To interpret the domestic and industrial wiring.
- To demonstrate analog devices and their characteristics.
- To illustrate the application of operational amplifier.

UNIT I	ELECTRICAL CIRCUITS	9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws– Simple problems- Nodal Analysis, Mesh analysis. Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – (Simple problems only)

UNIT II	ELECTRICAL MACHINES	9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and. Construction and Working Principle of DC motors, Back EMF equation, Types, Speed and Torque Equation, Transformer-Construction, Working principle and Three phase Alternator, Synchronous motor and Three Phase Induction Motor-construction, working principle and Applications(Qualitative Analysis)

UNIT III	DOMESTIC AND INDUSTRIAL WIRING	9

Lighting, provision of sockets-MCB- Selection of wires and cables-Protection-need for earthing, fuses, relay and circuit breakers. Load calculation, generation cost and Energy Tariff calculation for domestic and industrial loads- HT & LT wiring- Power factor correction.

UNIT IV	ANALOG ELECTRONICS	9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing – Types, I-V Characteristics and Applications, Rectifier. (Qualitative Analysis)

UNIT V	OPERATIONAL AMPLIFIERS AND ITS APPLICATIONS	9

Operational amplifiers, Inverting and Non Inverting Amplifier, Summer, Differentiators, Integrator, Voltage to Current (V/I) and Current to Voltage (I/V) Converter, Multivibrator using 555timer IC.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret the electric circuit parameters of simple DC Circuits.

CO2: Explain the working principle and applications of DC machines.

CO3: Demonstrate the working principle of AC machines.

CO4: Describe the characteristics of analog electronic devices.

CO5: Summarize the basic concepts of operational amplifiers.

TEXT BOOKS

1. Bhattacharya.S.K "Basic Electrical and Electronics Engineering", 2nd Edition, Pearson Education, 2017.
2. Sedha R.S., "A textbook book of Applied Electronics", 3rd Edition, S. Chand & Co., 2008.
3. Salivahanan. S, Suresh Kumar.N, "Electronic Devices and Circuits", 3rd Edition, Tata McGraw Hill 2012.
4. Roy Choudhary.D, Sheil B. Jani, "Linear Integrated Circuits", 5th Edition , New Age international Pvt Ltd publishers, 2018.

REFERENCES

1. Kothari DP and Nagrath. I.J, "Basic Electrical Engineering", 4th Edition, McGraw Hill Education, 2019.
2. Albert Malvino, David Bates, "Electronic Principles", 7th Edition, McGraw Hill Education; 2017.
3. Badriram, B.H.Vishwakarma, "Power system protection and switchgear", 2nd Edition, New age international Pvt Ltd publishers, 2011.

21CS103	PROGRAMMING IN C *(Common to B. E. CSE / B. Tech. IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate the fundamentals of C programming
- To describe the reusable modules (collections of function)
- To examine code, document, test, and implement a well-structured program using the C
- To use the C programming concepts in trivial problem solving.
- To develop logics which will help them to create programs, applications in C.

UNIT-I	BASICS OF C PROGRAMMING	9

Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Pre-processor directives - Compilation process

UNIT-II	ARRAYS AND STRINGS	9

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.

UNIT-III	FUNCTIONS AND POINTERS	9

Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference

UNIT-IV	STRUCTURES AND UNION	9

Structure - Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility

UNIT-V	FILE PROCESSING	9

Files –Defining and Opening a file, closing a file– input/output operations on files– error handling during I/O operations– random access to files–Command Line Arguments.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Develop simple applications using basic C components.

CO2: Solve applications adopting array and string concepts.

CO3: Construct and implement applications in C using functions and pointers.

CO4: Prepare applications in C by employing structure and union concepts.

CO5: Build applications using sequential and random access file processing.

TEXT BOOKS:

1. ReemaThareja, "Programming in C", Oxford University Press, 2nd Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", 2nd Edition, Pearson Education, 2015.
3. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", 8th edition, Pearson Education, 2018.
2. Yashwant Kanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.

21CH103	**ENVIRONMENTAL SCIENCE** *(Common to all B.E / B.Tech. Programmes)*	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To describe the structure and function of an ecosystem and biodiversity
- To interpret the environmental impacts of natural resources.
- To demonstrate causes, effects and control measures of different types of pollution.
- To manipulate the importance of disaster management, environmental ethics and values.
- To dramatize the important social issues and sustainable practices.

UNIT-I ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY 6

Multidisciplinary nature of environmental studies - ecosystem- general structure and function of an ecosystem-ecological succession-biodiversity-types-values of biodiversity- endangered and endemic species-red data book-hot spots of biodiversity-criteria- hot spots in India-threats to biodiversity(man-animal conflicts, habitat loss, poaching)-case studies-conservation of biodiversity- in-situ and ex-situ conservation

UNIT-II NATURAL RESOURCES AND ITS ENVIRONMENTAL IMPACTS 6

Natural resources-forest resource-ecological functions – causes, effects and control measures of deforestation-water resource-sources-conflict over water-dams benefits and problems-food resource-overgrazing- impacts of over grazing- impacts of modern agriculture-energy resource-environmental impacts of wind mills and solar panels- role of an individual in conservation of natural resources.

UNIT III ENVIRONMENTAL POLLUTION AND CONTROL 6

Air pollution-causes, effects and control methods - water pollution- causes, effects-waste water treatment-soil pollution-causes, effects-solid waste management–e-waste- causes, effects and management-Pollution control acts-air(prevention and control of pollution) act,1981-water(prevention and control of pollution) act,1974-wildlife (protection) act,1972 - e-waste management rules,2016-case studies - role of an individual in control of pollution.

UNIT IV DISASTER MANAGEMENT AND ENVIRONMENTAL ETHICS 6

Disaster management-causes, effects and management of- flood, landslide, earthquake and tsunami-case studies-environmental ethics- value education-traditional value systems in India-water conservation-rain water harvesting-watershed management.

UNIT V SOCIAL ISSUES AND SUSTAINABLE PRACTICES 6

Unsustainable development- social issues-climate change-causes, effects and control measures-global warming-causes, effects and control measures-Acid rain-causes, effects and control measures-ozone layer depletion-causes, effects and control measures-nuclear accident and holocausts-EIA-Sustainable development-goals-target- green buildings- ISO 14000 series.

	30 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able to

CO1: Explain the concept, structure and function of an ecosystem and biodiversity.

CO2: Demonstrate the environmental impacts of natural resources.

CO3: Illustrate the suitable management method for pollution control.

CO4: Relate the proper way of managing disaster with environmental ethics.

CO5: Apply social issues and adopt suitable sustainable practices.

TEXT BOOKS:

1. Kaushik, A &Kaushik. C.P, "Environmental Science and Engineering", 6th Edition, New Age International, 2018.
2. Garg S.K &Garg, Ecological and Environmental studies, Khanna Publishers, 2015.
3. Wright &Nebel, Environmental science towards a sustainable future, 12th Editon, Prentice Hall of India Ltd, 2015.

REFERENCE BOOKS:

1. ErachBharucha, "Text book of Environmental studies for Undergraduate courses", 3rd Edition, UGC, 2021.
2. Ravi P. Agrahari, Environmental ecology, Biodiversity, climatic change & Disaster management, 1st Edition, McGraw Hill, 2020
3. Benney Joseph, "Environmental Science and Engineering", 1st Edition, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017

21EM101	ENGINEERING PRACTICES LABORATORY *(Common to all B.E / B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To draw pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- To demonstrate the basic switch board wiring, fluorescent lamp wiring and stair case wiring using various electrical components.
- To choose various joints in steel plates using arc welding work and machining various simple processes like turning, drilling, tapping in parts
- To build a tray out of metal sheet using sheet metal work.
- To develop electronic circuit and testing for soldering and desoldering using PCB board.

LIST OF EXPERIMENTS:

GROUP – A (CIVIL & ELECTRICAL)

PART – I

CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.

- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

- Sawing,
- Planning and Making joints like T-Joint, Cross lap and Dovetail joint.

PART – II

ELECTRICAL ENGINEERING PRACTICES

- Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
- Staircase wiring
- Fluorescent Lamp wiring with introduction to CFL and LED types.
- Energy meter wiring and related calculations/ calibration
- Study of Iron Box wiring and assembly
- Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
- Measurement of resistance to earth of an electrical equipment.

GROUP – B (MECHANICAL & ELECTRONICS)

PART III

MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

- Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
- Practicing gas welding.

BASIC MACHINING WORK:

- Usage of Spanners and screw drivers
- Facing and Turning.
- Taper Turning

ASSEMBLY WORK:

- Assembling a centrifugal pump.
- Assembling a household mixer.
- Assembling an air conditioner.

SHEET METAL WORK:

- Making of a square tray

FOUNDRY WORK:

- Demonstrating basic foundry operations.

PART IV

ELECTRONIC ENGINEERING PRACTICES

SOLDERING WORK:

- Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

- Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

- Study elements of smart phone.
- Assembly and dismantle of computer / laptop

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build various plumbing joints

CO2: Develop various carpentry joints.

CO3: Construct various wiring electrical joints in common household electrical wire work.

CO4: Construct various welded joints, sheet metal and basic machining operations

CO5: Develop the electronic circuit for soldering and testing using PCB board.

21CS104	PROGRAMMING IN C LABORATORY *(Common to B.E. CSE / B.Tech IT)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To demonstrate the fundamentals of C programming
- To describe the reusable modules (collections of function)
- To examine code, document, test, and implement a well-structured program using the C
- To use the C programming concepts in trivial problem solving.
- To develop logics which will help them to create programs, applications in C.

LIST OF EXPERIMENTS

1. I/O statements, operators, expressions
2. decision-making constructs: if-else, goto, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, Multi-dimensional arrays, traversal
5. Strings: operations
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
10. Files: reading and writing, File pointers, file operations, random access, processor directives.
11. Mini project.

TOTAL :60 PERIODS

Course Outcomes:

At end of the course, learners will be able to

CO1: Develop simple applications using basic C components.
CO2: Solve applications adopting array and string concepts.
CO3: Construct and implement applications in C using functions and pointers.
CO4: Prepare applications in C by employing structure and union concepts.
CO5: Build applications using sequential and random access file processing.

SEMESTER-III

21MA203	DISCRETE MATHEMATICS (Common to B.E. CSE / B.Tech IT)	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To extend student's logical and mathematical maturity and ability to deal with abstraction.
- To discuss the basic concepts of Combinatorics.
- To explain the students about the properties and characteristics of different graphs.
- To demonstrate the applications of algebraic structures.
- To identify the concepts and significance of lattices and Boolean algebra which are widely used in computer science and engineering

UNIT I	LOGIC AND PROOFS	15

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs – Proof methods and strategy.

UNIT II	COMBINATORICS	15

Mathematical induction – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle and its applications

UNIT III	GRAPHS	15

Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

UNIT IV	ALGEBRAIC STRUCTURES	15

Groups – Subgroups – Cyclic groups - Homomorphism – Normal subgroup and Cosets – Lagrange's theorem – Definitions and examples of Rings and Fields.

UNIT V	LATTICES AND BOOLEAN ALGEBRA	15

Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Some special lattices: Bounded, Modular, Distributive, complemented.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Extend student's logical and mathematical maturity and ability to deal with abstraction.
CO2: Explain the basic concepts of combinatorics.
CO3: Make use of the concept of graph theory in computer science and engineering.

CO4: Manipulate the applications of algebraic structures.

CO5: Demonstrate the basic theorems and properties of Lattices and Boolean Algebra.

TEXT BOOKS:

1. Rosen, K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 2011.
2. Tremblay J.P. & Manohar.R,"Discrete Mathematics Structures with Application to Computer Science", 1st Edition, Tata McGraw Hill Publication Ltd., New Delhi, 30th reprint 2011.
3. Liu C.L, Mohapatra D.P, "Elements of Discrete Mathematics: A computer oriented approach", 4th Edition, Tata McGraw Hill, New Delhi, 2017.

REFERENCES:

1. Grimaldi.R.P.,"Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2. Koshy, "Discrete Mathematics with Applications", 1st Edition, Elsevier Publications, 2006.
3. Bernard Kolman, Robert C Busby, Sharon Cutler Ross, "Discrete Mathematical Structures", 3rd Edition, Prentice Hall, New Delhi, 2015.

21EC201	**DIGITAL PRINCIPLES AND SYSTEM DESIGN** *(Common to B.E CSE /B.Tech.IT /B.E ECE)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the digital fundamentals, Boolean algebra and its applications in digital systems.
- To model combinational digital circuits using logic gates.
- To develop synchronous sequential circuits.
- To solve asynchronous sequential circuits.
- To summarize the various semiconductor memories

UNIT I — DIGITAL FUNDAMENTALS — 9

Number systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map minimization, NAND and NOR implementations.

UNIT II — COMBINATIONAL CIRCUIT DESIGN — 9

Design of Half and Full adders, Half and Full subtractors, Binary parallel adder – Carry look ahead adder, BCD adder, Multiplexer, Demultiplexer, Magnitude comparator, Decoder, Encoder and Priority Encoder.

UNIT III — SYNCHRONOUS SEQUENTIAL CIRCUITS — 9

Flip flops – SR, JK, T, D, Master / Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - state minimization, state assignment, circuit implementation – Design of Counters- Ripple counters, Ring counters, Shift registers and Universal shift register.

UNIT IV — ASYNCHRONOUS SEQUENTIAL CIRCUITS — 9

K. kavitha

BoS-CHAIRMAN

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Design of Hazard free circuits.

UNIT V	MEMORY DEVICES AND VERILOG PROGRAMMING	9

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL. Design of half adder, full adder, flip flops and counters using Verilog.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of minimization techniques to simplify Boolean algebraic equations.
CO2: Build various combinational circuits using logic gates.
CO3: Develop synchronous sequential circuits using flip flops.
CO4: Build asynchronous sequential circuits using flip flops.
CO5: Explain various semiconductor memories and programmable logic devices.

TEXT BOOKS:

1. M. Morris R. Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog", 6th Edition, Pearson Education, 2017.
2. S.Salivahanan and S.Arivazhagan, "Digital Electronics", 1st Edition, Vikas Publishing House pvt Ltd, 2012.
3. Soumitra Kumar Mandal, "Digital Electronics", 2nd Edition, McGraw Hill Education Private Limited, 2016.

REFERENCES:

1. Charles H.Roth, "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011
3. A.Anand Kumar, "Fundamentals of Digital Circuits", 4thEdition, PHI Learning Private Limited, 2016.

21CS201	COMPUTER ORGANIZATION AND ARCHITECTURE	L	T	P	C
	(Common to B.E.CSE./ B.Tech.IT)	3	0	0	3

COURSE OBJECTIVES:

- To explain the basic organization and operation of computer system.
- To discuss the Arithmetic and logical unit
- To describe the building of data path with the basic concept of pipelining
- To illustrate the parallelism and multi-core processors
- To demonstrate hierarchical memory system and I/O technologies.

UNIT-I	BASIC ORGANIZATION OF COMPUTER SYSTEM	9

Functional Units – Basic Operational Concepts – Performance – Instructions – operations and operands of a computer hardware– representing instructions – Logical operations – Decision making – Addressing and addressing modes.

UNIT-II	ARITHMETIC FOR COMPUTERS	9

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations

UNIT-III	PROCESSOR AND CONTROL	9

K.Kavitha

Basic MIPS implementation – Building a Data path – Control Implementation scheme – Pipelining – Pipelined data path and control – Handling Data hazards & Control hazards – Exceptions.

UNIT-IV	PARALLELISM	9

Parallel processing challenges – Flynn's classification –SISD,MIMD,SIMD,SPMD - Hardware multithreading – Multi-core processors - Message-Passing Multiprocessors

UNIT-V	MEMORY AND I/O ORGANIZATION	9

Memory hierarchy – Memory technologies – Cache basics – Measuring and improving cache performance – Virtual memory – I/O Interface - Mode of Transfer - Programmed I/O, Interrupt –initiated I/O, DMA - Input/Output processors

TOTAL:45 PERIODS

COURSE OUTCOMES

At the end of the course, learners will be able to

CO1: Illustrate the basics structure of computers, operations and instructions.
CO2: Build arithmetic and logic unit to perform the arithmetic operations.
CO3: Utilize the data path to develop control unit.
CO4: Identify multithreading techniques to achieve parallelism.
CO5: Experiment with the performance of various memory and I/O technologies.

TEXT BOOKS:

1. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", 5th Edition, Morgan Kaufmann / Elsevier 2014
2. Morris Mano, "Computer System Architecture", 3rd Edition, Prentice Hall of India,2017
3. John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", Morgan Kaufmann, 5th Edition, Elsevier Publishers, 2012.

REFERENCES:

1. William Stallings, "Computer Organization and Architecture – Designing for Performance", 11th Edition, Pearson Education, 2019.
2. John P. Hayes, "Computer Architecture and Organization", 3rd Edition, Tata McGraw Hill, 2012.
3. Govindarajulu B"Computer Organization and Architecture"2nd Edition ,Tata McGraw Hill,2014

21CS202	**DATA STRUCTURES** *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the concepts of ADTs
- To describe linear data structures like lists, stacks and queues
- To illustrate nonlinear data structures like trees and graphs
- To demonstrate advanced nonlinear data structures and hashing.
- To develop skills to apply appropriate data structure concept in problem solving.

UNIT-I	LINEAR DATA STRUCTURES – LIST	9

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation — Singly linked lists- Circularly linked lists- Doubly-linked lists – Applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

UNIT-II	LINEAR DATA STRUCTURES – STACKS, QUEUES	9

Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT – Operations - Circular Queue – Priority Queue - deQue – applications of queues.		
UNIT-III	**NON LINEAR DATA STRUCTURES – TREES**	**9**
Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree.		
UNIT-IV	**ADVANCED NON LINEAR DATASTRUCTURES&HASHING**	**9**
Red-Black trees – Splay trees –Heap-Application of Heap-Binomial Heaps – Fibonacci Heaps. Hashing-Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.		
UNIT-V	**NON LINEAR DATA STRUCTURES – GRAPHS**	**9**
Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.		
		TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build abstract data types for linear data structures.

CO2: Make use of the different linear data structures for problem solving.

CO3: Select nonlinear tree data structures to resolve computing problems.

CO4: Utilize advanced nonlinear data structure and hashing for solving problems.

CO5: Infer data using graph structure and apply their algorithms for problem solving.

TEXT BOOKS:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2010.
2. Reema Thareja, "Data Structures Using C", 2nd Edition , Oxford University Press, 2011
3. Allen B Drowney "Think Data Structures", 1st Edition,O'Reilly,2017

REFERENCES:

1. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, University Press, 2008.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 2nd Edition, McGraw Hill, 2002.
3. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", 1st Edition, Pearson Education, 1983.

21CS203	**OBJECT ORIENTED PROGRAMMING** *(Common to B.E.CSE /B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe basic java programming constructs, classes, methods and inheritance.
- To develop application using exception handling concepts and strings
- To demonstrate threading and I/O concepts in java applications
- To illustrate generics and collections for solving programming problems.
- To build interactive applications using java swings and database connectivity

UNIT-I	**INTRODUCTION TO OOPS AND JAVA**	**12**
Basic OOPs concepts –Characteristics of Java- Data types , Variables and Arrays-Classes – constructors, methods – Inheritance- Packages –Abstract classes - Interfaces-Inner Classes		
UNIT-II	**EXCEPTION HANDLING AND STRINGS**	**7**

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements ,Object Class- Strings-String Comparison-String Methods-String buffer-String Tokenizer		
UNIT-III	**MULTITHREADING AND INPUT/OUTPUT**	**8**
Multi-threading Vs Multitasking-Java Thread model- Creating single and Multiple threads-Thread Methods- Synchronization- Inter thread Communication ,Input / Output Basics – Reading and Writing Console – Reading and Writing Files		
UNIT-IV	**EVENT DRIVEN PROGRAMMING AND DATABASE CONNECTIVITY**	**9**
Event handling Mechanisms-Event classes- Event Interfaces- Using Delegation event Model- Adapter classes- -Introduction to Swing –Swing Frames - Swing Components – Text Fields , Text Areas – Buttons-Check Boxes – Radio Buttons – Lists-Menus – layout management- Dialog Boxes-Connectivity to Databases- Drivers- DDL and DML operations		
UNIT-V	**GENERICS AND COLLECTIONS**	**9**
Generic Programming – Generic classes – generic methods – Bounded Types -Collections-Collection Interfaces-Collection Classes-Accessing a Collection – Arrays -ArrayList-– Map HashMap		
		TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Develop programs using basic java concepts.

CO2: Prepare java applications employing exception handling and strings

CO3: Construct java applications adopting thread and I/O concepts.

CO4: Solve java programming problems by incorporating Generics and collections.

CO5: Build GUI for java applications with database connectivity.

TEXT BOOK:

1. Herbert Schildt," Java The Complete Reference", 11th Edition, McGraw Hill Education, 2019
2. Paul Deitel, Harvey Deitel,," Java SE 8 for programmers", 3rd Edition, Pearson, 2015.
3. Cay S. Horstmann, Gary Cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013

REFERENCES:

1. DT Editorial Services, "Java 8 Programming Black book", 1st Edition, Dreamtech press, 2015.
2. Joshua Bloch, "Effective Java",2nd Edition ,Pearson's Education,2016
3. Allen B. Downey, Chris Mayfield, "Think Java",2nd Edition,O'Reilly,2017

21EC212	**DIGITAL SYSTEMS LABORATORY** *(Common to B.E CSE / B.Tech.IT/ B.E. ECE)*	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To explain the various basic logic gates.
- To develop and implement the various combinational circuits.
- To model and implement combinational circuits using MSI devices.
- To build and implement sequential circuits.

- To develop code using HDL programming.

LIST OF EXPERIMENTS:

1. Verification of Boolean theorems using basic gates.
2. Design and implementation of combinational circuits using basic gates for arbitrary functions and code converters.
3. Design and implement Half/Full Adder and Subtractor.
4. Design and implement combinational circuits using MSI devices:
    - 4 – bit binary adder / subtractor
    - Parity generator / checker
    - Magnitude comparator
5. Design and implement shift-registers.
6. Design and implement synchronous counters.
7. Design and implement asynchronous counters.
8. Coding combinational circuits using HDL.
9. Coding sequential circuits using HDL.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the basic working principles of logic gates.
CO2: Build simplified combinational circuits using basic logic gates.
CO3: Model combinational circuits using MSI devices.
CO4: Develop sequential circuits like registers and counters.
CO5: Solve combinational and sequential circuits using HDL.

21CS204	DATA STRUCTURES LABORATORY *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To demonstrate linear and non-linear data structures and their implementations.
- To describe the different operations of search trees.
- To compare various techniques of hashing.
- To illustrate graph traversal algorithms.
- To develop applications using different data structures.

LIST OF EXPERIMENTS

1. Implementation of Singly Linked List
2. Implementation of Doubly Linked List
3. Application of Linked List
4. Implementation of Stacks
5. Implementation of Queues
6. Application of Stack
7. Implementation of Tree Traversal
8. Implementation of Binary Search tree
9. Implementation of Balanced Tree
10. Create a hash table using open addressing with the following operations:

11. Implementation of Graph traversal Algorithms
12. Mini Project

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Develop functions for implementing linear data structures.
CO2: Make use of the different linear data structures for computational problem solving.
CO3: Build functions for implementing nonlinear tree data structures.
CO4: Choose appropriate hashing functions for collision free data storage and retrieval.
CO5: Utilize graph structure for manipulating data and problem solving.

21CS205	OBJECT ORIENTED PROGRAMMING LABORATORY *(Common to B.E.CSE / B.Tech.IT)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To describe basic java programming constructs, classes, methods and inheritance.
- To develop application using exception handling concepts and strings
- To demonstrate threading and I/O concepts in java applications
- To illustrate generics and collections for solving programming problems.
- To build interactive applications using java swings and database connectivity

LIST OF EXPERIMENTS

1. Arrays and Classes
2. Inheritance and Interfaces
3. Packages and Strings
4. Exception handling
5. Multithreading
6. Thread Synchronization
7. File I/O
8. Generic Programming
9. Collections
10. Event driven Programming
11. Database connectivity
12. Mini project

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Develop programs using basic java concepts.
CO2: Prepare java applications employing exception handling and strings
CO3: Construct java applications adopting thread and I/O concepts.
CO4: Solve java programming problems by incorporating Generics and collections.
CO5: Build GUI for java applications with database connectivity.

SEMESTER-IV

21MA205	STOCHASTIC PROCESS AND ITS APPLICATIONS (Common to B.E. CSE / B.Tech. IT)	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To discuss the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To explain the basic probability concepts with respect to two dimensional random variables
- To make use of the basic concepts of random processes which are widely used in IT fields.
- To experiment the significance of advanced queuing models.
- To identify the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering

UNIT I	RANDOM VARIABLES	15

Discrete and Continuous random variables-Moments-Moment Generating Function-Discrete Probability Distribution (Binomial , Poisson & Geometric) - Continuous Probability Distribution (Uniform, Exponential, Normal, Weibull & Gamma)

UNIT II	TWO DIMENSIONAL RANDOM VARIABLES	15

Joint Distributions-Marginal and Conditional Distributions-Covariance-Correlation and Linear Regression.

UNIT III	RANDOM PROCESSES	15

Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.

UNIT IV	QUEUEING MODELS	15

Markovian queues – Birth and Death processes – Single and multiple server queueing models – Little's formula - Queues with finite waiting rooms - Finite source models - M/G/1 queue – Pollaczek Khinchin formula.

UNIT V	NETWORKS, SERIES AND CYCLIC QUEUES	15

Series queues - Open Jackson networks - Closed Jackson networks - cyclic queues - extension of Jackson networks – Non Jackson networks.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the basic concepts of Random variables and standard discrete and continuous distributions.

CO2: Calculate the correlation and regression of two dimensional random variables.

CO3 :Construct the functions of time when the probability measure is associated through random Process.

CO4: Develop the knowledge of various queueing models.

CO5: Solve the given network (open) problem using the suitable techniques.

TEXT BOOKS:

1. Ibe. O.C., "Fundamentals of Applied Probability and Random Processes", 2nd Edition, Academic Press, 2014.

2. Gross. D. and Harris. C.M., "Fundamentals of Queueing Theory", 4th Edition, Wiley & Sons, 2004.

A.P. Pushpalai

3. John.F.Shortle, James M.Thompson, Donald Gross "Fundamentals of Queueing Theory", 5th Edition, Wiley Series, 2018.
4. Sheldon M.Ross, "Introduction to Probability Models". 11th Edition, Academic Press, 2014.

REFERENCES:

1. Robertazzi, "Computer Networks and Systems: Queueing Theory and performance evaluation", 3rd Edition, Springer, 2006.
2. Taha. H.A., "Operations Research", 8th Edition, Pearson Education, Asia, 2007.
3. Trivedi.K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
4. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, 2004.
5. Yates. R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd., Bangalore, 2012.

21CS206	DATA BASE MANAGEMENT SYSTEM *(Common to B.E.CSE / B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of data models and to represent a database system.
- To describe the internal storage structures using different file and indexing techniques which will help in physical DB design.
- To illustrate the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To demonstrate Storage and Query processing Techniques.
- To develop a solutions to the real time problems using NoSQL.

UNIT I **RELATIONAL DATABASES** **9**

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – PL/SQL, Triggers, Embedded SQL– Dynamic SQL.

UNIT II **DATABASE DESIGN** **9**

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT III **TRANSACTIONS** **9**

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT IV **IMPLEMENTATION TECHNIQUES** **9**

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Query optimization using Heuristics and Cost Estimation.

UNIT V **NOSQL DATABASE** **9**

Introduction to NoSQL Database system – Classification of NoSQL Databases : Graph databases – key – value stores – document stores – NoSQL vs SQL – Limitations of NoSQL – Mongo DB document model .

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Build and manipulate relational database using Structured Query Language and relational languages

CO2: Prepare database using ER-Diagram for real time Applications.

CO3:Make use of Normalization techniques to reduce cost due to redundancy constraints

CO4:Illustrate different types of scheduling and recovery techniques for concurrent transactions

CO5:Construct data structures like indexes and hash tables for the fast retrieval of data and Validate the query evaluation plan

TEXT BOOKS:

1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan,," Database System Concepts", 6th Edition, Tata McGraw Hill, 2011.
2. RamezElmasri, Shamkant B. Navathe," Fundamentals of Database Systems", 1st Edition, Pearson Education, 2011
3. Raghu Ramakrishnan, Database Management Systems‖, 4th Edition, McGraw-Hill College Publications, 2015

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan,," An Introduction to Database Systems",8th Edition, Pearson Education, 2006.
2. Elvis C Foster, "Database Systems-A pragmatic Approach"2nd Edition CRC Press,2016
3. G.K.Gupta,"Database Management Systems, 1st Edition, Tata McGraw Hill, 2011.

21CS207	**DESIGN AND ANALYSIS OF ALGORITHM** *(Common to B.E.CSE / B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe about different types of computing problem algorithms and learn how to analyze its efficiency.
- To explain how computing problems are solved using brute force and divide and conquer methods.
- To demonstrate dynamic programming and greedy techniques for solving the problem.
- To construct iterative improvement method for problem solving.
- To illustrate backtracking, branch and bound techniques

UNIT-I INTRODUCTION 9

Introduction to Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and Basic efficiency classes- - Mathematical analysis for Recursive and Non-Recursive algorithms-Example: Fibonacci Numbers

UNIT-II BRUTE FORCE AND DIVIDE-AND-CONQUER 9

Brute Force: Selection sort and Bubble sort-Sequential search and String Matching - Closest-Pair and Convex-Hull Problems-Exhaustive Search: Travelling Salesman Problem-Knapsack Problem- Assignment problem. Divide and Conquer: Binary Search-Merge sort – Quick sort- Multiplication of Large Integers – Strassen's Matrix Multiplication

UNIT-III	DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE	9
Dynamic programming: Coin-row problem, Computing a Binomial Coefficient –The Knapsack problem and Memory functions- Optimal Binary Search Trees – Warshall's and Floyd's algorithm. Greedy Technique: -Dijikstra's Algorithm - Huffman Trees and codes		
UNIT-IV	**ITERATIVE IMPROVEMENT**	**9**
The Simplex Method - The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs, Stable marriage Problem		
UNIT-V	**BACKTRACKING AND BRANCH &BOUND**	**9**
Backtracking: n-Queen problem - Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound: Assignment problem – Knapsack Problem – Travelling Salesman Problem – P,NP-Approximation Algorithms for NP-Hard Problems – Travelling Salesman problem – Knapsack problem		
		TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1:Examine mathematically the notion of algorithm, asymptotic notations, and algorithmic efficiency with properties.

CO2: Discover the efficiency of algorithms of time and space complexity using brute force and divide and conquer strategies.

CO3: Inspect the time and space complexity of the algorithms designed using Dynamic Programming and Greedy techniques.

CO4: Identify various iterative improvement techniques for problem solving

CO5: Construct the best solution for the given problem using backtracking and Branch & Bound technique.

TEXT BOOKS:

1 .Anany Levitin,"Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012.

2.Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, PHI Learning Private Limited, 2012.

3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", 3rd Edition, Pearson Education, Reprint 2006.

REFERENCES:

1. S. Sridhar," Design and Analysis of Algorithms" ,1st Edition, Oxford University Press,2015
2. I. Chandra Mohan," Design and Analysis of Algorithms" ,1st Edition, PHI Learning,2012
3. R.Pannerselvam, Design and Analysis of Algorithms,2nd Edition, PHI Learning,2016

21CS208	**OPERATING SYSTEMS** *(Common to B.E.CSE / B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the working of Assembler, Macro Processor, Loader and Linker.
- To explain Scheduling algorithms and Synchronization.
- To illustrate the concept of Deadlocks.
- To distinguish various memory management schemes.
- To demonstrate I/O management and File systems

UNIT-I	OVERVIEW OF SYSTEM SOFTWARE	9
Assemblers & Macro Processors: Simple Assembly Scheme, Pass Structure of assemblers, Macro Definition and Call, Macro Expansion, Nested Macro Calls, Linkers and Loaders: Introduction, Relocation and linking Concepts and Types of Loaders.		
UNIT-II	OVERVIEW OF OPERATING SYSTEMS	9
Introduction: Computer System Organization, Computer System Architecture, Operating System Operations. Operating System Structure: OS Services, System calls, Types of System Calls, Operating – System Structure, OS Generation and System Boot.		
UNIT-III	PROCESS MANAGEMENT AND DEADLOCK	9
Process Management: Process Synchronization. CPU Scheduling: Scheduling Criteria, Scheduling Algorithms. Deadlock: System Model, Characterization, Deadlock Detection, Deadlock Prevention, Deadlock Avoidance, Deadlock Recovery.		
UNIT-IV	STORAGE MANAGEMENT	9
Memory Management: Main Memory – Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Tables, Segmentation. Virtual Memory: Demand paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.		
UNIT-V	FILE SYSTEMS AND I/O SYSTEMS	9
Mass Storage System-Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, Swap-Space Management; File-System Interface-File Concept, Access Methods, Directory Structure, Directory Organization, File system mounting, File Sharing and Protection; File System Implementation-File System Structure, Directory Implementation, Allocation Methods, Free Space Management, Efficiency and Performance ,Recovery: I/O Systems –I/O Hardware, Application I/O Interface, Kernel I/O subsystem, Streams and Performance.		
		TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Examine the elements with various data structures used in development of language processors.

CO2: Make use of process scheduling, deadlocks and synchronization concepts to develop solutions for Multi-programmed environment.

CO3: Compare and contrast various memory management schemes.

CO4: Discover the functionality of file systems and disk.

CO5: Distinguish various schemes for I/O Management and File Systems.

TEXT BOOKS:

1. Leland L.Beck," System Software - An Introduction to System Programming", 3rd Edition, Pearson Education, 2011.
2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2018.
3. William Stallings, "Operating Systems – Internals and Design Principles", 7th Edition, Prentice Hall, 2017.

REFERENCES:

1. D.M.Dhamdhere ," System Programming", Tata McGraw Hill", 2nd Revised Edition, 2011.
2. Andrew S. Tanenbaum, Albert S.WoodHull," Operating Systems, Design and Implementation", 3rd Edition, Prentice Hall, 2012.
3. Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau,"Operating Systems-Three easy pieces",2nd

Edition, Create Space Independent Publishing Platform,2020

21CS209	INTERNET PROGRAMMING.	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain HTML5 and CSS3 elements to create webpages
- To describe java scripts to build interactive webpages at client side.
- To demonstrate java servlets and JSP for building web application with client server communication
- To build dynamic web applications using PHP and AJAX
- To construct web application using web services and XML

UNIT-I	WEBSITE BASICS, HTML 5, CSS 3	9

Web Essentials: Clients, Servers and Communication – The Internet – Basic Internet protocols – World wide web – HTTP Request Message – HTTP Response Message – HTML5 –Basic HTML Elements-Tables – Lists – Image – HTML5 control elements –Audio – Video controls - CSS3 – Inline, embedded and external style sheets – Backgrounds – Border Images –Colors – Shadows – Text – Transformations – Transitions – Animations

UNIT-II	CLIENT SIDE SCRIPTING	9

Java Script: An introduction to JavaScript–Control Statements – Functions- Arrays- JavaScript alert, prompt and confirm – Objects - Events- Regular Expressions- Validation-JQuery-Syntax-Selectors -Events- Effects

UNIT-III	SERVER SIDE PROGRAMMING	9

Servlets: Java Servlet Architecture- Servlet Life Cycle- Form GET and POST actions- Session Handling- Understanding Cookies- DATABASE CONNECTIVITY: JDBC perspectives, JDBC program example - JSP: Understanding Java Server Pages-JSP Standard Tag Library (JSTL)-Creating HTML forms by embedding JSP code

UNIT-IV	PHP and AJAX	9

An introduction to PHP: PHP- Using PHP- Variables- Program control- Built-in functions- Form Validation- Regular Expressions - –Cookies - Connecting to Database. AJAX: Ajax Client Server Architecture-XML Http Request Object

UNIT-V	XML and WEB SERVICES	9

XML: Basic XML- Document Type Definition- XML Schema , XSL and XSLT Transformation Web Services: Introduction- Java web services Basics – Creating, Publishing, Testing and Describing a Web services (WSDL)-Consuming a web service, Database Driven web service from an application –SOAP

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Construct Web pages using HTML/XML and style sheets.

CO2: Build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms.

CO3: Prepare dynamic web pages using server side scripting.

CO4: Make use of PHP programming to develop web applications.

CO5: Develop web applications using AJAX and web services.

TEXT BOOKS:

1. Deitel and Deitel and Nieto, "Internet and World Wide Web - How to Program", 5th Edition, Prentice Hall, 2011.
2. Jeffrey C and Jackson, "Web Technologies A Computer Science Perspective", 1st Edition, Pearson Education, 2011.
3. Chris Bates, "Web Programming – Building Intranet Applications", 3rd Edition, Wiley Publications, 2009

REFERENCES:

1. Stephen Wynkoop and John Burke, "Running a Perfect Website", 2nd Edition. QUE, 1999.
2. Gopalan N.P. and Akilandeswari J., "Web Technology", 1st Edition, Prentice Hall of India, 2011.
3. UttamK.Roy, "Web Technologies", 1st Edition, Oxford University Press, 2011

21CS210	DATABASE MANAGEMENT SYSTEMS LABORATORY *(Common to B.E.CSE / B.Tech.IT)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To explain data definitions and data manipulation commands
- To illustrate the use of nested and join queries
- To describe functions, procedures and procedural extensions of data bases
- To make use of a front end tool
- To construct the database applications

LIST OF EXPERIMENTS

1. Data Definition Language Commands
2. Data Manipulation Language Commands
3. Data Control Language Commands, Nested queries
4. Set Operators and Join Queries
5. Views, Sequences, Synonyms
6. Database Programming using PL/SQL
7. PL/SQL – Triggers
8. PL/SQL – Functions
9. PL/SQL – Procedures
10. PL/SQL – Cursors
11. Database Connectivity with Front End Tools
12. Document database creation using Mongo DB
13. Case Study using real life database applications

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will able to

CO1: Use data definition language commands and declare and enforce integrity constraints on a database.
CO2: Populate and query a database using simple SQL queries and complex SQL queries.
CO3: Make use of database objects such as views, sequences and synonyms using SQL.
CO4: Prepare database Triggers, stored procedures, stored functions and cursors using PL/SQL.
CO5: Construct Mongo DB for database creation.

21CS211	**OPERATING SYSTEMS LABORATORY** *(Common to B.E.CSE / B.Tech.IT)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To describe the process involved in Assembler, Macro Processor, Loader and Linker.
- To illustrate Process Creation and Inter Process Communication.
- To demonstrate Deadlock Avoidance and Deadlock Detection Algorithms
- To explain Page Replacement Algorithms
- To discuss File Organization and File Allocation Strategies

LIST OF EXPERIMENTS

1. Implementation of Single Pass Assembler.
2. Implementation of Multi Pass Assembler.
3. Given the list of processes, their CPU burst times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.
4. Given the list of processes, their CPU burst times display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.
5. Implement the Producer – Consumer problem using semaphores.
6. Developing Application using Inter Process Communication (using shared memory, pipes or message queues.
7. Implementation of Deadlock Avoidance using Bankers algorithm.
8. Implementation the following Memory Allocation Methods for fixed partition
   i. a) First Fit b) Worst Fit c) Best Fit
9. Implement the Paging Technique of Memory Management.
10. Implement the following Page Replacement Algorithms
    a) FIFO b) LRU c) Optimal
11. Implement the following File Allocation Strategies
    a) Sequential b) Indexed c) Linked
12. Implement Disk Management using Algorithms such as FCFS, SSTF, SCAN and C- SCAN.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Develop the programs on Assembler, Macro Processor, Loader and Linker

CO2:Make use of Scheduling Algorithms such as FCFS, SJF , Priority and Round Robin to schedule a given set of processes.

CO3: Utilize Banker's Algorithm for Deadlock avoidance.

CO4: Infer Solutions to Critical Section Problem using Semaphores.

CO5: Compare the performance of the various Memory management techniques.

21CS212	**INTERNET PROGRAMMING LABORATORY**	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To explain HTML5 and CSS3 elements to create webpages
- To describe java scripts to build interactive webpages at client side.

- To demonstrate java servlets and JSP for building web application with client server communication
- To build dynamic web applications using PHP and AJAX
- To construct web application using web services and XML

LIST OF EXPERIMENTS

1. Create a web page with the following using HTML
   i. To embed an image in a web page
   ii. To fix the hot spots in that image
   iii. Show all the related information when the hot spots are clicked.
2. Create a web page with the following
   i. Cascading style sheets.
   ii. Embedded style sheets.
   iii. Inline style sheets..
3. Form validation using JavaScript.
4. Access and Modify web page using JQuery effects.
5. Write programs in Java using Servlets
   i. To invoke servlets from HTML forms
   ii. Session tracking using hidden form fields and cookies
6. Write programs in Java to create three-tier applications using servlets. Assume that the information is available in a database server.
7. Server side programs using JSTL.
8. i. Validate the form using PHP regular expression.
   ii. Creating AJAX application using PHP and MYSQL
9. i. Validating XML using XML Schema
   ii. Transforming XML using XSL and XSLT
10. Creating, publishing and testing web services

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Construct Web pages using HTML/XML and style sheets.

CO2: Build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms.

CO3: Prepare dynamic web pages using server side scripting.

CO4: Make use of PHP programming to develop web applications.

CO5: Develop web applications using AJAX and web services.

SEMESTER-V

21CS301	THEORY OF COMPUTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate the different types of finite automata and regular languages.
- To recognize the context free grammars
- To describe about push down automata.
- To illustrate the working of Turing machines

- To make use of Decidability and Un-decidability of various problems.

UNIT-I	AUTOMATA FUNDAMENTALS	7
Chomskian Hierarchy-Introduction to Automata Theory-Alphabets, Strings and Languages, Finite Automata- Deterministic finite Automata (DFA)-Nondeterministic finite Automata (NFA)-Finite Automata with epsilon transition.		
UNIT-II	**REGULAR EXPRESSIONS AND LANGUAGES**	**11**
Operation of regular expression and their precedence-Finite Automata and Regular expression-DFA to Regular Expression-Regular expression to Finite Automata-Algebric laws of Regular Expression- Pumping Lemma for regular Languages, Closure properties of Regular Languages-Equivalance and Minimization of Finite Automata.		
UNIT-III	**CONTEXT FREE GRAMMAR AND LANGUAGES**	**9**
Context Free Grammar-Parse tree-Ambiguity in Grammar and Language- Simplification of CFGs- Normal forms for CFGs – Chomsky Normal Form,Greibach Normal Form- Closure properties of CFLs-Pumping lemma for CFLs.		
UNIT-IV	**PUSHDOWN AUTOMATA AND LINEAR BOUNDED AUTOMATA**	**9**
PUSH DOWN AUTOMATA (PDA): Definition of PDA- Language of PDA-Equivalence of PDA and CFG- Deterministic PDA. LINEAR BOUNDED AUTOMATA (LBA):Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG.		
UNIT-V	**TURING MACHINES AND UNDECIDABILITY**	**9**
Turing Machine-Programming Techniques for TM, Variations of TM- Universal TM. Non Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM – Post's Correspondence Problem.		

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Construct finite automata to recognize the patterns for the real world problems.

CO2:Make use of algebraic laws and properties to write a regular language

CO3:Simplify the context free grammar by applying normal forms

CO4: Construct Pushdown automata and linear bound automata for the given Language.

CO5: Examine the suitable programming techniques for the construction of Turing Machine.

TEXT BOOKS:

1. Hopcroft J.E., Motwani R. and Ullman J.D, "Introduction to Automata Theory, Languages and Computations", 3rd Edition, Pearson Education, 2008.
2. John C Martin, "Introduction to Languages and the Theory of Computation", 4th Edition, Tata McGraw Hill Publishing Company, New Delhi, 2010.
3. Mishra K L P and Chandrasekaran N, "Theory of Computer Science - Automata, Languages and Computation", 3rd Edition, Prentice Hall of India, 2007.

REFERENCES:

1. Harry R Lewis and Christos H Papadimitriou, "Elements of the Theory of Computation", 2nd Edition, Prentice Hall of India, Pearson Education, New Delhi, 2015.
2. Peter Linz, "An Introduction to Formal Language and Automata", 3rd Edition, Narosa Publishers, New Delhi, 2016.
3. Kamala Krithivasan and Rama. R, "Introduction to Formal Languages, Automata Theory and Computation",1st Edition, Pearson Education 2009

21MCCS01	CONSTITUTION OF INDIA	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- To explain the basic features and fundamental principles of Constitution of India.
- To explain the salient features and characteristics of the Constitution of India
- To explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers
- To explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India
- To explain the Local Self Government – Constitutional Scheme in India

TOPICS TO BE COVERED

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States.
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India.
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21 ·

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the meaning of the constitution law and constitutionalism and Historical perspective of the Constitution of India.

CO2: Explain the salient features and characteristics of the Constitution of India, scheme of the fundamental rights and the scheme of the Fundamental Duties and its legal status.

CO3: Explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers between the Union and the States, and Parliamentary Form of Government in India.

CO4: Explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India, and Emergency Provisions.

CO5: Explain the Local Self Government – Constitutional Scheme in India, Scheme of the Fundamental Right to Equality.

TEXT BOOKS:

1. Durga Das Basu,"Introduction to the Constitution of India", LexisNexis Butterworth's Wadhwa, 20th Edition, Reprint 2011.
2. Web link: https://www.india.gov.in/my-government/ constitution-India.

21CS302	COMPUTER NETWORKS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To describe the Network Architecture and the performance metrics of switched networks.
- To demonstrate the various Link layer services..
- To explain the concepts of subnetting and routing mechanisms.
- To illustrate the process-to-process delivery models and congestion control principles.
- To summarize the services of various protocols in Application layer.

UNIT-I | INTRODUCTION AND PHYSICAL LAYER | 9

Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.

UNIT-II | DATA LINK LAYER | 9

Introduction – Link-Layer Addressing – Error Detection and Correction– DLC Services-Framing –Data Link Layer Protocols – HDLC – PPP - Media Access Control –Random access- Wired LANs: Ethernet - Wireless LANs –IEEE 802.11- Connecting Devices.

UNIT-III | NETWORK LAYER | 9

Network Layer Services– IPV4 Addresses-Classful Addressing-Classless Addressing-Dynamic Host Configuration Protocol (DHCP)- Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms and Protocols- IPV6 Addressing.

UNIT-IV | TRANSPORT LAYER | 9

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

UNIT-V | APPLICATION LAYER | 9

World Wide Web and HyperText Transfer Protocol – File Transfer Protocol – Electronic Mail –Telnet – Secure Shell – Domain Name System – Simple Network Management Protocol.

45 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Make use of various networking commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine.
2. Design a topology using PCs and Switch with configuration of IP address and Observe the flow of data from host to host by creating network traffic.
3. Create a Network scenario and examine dynamically learning configured Switch MAC address table and ARP Cache table using simulation tool.
4. Simulation of Error correction and detection techniques.
5. Create a Network Scenario and assign subnet IP Addresses to various Network Devices and Verify the Connectivity using simulation tool.
6. Create a Network scenario with multiple routers and configure using RIP Routing in simulation tool.
7. Create a Network scenario with multiple routers and configure using OSPF Routing in simulation tool.
8. Create a Network scenario and generate the network traffic to examine the TCP/UDP communication using Simulation tool.

9. Implement the applications using TCP /UDP sockets like:
    - Chat
    - File transfer

10. Setting up DNS, HTTP, DHCP and E-mail server using simulation tool.

TOTAL:75 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Make use of evaluation metrics to measure the performance of packet switched network.

CO2: Utilize the Link layer services for various IEEE standards.

CO3: Experiment with subnetting to optimize network configuration and various routing algorithms for unicast routing.

CO4: Choose protocols for Process to Process communication in various application.

CO5: Utilize application layer protocols for real time Scenario.

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, Tata McGraw Hill, 2017.
2. William Stallings, "Data and Computer Communication", 10th Edition, Pearson Education, 2022.
3. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", 6th Edition, Morgan Kaufmann Publishers Inc., 2017.

REFERENCES:

1. Nader F. Mir, "Computer and Communication Networks", 2nd Edition, Prentice Hall, 2015.
2. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", 8th Edition, Pearson Education, 2022
3. Mulayam Singh, "CISCO PACKET TRACER LABS: Best practice of configuring or troubleshooting Network", 1st Edition, BookRix, 2019.

21CS303	ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To infer knowledge in various search algorithms for problem solving.
- To relate uncertainty in causal networks through probabilistic reasoning.
- To extend the knowledge representation in solving AI based problems.
- To contrast the knowledge in supervised Machine learning algorithms
- To demonstrate unsupervised Machine learning algorithms and ensemble techniques.

UNIT-I PROBLEM SOLVING 9

Introduction to AI - AI Applications - Problem solving agents – search algorithms – uninformed search strategies – Heuristic search strategies – Local search and optimization problems – adversarial search – constraint satisfaction problems (CSP)

UNIT-II PROBABILISTIC REASONING 9

Acting under uncertainty – Bayesian inference – Naïve Bayes models. Probabilistic reasoning – Bayesian networks – exact inference in BN – approximate inference in BN – causal networks

UNIT-III KNOWLEDGE REPRESENTATION 9

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining - Backward Chaining –Resolution– Knowledge Representation - Ontological Engineering - Categories and Objects – Events -

Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information		
UNIT-IV	**SUPERVISED LEARNING**	**9**
Introduction to machine learning – Linear Regression Models -Least squares - single & multiple variables- Bayesian linear regression- gradient descent- Linear Classification Models- Discriminant function – Probabilistic discriminative model - Logistic regression - Probabilistic generative model – Naive Bayes- Maximum margin classifier – Support vector machine - Decision Tree - Random forests		
UNIT-V	**UNSUPERVISED LEARNING AND ENSEMBLE TECHNIQUES**	**9**
Unsupervised learning - K-means - Instance Based Learning –KNN - Gaussian mixture models and Expectation maximization-Combining multiple learners- Model combination schemes – Voting- Ensemble Learning – bagging -Boosting – stacking		
		45 PERIODS
PRACTICAL EXERCISES:		**30 PERIODS**

1. Create the Tic-Tac-Toe game using any adversarial searching algorithm.
2. Design the Towers of Hanoi problem using search algorithms.
3. Create the environment for probabilistic inference using a Bayesian network.
4. Design a program using naïve Bayesian classifier for a sample training data set stored as a .CSV file.
5. Model the Greedy Best-First and A* search algorithms in generic ways.
6. Design a program in k-Nearest Neighbour algorithm to classify the iris data set.
7. Model the K-Means Algorithm for Colour Compression.
8. Create Linear Regression models using Python
9. Model the Decision Trees for data classification, using the real-time data set.
10. Design data classification for the real-time data set using Support Vector Machine

TOTAL :75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Choose appropriate search algorithms for AI based problems. .

CO2: Make use of reasoning under uncertainty in Bayesian networks.

CO3:Utilize first order and predicate logic to solve AI based problems

CO4: Identify and apply Supervised Machine Learning algorithms to solve real world problems.

CO5: Build classifier models using Machine Learning algorithms for unstructured data.

TEXTBOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", 4th Edition, Pearson Education,2021
2. Ethem Alpaydin,"Introduction to MachineLearning",4th Edition,MIT Press,2020.
3. Saikat Dull, S. Chjandramouli, Das, "Machine Learning ",1st Edition, Pearson,2018

REFERENCES:

1. Kevin Night,Elaine Rich,andNairB., "Artificial Intelligence",3rd Edition, McGraw Hill,2017
2. Mehryar Mohri, Afshin Rostamizadeh and Ameet Talwalkar, "Foundations of Machine Learning", 2nd Edition, MIT Press, 2018.
3. Deepak Khemani,"Artificial Intelligence", 2nd Edition,Tata McGraw Hill Education,2013

21CS304	OBJECT ORIENTED SOFTWARE ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To describe the knowledge wider in Software engineering concepts and engineering Process.
- To build Software Engineering Development Activities for efficient software systems.
- To familiarize using UML modeling to articulate complex ideas succinctly and precisely.
- To explain the importance of testing through various testing activities.
- To choose various project management techniques to maintain quality assurance.

UNIT - I	INTRODUCTION TO SOFTWARE ENGINEERING	9

Software Engineering- Software Engineering As A Branch Of The Engineering Profession- Stakeholders In Software Engineering-Software Quality- Software Engineering Projects - Activities Common To Software Projects

UNIT – II	SOFTWARE ENGINEERING DEVELOPMENT ACTIVITIES	9

Requirements Elicitation -Analysis -Types Of Requirements - Types Of Requirements Document- System Design -Object Design - Implementation –Testing.

UNIT – III	MODELING WITH UML	9

Introduction -An Overview Of UML -Use Case Diagrams- Class Diagrams Interaction Diagrams- State Machine Diagrams -Activity Diagrams

UNIT – IV	TESTING	9

Introduction: Testing The Space Shuttle - An Overview Of Testing - Testing Concepts - Faults, Erroneous States, And Failures - Test Cases - Test Stubs And Drivers - Corrections - Testing Activities - Component Inspection -Usability Testing - Unit Testing - Integration Testing - System Testing - Managing Testing .

UNIT – V	MANAGING THE SOFTWARE PROCESS	9

Project Management-Software Process Models -Cost Estimation -Building Software Engineering Teams -Project Scheduling And Tracking -Contents Of A Project Plan -Difficulties And Risks In Project Management.

45 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Develop a SRS document for an application.
2. Develop the Use Case model for an application.
3 .Develop an UML Activity diagram by Identifying the business activities.
4. Identity the conceptual classes to develop a refinement domain model for an application.
5. Build the Interaction diagram for a scenario by identifying suitable objects.
6. Identify the User Interface, Domain objects, and Technical services. Draw the partial layered, logical architecture diagram with UML package diagram notation.
7. Develop Component and Deployment diagrams for an application.

TOTAL:75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to :

CO1: Illustrate the fundamental concepts of software engineering to build software projects
CO2. Develop SRS document for a real-time application
CO3. Identify various Modeling with UML diagrams based on software requirements to construct UML Diagrams
CO4. Examine key techniques involved in testing the software based on requirements
CO5.Examine various software development process and requirement management techniques

TEXT BOOKS:
1. Bernd Bruegge,Allen H.Dutoit,"Object-Oriented Software Engineering Using UML, Patterns, and Java", 3rd Edition, Pearson Education 2018. 2. Roger Pressman, "Software Engineering: A Practitioner's Approach", 7th Edition, McGraw-Hill, 2020. 3. Ian Sommerville, "Software Engineering", 9th Edition, Addison-Wesley, 2016
REFERENCES:
1. Rajib Mall, "Fundamentals of Software Engineering", 4th Edition, PHI Learning Publications 2020. 2. G.P. Bherde Deven, N. Shah, "Object Oriented Software Engineering", 4th Edition,DreamTech Publisher 2010. 3. Grady Booch, Robert A. Maksimchuk, Michael W. Engle, Bobbi J. Young, Ph.D., Jim Conallen, Kelli A. Houston ,"Object-Oriented Analysis and Design with Applications",3rd Edition, Addison Wesley 2007.

SEMESTER- VI

21CS305	COMPILER DESIGN	L	T	P	C
		3	2	0	4
COURSE OBJECTIVES: • To describe the fundamental principles in compiler design. • To construct lexical analyzer for the various programming language tokens. • To discover the skills needed for building parser for the various programming Language grammatical constructs. • To illustrate the runtime storage management and various storage organizations. • To classify a modern high-level language to executable optimized target code.					
UNIT-I	**INTRODUCTION AND LEXICAL ANALYSIS**				**15**
Introduction: Process of Compilation - Phases of Compiler - Grouping of Phases - Cousins of Compiler – Assemblers-Linkers-Loaders- Compiler Construction Tools Lexical Analyzer: Role Of The Lexical Analyzer - Input Buffering - Specification of Tokens - Recognition Of Tokens - Language For Specifying Lexical Analyzer					
UNIT-II	**SYNTAX ANALYSIS**				**15**
Need and Role of the Parser - Context Free Grammars –Writing Grammars- Top Down Parsing - Recursive Descent Parser - Predictive Parser - Bottom Up Parsing - Shift Reduce Parser – Operator Precedence Parser LR Parsers -SLR, CLR And LALR Parsing Table –Error Recovery In Parsers - Syntax Analyzer Generators					
UNIT-III	**INTERMEDIATE CODE GENERATION**				**15**
Syntax Directed Definitions - Construction of Syntax Tree - Intermediate Languages - Declarations - Assignment Statements - Arithmetic Expression Evaluation In Assignment Statements - Boolean Expressions - Case Statements - Back Patching- Procedure Calls					
UNIT-IV	**TYPE SYSTEM AND RUN-TIME ENVIRONMENT**				**15**
Type Systems- Specification of a Simple Type Checker - Run-Time Environments: Source Language Issues-Storage Organization - Stack Allocation Space - Access to Non-Local Data on the Stack - Heap Management					
UNIT-V	**CODE OPTIMIZATION AND CODE GENERATION**				**15**

Code Optimization: Principal Sources of Optimization - DAG - Optimization of Basic Blocks - Global Data Flow Analysis.

Code Generation: Issues in Design of a Code Generator – Simple Code Generator Algorithm -Register Allocation And Assignment - Generating Code From Dags

TOTAL :75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Construct the Deterministic Finite Automata and simulate using LEX Tool

CO2: Build a suitable parser for the Context free Grammar to validate the given inputs and simulate using YACC tool

CO3:Construct the semantics rules for the given context free grammar and generate the intermediate code for programming construct

CO4:Apply various types of local and global optimization techniques for the given Programming construct

CO5:Develop a target program for the given programming language construct

TEXT BOOKS:

1. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman, "Compilers: Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2013.
2. Keith D. Cooper and Linda Torczon," Engineering a Compiler", 2nd Edition, Morgan Kaufmann Publishers Elsevier Science, 2012.
3. Des Watson," A Practical Approach to Compiler Construction", 1st Edition, Springer International Publishing, 2017.

REFERENCES:

1. Randy Allen, Ken Kennedy, "Optimizing Compilers for Modern Architectures: A Dependence-based Approach", 1st Edition, Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, "Advanced Compiler Design and Implementation, "1st Edition, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.
3. Charles N. Fischer, Richard. J. LeBlanc, "Crafting a Compiler with C", 1st Edition, Pearson Education, 2008.

21CS306	DISTRIBUTED SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the foundation and challenges of distributed systems
- To infer the knowledge of message ordering and group communication
- To demonstrate the distributed mutual exclusion and deadlock detection algorithms.
- To predict the significance of check pointing and rollback recovery algorithms
- To summarize the characteristics of peer-to-peer and distributed shared memory systems

UNIT-I INTRODUCTION 9

Introduction: Definition – Characteristics–Relation to computer system components –Motivation – Message-passing systems versus shared memory systems –Primitives for distributed communication – Synchronous versus asynchronous executions –Challenges of Distributed system: System Perspective. A model of distributed computations: A distributed program –A model of distributed executions –Models of communication networks –Global state – Cuts of a distributed computation.

UNIT-II	MESSAGE ORDERING AND GROUP COMMUNICATION	9
Message ordering and group communication: Message ordering paradigms –Asynchronous execution with synchronous communication –Synchronous program order on an asynchronous system –Group communication – Causal order (CO) - Total order.		
UNIT-III	**DISTRIBUTED MUTEX & DEADLOCK**	**9**
Distributed mutual exclusion algorithms: Introduction – Preliminaries – Lamport's algorithm – Ricart-Agrawala algorithm – Maekawa's algorithm – Suzuki–Kasami's broadcast algorithm. Deadlock detection in distributed systems: Introduction – System model – Preliminaries – Models of deadlocks – Knapp's classification		
UNIT-IV	**CHECKPOINTING AND ROLLBACK RECOVERY**	**9**
Introduction – Background and definitions – Issues in failure recovery – Checkpoint-based recovery – Log-based rollback recovery – Koo–Toueg coordinated checkpointing algorithm – Juang–Venkatesan algorithm for asynchronous checkpointing and recovery.		
UNIT-V	**P2P & DISTRIBUTED SHARED MEMORY**	**9**
Peer-to-peer computing and overlay graphs: Introduction – Data indexing and overlays –Content addressable networks – Tapestry. Distributed shared memory: Abstraction and advantages – Types of memory consistency models		
		TOTAL: 45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Illustrate the models of communication in building a distributed environment

CO2: Interpret the order of message in communication network for synchronous and asynchronous system

CO3: Use the Mutex and Deadlock detection algorithm in real time application

CO4: Discover the issues of check pointing and rollback recovery mechanisms in distributed environment

CO5: Relate the features of peer-to-peer and memory consistency models for a given application.

TEXT BOOKS:

1. George Coulouris, Jean Dollimore and Tim Kindberg, "Distributed Systems Concepts and Design", 5th Edition, Pearson Education, 2017
2. Tanenbaum A.S., Van Steen M., "Distributed Systems: Principles and Paradigms", 2nd Edition ,Pearson Education, 2017.
3. Kshemkalyani, Ajay D, and Mukesh Singhal," Distributed computing: principles, algorithms, and Systems",1st Edition, Cambridge University Press, 2012.

REFERENCES: :

1. Liu M.L., "Distributed Computing, Principles and Applications", 4th, Pearson Education, 2019.
2. Brendon Burns, "Designing Distributed Systems", OReilly Publication, 1st Edition, 2018
3. Pradeep K Sinha, "Distributed Operating Systems: Concepts and Design", 1st Edition, Prentice Hall of India, 2012.

21MCCS02	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- To explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge.
- To explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.

- To explain about the use of Traditional Knowledge to meet the basic needs of human being.
- To explain the rich biodiversity materials and knowledge preserved for practicing traditional lifestyle.
- To explain the use of Traditional Knowledge in Manufacturing and Industry.

UNIT-I	TRADITIONAL AND MODERN KNOWLEDGE	3

Two Worlds of Knowledge - Phase of Explorers, Sir Arthur Cotton and Irrigation, Smallpox Vaccination, Late Nineteenth Century, Voelcker, Howard and Agriculture, Havell and Indian Art; Indians at the Encounter - Gaekwad of Baroda and Technical Education, Science Education and Modern Industries, Hakim Ajmal Khan and Ayurveda, R. N. Chopra and Indigenous Drugs, Gauhar Jaan and Indian Classical Music; Linking Science and the Rural - Tagore's Sriniketan Experiment, Marthandam, the YMCA Model, Gandhi's Thoughts on Development, Nehru's View of Growth; Post- Independence Era - Modernization and Traditional Knowledge, Social Roots of Traditional Knowledge Activism, Global Recognition for Traditional Knowledge.

UNIT-II	PROTECTION AND SHARING	3

For Recognition and Protection - United Nations Educational, Scientific and Cultural Organization (UNESCO), World Health Organization (WHO), International Labour Organization (ILO), UN Working Group on Indigenous Populations, Evolution of Other Organizations; Norms of Sharing - United Nations Environment Programme (UNEP), World Intellectual Property Organization (WIPO), World Trade Organization (WTO); IPR and Traditional Knowledge - Theoretical Background, Positive Protections of TK, Defensive Strategies, IPR Facilitation for TK.

UNIT-III	TRADITIONAL KNOWLEDGE FOR BASIC NEEDS	3

Indian Midwifery Tradition—The Dai System, Surface Flow Irrigation Tanks, Housing - A Human Right, Changing Priorities—Niyamgiri.

Biodiversity and Genetic Resources: Jeevani - The Wonder Herb of Kanis, A Holistic Approach - FRLHT, Basmati - In the New Millennium, AYUSH-Based Cosmetics.

UNIT-IV	TRADITIONAL KNOWLEDGE IN MANUFACTURING	3

Drug Discovery, A Sweetener of Bengal, The Sacred Ring of Payyanur, Channapatna Toys.

UNIT-V	TRADITIONAL CULTURAL EXPRESSIONS	3

Banarasi Saree, Music, Built and Tangible Heritage, Modern Yoga, Sanskrit and Artificial Intelligence, Climate Change and Traditional Knowledge.

TOTAL :15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge.

CO2: Explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.

CO3: Explain about the use of Traditional Knowledge to meet the basic needs of human being.

CO4: Explain the rich biodiversity materials and knowledge preserved for practicing traditional lifestyle.

CO5: Explain the use of Traditional Knowledge in Manufacturing and Industry.

TEXT BOOKS:

1. Nirmal Sengupta "Traditional Knowledge in Modern India Preservation, Promotion, Ethical Access and Benefit Sharing Mechanisms" Springer, 2019.
2. Amit Jha,"Traditional Knowledge System in India", Atlantic Publishers and Distributors Pvt Ltd, 2009.
3. Basanta Kumar Mohanta, Vipin Kumar Singh "Traditional Knowledge System and Technology in India", Pratibha Prakashan, 2012.
4. Kapil Kapoor, Michel Danino "Knowledge Traditions and Practices of India", Central Board of Secondary

Education, 2012.

WEB REFERENCES :

1.NPTEL video lecture on "Ayurvedic Inheritance of India",
Video link: https://nptel.ac.in/courses/121/106/121106003/#.
2. Youtube video on "Introduction to Indian Knowledge Systems",
Video link: https://www.youtube.com/watch?v=LZP1StpYEPM.
3.Youtube video on "12 Great achievements of Indian Civilization",
Video link: https://www.youtube.com/watch?v=xmogKGCmclE.

21CS307	EMBEDDED SYSTEMS AND IoT	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To demonstrate the internal architecture and programming of an embedded processor.
- To develop embedded C code for I/O interfacing.
- To outline the features of smart objects, IoT architectures and protocols.
- To build simple IoT system using Arduino/Raspberry Pi/open platform.
- To apply the concept of Internet of Things in real world scenario

UNIT-I | EMBEDDED PROCESSOR — 9

8051 Microcontroller – Architecture – Instruction Set and Assembly Language Programming – Memory and I/O Devices Interfacing -Programming Parallel Ports – Timers and Serial Port – Interrupt Handling – LCD and Keyboard interface - Stepper motor interface

UNIT-II | EMBEDDED C PROGRAMMING — 9

Basic techniques for reading from port pins, creating delay using Timer 0 and Timer 1 –Timeout mechanisms: Creating and testing loop timeouts-Creating and testing hardware timeout –Serial Port and Interrupt programming

UNIT-III | FUNDAMENTALSOF INTERNET OF THINGS — 9

Overview of IoT - Physical Design of IoT – Logical Design of IoT: Functional Block, Communication models and APIs - IoT Enabling Technologies – IoT Levels and Deployment Templates - Smart Objects: The Things in IoT, Sensors and Actuators

UNIT-IV | IoT OPEN PLATFORMS — 9

IoT system building blocks –Arduino – Arduino Toolchain – Arduino Programming Structure – Integration of Sensors and Actuators with Arduino -Raspberry Pi Architecture and Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving Signals Using GPIO Pins – Connecting to the Cloud.

UNIT-V | APPLICATIONS OF EMBEDDED IoT — 9

Smart and Connected Cities - Home Automation – Smart Agriculture – Smart Grids – Smart Healthcare – IoT for environment monitoring, Cisco IoT system - IBM Watson IoT platform

45 PERIODS

PRACTICAL EXERCISES: **30 PERIODS**

1. Develop Assembly Language programs for ALU operations in 8051 microcontrollers
2. Interface and control an LED with embedded Processor
3. Perform speed control of stepper motor with embedded processor
4. Light Intensity control using Arduino.
5. Temperature notification using Arduino.
6. IoT Data Logging using Beaglebone Black and Thingspeak

7. Turn the smartphone into an IoT device using the IBM Watson IoT Platform cloud-hosted service
TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of assembly language to interface I/O devices with 8051 microcontrollers.

CO2: Utilize embedded C for programming timers and interrupts.

CO3: Summarize the fundamentals of IoT architecture and its protocols.

CO4: Develop portable IoT systems using Arduino/Raspberry Pi /open platform.

CO5: Make use of IoT and its protocols in developing the model for real time application.

TEXT BOOKS:

1. Muhammed Ali Mazidi, Janice Gillispie Mazidi, Rolin D. McKinley, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education, 2014.
2. Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", 1st Edition, Universities Press, 2015.
3. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry, Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", 1st Edition, CISCO Press, 2017.

REFERENCES:

1. David Etter, "IOT (Internet of Things) Programming: A Simple and Fast Way of Learning", IOT Kindle Edition, 2016.
2. Wayne Wolf, "Computers as Components: Principles of Embedded Computer System Design", Elsevier, 3rd Edition, 2012.
3. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1stEdition, McGraw Hill, 2017

21EN301	**PROFESSIONAL COMMUNICATION LABORATORY** *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To enhance effective communication skills that can lead to improved interpersonal relationships.
- To encourage and motivate students to set and achieve goals.
- To prepare students for an organized work life with confidence.
- To encourage students to participate in group discussion with positive attitude.
- To develop their confidence and help learners to attend interviews successfully.

UNIT I	COMMUNICATION AND PROFESSIONAL ETIQUETTES	6

Importance and Types of Communication Verbal communication -Presentation skills- Non-Verbal communication - Personal Appearance, Posture, Gestures, Facial Expressions, Eye Contact and Space Distancing - Professional Etiquettes.

UNIT II	GOAL SETTING AND MOTIVATION	6

Short term and Long term Goals- Strategies to set and achieve goals- Motivation.

UNIT III	TIME AND STRESS MANAGEMENT	6

Importance of Time - Time Management Skills - Sources of Stress - Managing Stress - Analysis of the Case Studies on time and stress management.

UNIT IV	GROUP DISCUSSIONS AND POSITIVE ATTITUDE	6

Group Discussions - Leadership Qualities - Decision Making - Problem Solving - Negotiation Skills - Positive Attitude.

UNIT V	RESUME MAKING AND INTERVIEW SKILLS	6

Preparing Resume - E-Resume - Covering Letter - Job Application through email - Career Portfolio -Types of Interviews - Mock Interviews.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Demonstrate effective communication skills through presentations.

CO2: Utilize their knowledge of motivation in setting and achieving goals.

CO3: Examine time and stress management.

CO4: Formulate their ideas into an effective communication in formal contexts.

CO5: Develop a well-composed resume and face interviews confidently.

TEXT BOOK:

1. Dhanavel S P, "English and Soft Skills", 1st Edition, Orient Black Swan Ltd, Hyderabad: 2012.
2. Dr.Tobin Porterfield and Bob Graham, "The 55 Soft Skills That Guide Employee and Organizational Success", Mason-West Publishing House, January, 2018.
3. Prashant Sharma, "Soft Skills Personality Development for Life Success", BPB Publications, New Delhi, January 2018.

REFERENCES:

1. M. Ashraf Rizvi, "Effective Technical Communication", Tata McGraw Hill Education Pvt. Ltd. New Delhi, 2016.
2. Mohan Krishna and Meera Banerji, "Developing Communication Skills", 1st Edition, Trinity Press, 2017.
3. N. Krishnaswami and T. Sriraman, "Creative English for Communication", 3rd Edition, Laxmi Publications Private Limited, 2017.

SEMESTER- VII

21CS401	CRYPTOGRAPHY AND NETWORK SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the OSI security architecture and classical encryption techniques.
- To demonstrate mathematical foundation and various ciphers in symmetric key cryptosystem.
- To interpret the Asymmetric key cryptosystem using various ciphers.
- To illustrate the message integrity and Authentication schemes.
- To explain the Network and System security services.

UNIT-I INTRODUCTION 9

Computer Security concepts- OSI security architecture: Security Attacks, Security Services, Security Mechanisms -Fundamental security Design Principles-Attack Surfaces and Attack Trees -A Model of Network Security – Classical encryption techniques: Symmetric Cipher Model- Substitution Techniques-Transposition Techniques-Rotor Machines-Steganography.

UNIT-II SYMMETRIC KEY CRYPTOGRAPHY 9

Mathematics of Symmetric Key Cryptography: Algebraic structures – Modular arithmetic-Euclid's algorithm-Congruence and matrices - Finite Fields: Groups-Ring- Fields- Symmetric Key Ciphers: SDES-DES- Strength of DES - Block cipher design principles – Advanced Encryption Standard - Block cipher Mode of operations-Stream ciphers-RC4.

UNIT-III ASYMMETRIC KEY CRYPTOGRAPHY 9

Mathematics of Asymmetric Key Cryptography: Prime Numbers, Fermat's and Euler's Theorem, Testing for Primality- Discrete Logarithms - Chinese Remainder Theorem - ASYMMETRIC KEY CIPHERS: Principles of Public key cryptosystem-RSA Algorithm – Key Management - Diffie-Hellman key exchange - ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.

UNIT-IV	MESSAGE INTEGRITY AND AUTHENTICATION	9

Message Authentication Codes: Message Authentication Requirements -Message Authentication Functions -Requirements for Message Authentication Codes -Security of MACs - Cryptographic Hash Functions: Applications of Cryptographic Hash Functions - Requirements and Security of Hash-Secure Hash Algorithm (SHA-512) - Digital Signatures: NIST Digital Signature Algorithm- Authentication Applications: Kerberos- X.509

UNIT-V	NETWORK AND SYSTEM SECURITY	9

Web Security: SSL-TLS –SET – Wireless Security - Email Security: Pretty Good Privacy- S/MIME - IP security –Intruders – Malicious software – Firewalls.

TOTAL: 45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Experiment with various classical encryption techniques by gaining knowledge from OSI security architecture.

CO2: Make use of symmetric cryptographic algorithms for performing cryptographic operations.

CO3: Utilize the asymmetric ciphers for Secured Data and key exchange.

CO4: Identify Integrity and Authentication schemes for various applications.

CO5: Choose security services for different real time scenario.

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security", 7th Edition, Pearson Education Limited, 2017.
2. Behrouz A. Ferouzan, "Cryptography & Network Security", 1st Edition, Tata Mc Graw Hill, 2007.
3. William Stallings, "Data and Computer Communication", 10th Edition, Pearson Education, 2013.

REFERENCES:

1. Man Young Rhee, "Internet Security: Cryptographic Principles", "Algorithms and Protocols", 1st Edition, Wiley Publications, 2003.
2. Charles Pfleeger, "Security in Computing", 4th Edition, Prentice Hall of India, 2006.
3. Bruce Schneier and Neils Ferguson, "Practical Cryptography", 1st Edition, Wiley Dreamtech India Pvt Ltd, 2003.

21IT401	**BIG DATA ENGINEERING** *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of big data.
- To develop simple MapReduce applications.
- To outline the concepts of data analytics.
- To experiment with data models.
- To demonstrate MongoDB architecture and its operations.

UNIT-I	INTRODUCTION	9

Big Data Overview, Evolution of Big Data, Definition of Big Data, Challenges with Big Data - State of practice in Analytics, Key roles for New Big Data Ecosystem, Data Analytics Lifecycle Overview, Examples for Big Data Analytics.

UNIT-II	MAP REDUCE	9
HDFS Overview, Hadoop and Spark, Map Reduce Programming Basics, Analyzing the data with Hadoop: Java MapReduce - Developing Map Reduce Application.		
UNIT-III	**DATA ANALYTICS**	**9**
Map reduce solution: Market Basket Analysis, K-means Clustering, Naïve Bayes, Implementation in Spark - KNN Classification, Logistic Regression, streaming data analytics.		
UNIT-IV	**TECHNOLOGY AND TOOLS**	**9**
Hadoop Ecosystem: PIG - Data Storage: Value of Relational Databases – The emergence of NoSQL, Aggregate Data Models: Key value - Document Data Models - Column Family Stores - Hbase.		
UNIT-V	**MONGODB**	**9**
Introduction to MongoDB - Architecture - Schema Design and Modelling - CRUD operations - Integration of MongoDB with Hadoop and Data Migration MongoDB with Hadoop (MongoDB to Hive)		
		TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Outline the big data technologies used for storage, analysis and manipulation of data.

CO2: Develop simple applications using Hadoop MapReduce framework.

CO3: Outline the concepts of data analytics.

CO4: Make use of technology and tools for data modeling.

CO5: Explain the MongoDB architecture and its operations.

TEXT BOOKS:

1. EMC Education services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", 2nd Edition, John Wiley and Sons, 2015.
2. Mahmoud Parsian, "Data Algorithms: Recipes for Scaling Up with Hadoop and Spark", 1st Edition, O`Reilly media Inc., 2015.
3. Kyle Banker, Peter Bakkum, et al.,"MongoDB in Action", 2nd Edition, Manning Publications, 2016.

REFERENCES :

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", 1st Edition, Wiley publications, 2014.
2. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence",1st Edition, Addison Wesley, 2013.
3. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly, USA, 2015.
4. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2017.

21CS402	DATA SCIENCE	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the data science process and data exploration.
- To interpret the fundamentals mathematics required for data science.
- To demonstrate the usage of R programming for data science.
- To experiment with data wrangling.
- To choose the data visualization techniques for data interpretation.

UNIT-I	INTRODUCTION TO DATA SCIENCE	8
Introduction to data science: data science classification - data science algorithms - Data Science Process: prior knowledge -data preparation –modeling –application –knowledge -Data Exploration: objectives of data exploration –datasets -descriptive statistics.		
UNIT-II	**MATHEMATICS FOR DATA SCIENCE**	**11**
Mathematical preliminaries: Probability - Descriptive Statistics – Correlation Analysis – Statistical Analysis: Statistical Distributions - Statistical Significance - Linear Algebra: The Power of Linear Algebra - Factoring Matrices - Eigenvalues and Eigenvectors - Eigenvalue Decomposition.		
UNIT-III	**PROGRAMMING FOR DATA SCIENCE**	**9**
R programming fundamentals: Data Types and Variables – Operators - Conditional Statements – Loops - R script – Functions – Vectors – Data frames - Common R libraries for Data Science: Dplyr -Esquisse - Ggplot2 - Tidyr - Shiny – Caret - E1071 – Mlr.		
UNIT-IV	**DATA WRANGLING**	**8**
Introduction to Data Wrangling – Benefits –Data Wrangling Tasks: Data Discovery - Data Structuring - Data Cleaning - Data Enriching - Data Validating - Data Publishing – Web Scraping – String processing.		
UNIT-V	**DATA VISUALIZATION**	**9**
Introduction to data visualization: Data Visualization and Theory - Computational Statistics and Data Visualization–Visualizing data distributions: Statistical visualizations – histograms - scatter plots - box plots – Data visualization in practice: Case studies.		
		45 PERIODS
PRACTICAL EXERCISES:		**30 PERIODS**

1. Case study: Application of linear algebra in dimensionality reduction, correlation analysis and regression analysis of real-world data.
2. Case study: Outlier analysis on real-time data using probability and statistics.
3. Reading and pre-processing the given data using R programming.
4. To understand the nature of data through box-plot analysis using R programming.
5. Correlation analysis for feature selection using R programming.
6. Trend analysis through regression model using R programming.
7. Predictive analysis on health care data using R programming.
8. Prescriptive analysis on sales data using R programming.

TOTAL: 75 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Illustrate the data science process and data exploration.

CO2: Experiment with probability, statistics and linear algebra in data science applications.

CO3: Utilize R programming packages for real time data analysis.

CO4: Make use of data wrangling for different real world datasets.

CO5: Examine real-time data analysis using visualization techniques.

TEXT BOOKS:

1. Vijay Kotu, Bala Deshpande, "Data Science: Concepts and Practice", 2nd Edition, Elsevier Publications, 2019.
2. B. Uma Maheswari, R. Sujatha, "Introduction to Data Science: Practical Approach with R and Python", 1st Edition, Wiley, 2021.

3. Rafael A. Irizarry, "Introduction to Data Science Data Analysis and Prediction Algorithms with R", 1st Edition, Chapman & Hall, 2020.
REFERENCES:
1. Steven S. Skiena, "The Data Science Design Manual", Springer, 2017. 2. C.Chen, W.Hardle, A.Unwin, "Hand book of Data Visualization", Springer, 2008. 3. Roger D. Peng, "R Programming for Data Science",1st Edition , Leanpub, 2015.

VERTICAL 1- DATA SCIENCE

21PCS01	DATA SCIENCE AND BIG DATA ANALYTICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To illustrate the data science process and mathematics required for data science.
- To demonstrate Python programming for data analytics.
- To develop knowledge on analytic tools.
- To experiment NoSQL database.
- To choose the techniques for big data analytics.

UNIT-I	INTRODUCTION TO DATA SCIENCE	12

Data Science - Related Terminologies - Types of Analytics - Applications of Data Science - Data Science Process Model – Data Exploration - Mathematical preliminaries for Data Science: Probability – Statistics - Linear Algebra.

SUGGESTED ACTIVITIES:

- Case study-1: Outlier analysis on real-time data using probability and statistics.
- Case study-2: Application of linear algebra in dimensionality reduction, correlation analysis and regression analysis of real-world data.

UNIT-II	DATA ANALYTICS USING PYTHON	12

Introduction to Python- Data types and basic operators – Environment setup and essentials – Python libraries: NUMPY for mathematical essentials –Data manipulation using PANDAS – Data visualization by MATPLOTLIB.

SUGGESTED ACTIVITIES:

- Data pre-processing using PYTHON.
- Visualizing statistical analysis using PYTHON.

UNIT-III	DATA ANALYTICS – TECHNOLOGY AND TOOL	12

Map Reduce and Hadoop - Hadoop Framework, Understanding Map Reduce functions Analytics of Unstructured Data, Hadoop Eco System: PIG, HIVE, HBASE.

SUGGESTED ACTIVITIES:

- K-means clustering using Map Reduce.
- Setting up single node cluster in Hadoop to run word count application.

UNIT-IV	NOSQL DATA MANAGEMENT FOR BIG DATA	12

Introduction to NoSQL –RDBMS vs MongoDB - MongoDB: Introduction - Data types - MongoDB Query Language: Creating - Updating and deleing documents – Querying.

SUGGESTED ACTIVITIES:

- Creating and manipulating NOSQL database using MongoDB.

UNIT-V	TECHNIQUES FOR ANALYTICS	12

Defining big data analytics -Visual data analysis - Analytics techniques for decision making: Descriptive - Diagnostics - Predictive - Prescriptive–Case studies: Sentiment analysis - Health Care – Finance.

SUGGESTED ACTIVITIES:

- Prescriptive analysis on health care data using PYTHON.
- Predictive analysis on finance using PYTHON.

TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Utilize probability, statistics and linear algebra for data science process and data exploration.
CO2: Make use of PYTHON for statistical data analytics on real world data applications.
CO3: Utilize Hadoop and Map Reduce technologies for huge data storage and management.
CO4: Experiment the NoSQL database using MongoDB.
CO5: Examine the variants of data analytic techniques to analyze the data of various domains.

TEXT BOOKS:

1.B. Uma Maheswari, R. Sujatha, "Introduction to Data Science: Practical Approach with R and Python", 1st Edition, Wiley, 2021.
2.Wes McKinney, "Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython", 2nd Edition, O'Reilly Media, Inc, 2017.
3.Rafael A. Irizarry, "Introduction to Data Science Data Analysis and Prediction Algorithms with R", 1st Edition, Chapman & Hall, 2020.

REFERENCES:

1. Raj Kamal and Preeti Saxena, "Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning", 1st Edition, TMH, 2019.
2. Steven S. Skiena, "The Data Science Design Manual", Springer, 2017.
3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", 1st Edition, Wiley Publishers, 2015.

21PCS02	EXPLORATORY DATA ANALYSIS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To describe the methods and characteristics of data.
- To identify the relationship and groups among data.
- To demonstrate the characteristics of the data through statistical analysis.
- To summarize the concepts of building models from data.
- To examine and analyze the real time data.

UNIT-I	EXPLORING AND UNDERSTANDING DATA	12

Introduction: Sources of data – Process for making sense of data - Describing data: Variable types – Distribution of data – Hypothesis test – Preparing data tables: Cleaning the data – data type conversion – Combining variables – Unstructured data.

SUGGESTED ACTIVITIES:

- Hypothesis test for the given data using python/R.

- Data Pre-processing for the given data using python/R.

UNIT-II **RELATIONSHIPS AND GROUPS AMONG DATA** **12**

Understanding relationship: Exploring relationships between variables – Visualizing relationships – Understanding groups: Clustering - Association Rules - Learning Decision Trees from Data.

SUGGESTED ACTIVITIES:

- Association Rule Mining for the given data using python/R.
- Classification model generation using decision tree algorithm.

UNIT-III **EXPLORING THE DATA VISUALY** **12**

Principles of Analytic Graphics: Show comparisons - Show multivariate data - Exploratory Graphs: Characteristics of exploratory graphs – Boxplot – Histogram – Barplot – Scatterplots - Plotting Systems: The Base Plotting System - The ggplot2 System.

SUGGESTED ACTIVITIES:

- Statistical analysis for the given data using python/R.

UNIT-IV **BUILDING MODELS FROM DATA** **12**

Overview - Linear Regression - Logistic Regression - k-Nearest Neighbors - Classification and Regression Trees.

SUGGESTED ACTIVITIES:

- Trend analysis on numerical data using python/R.
- Classifier model building through logistic regression using python/R.

UNIT-V **CASE STUDIES** **12**

Data Analysis Case Study: Changes in Fine Particle Air Pollution – Credit card fraud detection – Trend analysis in stock market data.

SUGGESTED ACTIVITIES:

- Stock market data analysis

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of modern tools to explore the data and its characteristics.

CO2. Illustrate the relationship and groups among the data for decision Making.

CO3. Experiment with the statistics and group the nature of the data.

CO4. Develop the data models using regression and classification techniques for real world data.

CO5. Complete appropriate analysis technique for solving the data.

TEXT BOOKS:

1. Glenn J. Myatt, Wayne P. Johnson, "Making Sense of Data I: A Practical Guide to Exploratory Data Analysis and Data Mining", 2nd Edition, Wiley, 2014.
2. Roger D. Peng, "Exploratory Data Analysis with R", 1st Edition, Leanpub, 2020.
3. Ronald K. Pearson,"Exploratory Data Analysis Using R", 1st Edition, CRC Press, 2018.

REFERENCES:

1. Brett Lantz, "Machine Learning with R", 2nd Edition, Packt Publishing, 2013.
2. Moro, P. Cortez and P. Rita. "A Data-Driven Approach to Predict the Success of Bank Telemarketing." Decision Support Systems, Elsevier, June 2014.

3. Steven S. Skiena, "The Data Science Design Manual", Springer, 2017.

21PCS03	NEURAL NETWORKS AND DEEP LEARNING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize the theoretical foundations, algorithms and methodologies of neural network
- To experiment with different activation functions working in neural network.
- To design building blocks of deep learning models.
- To construct architectures and to train deep neural network.
- To utilize the practical knowledge in handling and analyzing real world applications

UNIT-I	INTRODUCTION TO NEURAL NETWORKS	12

Neural Networks: The Biological Neuron - The Perceptron - Multilayer Feed-Forward Networks. Training Neural Networks: Backpropagation Learning.

SUGGESTED ACTIVITIES: Implement XOR problem using Multilayer perceptron.

UNIT-II	ACTIVATION FUNCTIONS AND PARAMETERS	12

Activation functions, Loss Functions: Notation - Loss function for Reconstruction - Parameters Vs Hyperparameters

SUGGESTED ACTIVITIES: Estimate depth and width of Neural Networks

UNIT-III	INTRODUCTION TO DEEP NETWORKS	12

Defining Deep Learning - Common Architectural Principles of Deep Networks - Building Blocks of Deep Networks

SUGGESTED ACTIVITIES: Build CNN model for Handwritten Digit Recognition

UNIT-IV	ARCHITECTURES OF DEEP NETWORKS	12

Introduction to Convolutional Neural Networks (CNNs) - Recurrent Neural Networks - Recursive Neural Networks.

SUGGESTED ACTIVITIES: Develop a code to design object detection and classification using CNN

UNIT-V	APPLICATIONS	12

Large-Scale Deep Learning. Computer Vision- Speech Recognition- Natural Language Processing-Other Applications

SUGGESTED ACTIVITIES: Predict Sentiment for Movie Reviews Using Deep Learning

TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1:Utilize different methodologies to create application using neural network

CO2: Make use of activation function and parameters to train the neural network

CO3: Experiment with working knowledge of deep learning models for solving problem

CO4: Identify appropriate deep learning models for analyzing the data for a variety of problems.

CO5: Build deep learning models for solving real world problems.

TEXT BOOKS:

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach",1st Edition ,O'Reilly Media, 2017

2. Ian Goodfellow, YoshuaBengio, Aaron Courville," Deep Learning", 1st Edition, The MIT press, 2017
3. Bengio, Yoshua., "Learning deep architectures for AI. Foundations and trends in Machine Learning 2.1", 1st Edition, New Publishers, 2009

REFERENCES:

1. Nikhil Buduma and Nicholas Lacascio, "Fundamentals of Deep Learning", 1st Edition, O.Reilly, 2017.
2. Pradeep Pujari, Md. And Rezaul Karim, Mohit Sewak, "Practical Convolutional Neural Networks", 1st Edition, Packt Publishing, 2018.
3. Ragav Venkatesan and Baoxin Li, "Convolutional Neural Networks in Visual Computing (Data Enabled Engineering)", 1st Edition, CRC Press, 2017.

21PCS04	INFORMATION RECOMMENDER SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To identify the basic concepts of recommender systems.
- To describe different techniques of recommendation techniques.
- To discuss the performance evaluation of recommender systems based on various metrics.
- To indicate the advanced topics and current applications of recommender systems.
- To infer a simple recommender system using R.

UNIT-I | INTRODUCTION TO RECOMMENDER SYSTEMS | 12

Introduction to Recommender system-Recommender System Function-Recommendation Techniques-Applications and Evaluation of recommendation systems-Issues with recommender system-Data Mining methods for Recommender System

SUGGESTED ACTIVITIES:

Construct the Similarity matrix for given application using R.

UNIT-II | COLLABORATIVE FILTERING | 12

User-based nearest neighbor recommendation-Item-based nearest neighbor recommendation-Model based and pre-processing based approaches-Advances in Collaborative Filtering: Matrix Factorization model.

SUGGESTED ACTIVITIES:

Develop the model applicable for given application using R.

UNIT-III | CONTENT-BASED RECOMMENDATION | 12

High level architecture of content-based systems-Advantages and drawbacks of content based filtering-State of art continent based system: Item Representation, Methods for user profiles-The role of user generated content in the recommendation.

SUGGESTED ACTIVITIES:

Identify the data ratings based on the customer feedback.

UNIT-IV | KNOWLEDGE BASED RECOMMENDATION | 12

Introduction-Knowledge representation and reasoning-Interacting with constraint-based recommenders-Interacting with case-based recommenders-Developing constraint based recommenders.

SUGGESTED ACTIVITIES:

Choose the appropriate data set based on the similarity to evolve recommender models.

UNIT-V | HYBRID APPROACHES AND EVALUATION | 12

Opportunities for hybridization-Monolithic hybridization design-Parallelized hybridization design –Pipelined hybridization design-Evaluation of Recommender System: Experimental Settings,Recommnedation System Properties-Recent Developments:Attackes on Collaborative recommender System

SUGGESTED ACTIVITIES:

Develop the recommender system using ITEM based collaborating filtering.

COURSE OUTCOMES **TOTAL:60 PERIODS**

At end of the course, learners will be able to:

CO1: Relate the basic knowledge of recommender systems for real world problems

CO2: Prepare the concepts of collaborative filtering for measuring the similarity

CO3: Make use of content based and knowledge based techniques for solving real world applications

CO4: Choose hybrid approaches for current applications to generate precise recommendations

CO5: Develop a simple recommender system using R programming

TEXT BOOKS:

1. Francesco Ricci · Lior Rokach · Bracha Shapira · Paul B. Kantor,"Recommender Systems Handbook",3rd Edition,Springer,2022
2. Jannach D., ZankerM.and FelFering A., "Recommender Systems: An Introduction",1st Edition, Cambridge University Press,2011.
3. C.C. Aggarwal, Recommender Systems: The Textbook", Springer Edition, 2016.

REFERENCES:

1. Suresh K. Gorakala, Michele Usuelli ,"Building a Recommendation System with R", 1st Edition, Packt Publishing,2015
2. J. Leskovec, A. Rajaraman and J. Ullman, "Mining of massive datasets", 2nd Edition. Cambridge, 2012.
3. Manouselis N., Drachsler H., Verbert K., Duval E., "Recommender Systems For Learning", 1st Edition, Springer, 2013

21PCS05	COMPUTER VISION ALGORITHMS AND APPLICATIONS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To outline the image processing foundations for computer vision
- To utilize the concepts of edge detection techniques
- To classify the methods of digital morphology
- To demonstrate three-dimensional motion and object recognition techniques
- To find the steps for detect and recognize the face and human gait analysis

UNIT-I IMAGE PROCESSING FOUNDATIONS **12**

Introduction- Elements of visual perception- Histogram Processing-Spatial Filters-Image Restoration and Reconstruction

SUGGESTED ACTIVITIES:

- Develop application to display grayscale image using read and write operation.

UNIT-II EDGE-DETECTION TECHNIQUES **12**

Edge Detection - Models of Edges- Noise- Template-Based Edge Detection- The Canny Edge Detector- The Shen-Castan (ISEF) Edge Detector- Color Edges.

SUGGESTED ACTIVITIES:

- Create application for Non Linear Filtering technique using edge detection

UNIT-III	DIGITAL MORPHOLOGY	
Morph Grey-Level Morphology- Elements of Digital Morphology: Binary Operations, Binary Dilation, Binary Erosion, MAX, Color Morphology.		12

SUGGESTED ACTIVITIES:

- Create a vision program to implement the binary operations.

UNIT-IV	3D VISION AND MOTION	
Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus- 3D object recognition		12

SUGGESTED ACTIVITIES:

- Develop a program to determine the 3D shape from texture and 3D object detection.

UNIT-V	APPLICATIONS	
Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape- human gait analysis.		12

SUGGESTED ACTIVITIES:

- Create an application to face detection and human gait actions.

COURSE OUTCOMES: **TOTAL:60 PERIODS**

At end of the course, learners will be able to:

CO1: Demonstrate the image processing foundations for computer vision.

CO2: Make use of edge detection techniques for image segmentation and data extraction

CO3: Classify the elements of digital morphology techniques

CO4: Make use of 3D vision, motion for object recognition techniques

CO5: Develop applications to recognize the face and human gait analysis

TEXT BOOKS:

1. Rafael C.Gonzalez, Richard E.Woods," Digital Image Processing", 3rd Edition, Pearson, 2018.
2. J.R.Parker,"Algorithms for Image Processing and Computer Vision",2nd Edition, Wiley, 2019.
3. Richard Szeliski, "Computer Vision: Algorithms and Applications", 2nd Edition, Springer 2022.

REFERENCES:

1. Jan Erik Solem,"Programming Computer Vision with Python: Tools and algorithms for analyzing images", 2nd Edition, O'Reilly Media, 2019.
2. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", 3rd Edition, Academic Press, 2018.
3. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", 2nd Edition, Cambridge University Press, 2018.

21PCS06	IMAGE AND VIDEO ANALYTICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize the basic steps image processing system
- To demonstrate the feature extraction techniques
- To make use of methods on image retrieval and object recognition
- To explain the video enhancement and noise reduction
- To determine and demonstrate video analysis action recognition

UNIT-I IMAGE PROCESSING 12

Basic steps of Image processing system – Pixel relationship- Image Transforms-. Image Enhancement- Image Segmentation.

SUGGESTED ACTIVITIES:

- Create a program for implement the Contrast-limited adaptive histogram equalization on medical images.

UNIT-II FEATURE EXTRACTION 12

Feature Extraction - Binary object feature, Histogram-based (Statistical) Features, Intensity features, Shape feature extraction.

SUGGESTED ACTIVITIES:

- Create application for geometric and radiometric distortions of binary images.

UNIT-III OBJECT RECOGNITION AND IMAGE RETRIEVAL 12

Object Recognition -Patterns and pattern class, Bayes' Parametric classification, Feature Selection and image retrieval.

SUGGESTED ACTIVITIES:

- Create a vision program to determine the edge detection of an image using different operators.

UNIT-IV DIGITAL VIDEO PROCESSING 12

Digital Video, Sampling of video signal, Video Enhancement and Noise Reduction- Change Detection.

SUGGESTED ACTIVITIES:

- Develop an application for video enhancement and noise reduction.

UNIT-V VIDEO ANALYSIS ACTION RECOGNITION 12

Video Analysis Action Recognition, Video based rendering, Context and scene understanding. Case Study: Surveillance.

SUGGESTED ACTIVITIES:

- Create a program for video action recognition in surveillance systems.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to:

CO1: Demonstrate the steps involved image processing system

CO2: Classify the feature extraction for real time applications.

CO3: Make use of the image retrieval and object recognition.

CO4: Demonstrate the video enhancement and noise reduction

CO5: Develop an applications in video analysis action recognition

TEXT BOOKS:
1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", 4th Edition. Prentice-Hall, 2018. 2. A. Murat Tekalp, "Digital Video Processing", 2nd Edition, Prentice Hall, 2015. 3. Debjyoti Paul, Charan Puvvala,"Video Analytics Using Deep Learning",1st Edition, APress, 2020.
REFERENCES:
1. Oge Marques, "Practical Image and Video Processing Using MATLAB", 2nd Edition, Wiley-IEEE Press,2019 2. Yu Jin Zhang, "Image Engineering: Processing, Analysis and Understanding", 2nd Edition, Tsinghua University Press, 2015. 3. Francesco Camastra, Alessandro Vinciarelli,"Machine Learning for Audio, Image and Video Analysis",1st Edition, Springer, 2018. 4. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", 3rd Edition, Academic Press, 2019.

21PCS07	**TEXT AND SPEECH ANALYSIS**	**L**	**T**	**P**	**C**
COURSE OBJECTIVES:		**2**	**0**	**2**	**3**

- To describe the basic need of Online Data Analysis.
- To indicate the text processing models involved in Text Mining.
- To build Text classification using supervised learning algorithms.
- To explain filters and transform methods in Speech Processing.
- To summarize various classification methods in Speech recognition.

UNIT-I	**INTRODUCTION**	**12**

Introduction –Approaches to Text Analysis – Analysis of Text as Social Information – Online Data sources –NGram viewer- Challenges and limitations of Online data Digital sources.

SUGGESTED ACTIVITIES:

- Implement Ngram viewer using Python.
- Text Preprocessing Using Python.

UNIT-II	**TEXT PREPROCESSING**	**12**

Lexical Resources – WordNet, Roget Thesaurus, Wikipedia –Basic Text Processing – Tokenization , Stop word Removal , Stemming and Lemmatization –Language Models –Text statistics – Advanced Text processing – Part of speech Tagging, Collocation identification.

SUGGESTED ACTIVITIES:

- Perform Text analysis using Voyant tool.

UNIT-III	**TEXT CLASSIFICATION**	**12**

Supervised Learning Algorithms – Regression , Decision Trees, Support vector Machines – Text Analysis Methods – Approaches, Plan and Qualitative Narrative Analysis – Sentimental Analysis

SUGGESTED ACTIVITIES:

- Sentiment analysis using Stanford's sentiment analysis.

UNIT-IV	**SPEECH PROCESSING**	**12**

Introduction – dimensions of Automatic Speech recognition – Digital signal processing –Digital filters - Discrete Fourier Transforms – Fast Fourier Transforms methods – relation between DFT and Digital filters

SUGGESTED ACTIVITIES:

- Speech processing using MatLab.

UNIT-V	SPEECH ANALYSIS	12

Feature Extraction – Pattern classification Methods – Minimum Distance Classifiers, Discriminant Functions, Generalized discriminators – Minimum Error classification –Bayes Classifier – Iterative Training : The EM Algorithm

SUGGESTED ACTIVITIES:

- Explore the Tool PRRAT for speech analysis.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of Ngram viewer as a tool for text analysis.
CO2: Choose the available tools for text pre-processing.
CO3: Utilize Supervised classification algorithms to perform text classification.
CO4: Experiment with filter and Transformation methods for speech processing.
CO5: Select the appropriate Classification methods for pattern analysis.

TEXT BOOKS:

1. Gabe Ignatow,Rada mihalcea, "An Introduction to Text mining, Research Design, Data Collection and Analysis",1st Edition, SAGE Publications, 2018.
2. Brandon walsh, Sarah Horowitz," A course book on "Introduction to Text Analysis, License under Creative Commons Attribution-Non Commercial-ShareAlike 4.0", 1st Edition, International License. 2018.
3. Ben Gold, Nelson Morgan, Dan Ellis, "Speech and Audio Signal Processing", 2nd Edition, Willey Publications, 2011.

REFERENCES:

1. Cheng Xiang Zhai, Sean Massung, "Text Data Management and Analysis: A Practical Introduction to Information Retrieval and Text Mining", 1st Edition, Morgan & Claypool Publishers, 2016.
2. Emil Hvitfeldt, Julia Silge, "Supervised Machine Learning for Text Analysis in R", 1st Edition , Chapman and Hall/CRC, 2021
3. Himanshu Mohan, Megha Yadav , "Speech Recognition System and its Application", 3rd Edition, LAP LAMBERT Academic Publishing.2019.

21PCS08	ESSENTIALS OF BUSINESS ANALYTICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To discuss the concepts and methods of business analytics.
- To summarize the knowledge of organizational structures of business analytics.
- To infer the knowledge of descriptive analytics in business analytics.
- To identify the concept of predictive and prescriptive analytics in real world problems.
- To demonstrate the business analytics concepts in recent trends.

UNIT-I	INTRODUCTION TO BUSINESS ANALYTICS	12

Business analytics-Terminology-Business Analytics Process-Relationship of Business Analytics Process and organization Decision making Process-Business Analytics Data-Business Analytics Technology **SUGGESTED ACTIVITIES:** Make use of analytics tool for health care analytics. (Case Study).	
UNIT-II **ORGANIZATION STRUCTURES OF BUSINESS ANALYTICS**	**12**
Organization Structures of Business analytics-Team management-Management Issues: Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. **SUGGESTED ACTIVITIES:** Select the measures to determine the data set for health care analytics.	
UNIT-III **DESCRIPTIVE ANALYTICS**	**12**
Introduction, Visualizing and Exploring Data, Descriptive Statics, Sampling and Estimation, Introduction to probability Distributions. **SUGGESTED ACTIVITIES:** Develop the model using descriptive analytics for healthcare analytics.	
UNIT-IV **PREDICTIVE ANALYTICS**	**12**
Introduction to Predictive Modelling, Logic Driven Models, Data Driven Models, Data Mining: Simple illustration of Data Mining, Data Mining methodologies **SUGGESTED ACTIVITIES:** Develop and test predictive model for health care analytics.	
UNIT-V **PRESCRIPTIVE ANALYTICS**	**12**
Introduction to prescriptive modelling, Linear Optimization, Integer and Non Linear Optimizations, Optimization Analytics **SUGGESTED ACTIVITIES:** Develop the prescriptive model for health care applications.	
	TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Discover the knowledge of business analytics to solve the business problems.

CO2: Choose the organizational structures for small business.

CO3: Make use of technical skills in descriptive analytics for real world problems.

CO4: Demonstrate the concept of predictive analytics and prescriptive analytics to establish best decision for the small business.

CO5: Develop data-driven solutions to support decision-making in real-world business situations.

TEXT BOOKS:

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M., "Starkey Business Analytics Principles,Concepts,and Applications with SAS:What,Why, and How",1st Edition, Pearson Education, 2014.
2. James Evans,"Analytics, Global Edition", 1st Edition, Pearson's Education, 2020.
3. JayLiebowitz ,"Business Analytics, An Introduction",1st Edition, Auer Bach Publications,2013

REFERENCES:

1. Randy Bartlett,"A Practitioner's Guide To Business Analytics: Using Data Analysis Tools to Improve Your Organization's Decision Making and Strategy", 1st Edition, McGraw Hill Professional, 2013.
2. Larissa T. Moss & Shaku Atr,"Business Intelligence Roadmap: The Complete Project Lifecycle For Decision-Support Applications", 1st Edition, Addition Wesley Technology Series, 2013.
3. S.Albright,Wayne Winston, "Business Analytics: Data Analysis &Decision Making",6th Edition, Cengage Learning, 2014.

VERTICAL 2-FULL STACK DEVELOPMENT

21PCS09	PRINCIPLES OF PROGRAMMING LANGUAGES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the various ways to describe syntax and semantics of programming languages
- To interpret data, data types, and basic statements of programming languages
- To demonstrate the parameter passing and function call mechanisms
- To illustrate the object-orientation, concurrency, and event handling in programming languages
- To summarize knowledge about functional and logic programming paradigms

UNIT-I | SYNTAX, SEMANTICS AND BASIC STATEMENTS | 12

Describing syntax & semantics: Introduction – The General Problem of Describing Syntax – Formal Methods of Describing Syntax – lexical analysis – The Parsing Problem – Recursive-decent parsing – Bottom-up parsing – Data Types: User-Defined Ordinal Types – Array Types – Record Types - Statement-level Control structures.

SUGGESTED ACTIVITIES:

Determine type compatibility rules of a C compiler, Determine the scope of variables having the same name and different names declared within a while / for loop.

UNIT-II | SUBPROGRAMS | 12

Subprograms – Design Issues – Local referencing – Overloaded subprograms – Generic Subprograms – Design Issues for function.

SUGGESTED ACTIVITIES:

Devise a subprogram and calling code in which pass-by-reference and pass-by-value-result of one or more parameters produces different results.

UNIT-III | IMPLEMENTING SUBPROGRAMS | 12

The general semantics of calls and returns – Implementing subprograms with Stack-Dynamic Local Variables – Nested Subprograms – Blocks – Implementing Dynamic Scoping.

SUGGESTED ACTIVITIES:

Chess / checkers game using object oriented programming – C++/Smalltalk / Python / Java, Design a Tic-tac-toe game that uses even driven programming concepts.

UNIT-IV | FUNCTIONAL PROGRAMMING | 12

Introduction – Mathematical Functions - Fundamentals of Functional programming languages – Introduction to LISP – An Introduction to Scheme – Common LISP – F# - Error handling.

SUGGESTED ACTIVITIES:

Lisp recursive function to return 'nth' item from a list, diagonal of a matrix, sum of the diagonal of matrix & a sub-string from a string.

UNIT-V | LOGIC PROGRAMMING | 12

Introduction – Logic Programming concept – Prolog – Theoretical Foundation: Clausal Form, Limitations, Skolemization - Logic Programming in Perspective.

SUGGESTED ACTIVITIES:

Prolog program to find the factorial of a number, simplification of arithmetic expression involving additive, multiplicative identity & solve Sudoku puzzle.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to:

CO1: Illustrate data types, functions, syntax and semantics of all programming languages

CO2: Classify the design of subprograms

CO3: Develop a dynamic subprograms

CO4: Examine the concepts of Functional Programming LISP and F#

CO5: Inspect Prolog Programming to solve logical problems

TEXT BOOKS:

1. Robert W. Sebesta, "Concepts of Programming Languages", 10th Edition, Addison Wesley, 2012
2. Michael L. Scott, "Programming Language Pragmatics", 3rd Edition, Morgan Kaufmann, 2009.
3. Allen B Tucker, and Robert E Noonan, "Programming Languages – Principles and Paradigms", 2nd Edition, Tata McGraw Hill, 2007.

REFERENCES:

1. Richard A. O'Keefe, "The Craft of Prolog", 1st Edition, MIT Press, 2009.
2. R. Kent Dybvig, "The Scheme Programming Language", 4th Edition, MIT Press, 2009.
3. W. F. Clocksin, C. S. Mellish, "Programming in Prolog: Using the ISO Standard", 5th Edition, Springer, 2003.

21PCS10	WEB TECHNOLOGY AND DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To apply HTML5 elements to create webpages
- To build interactive webpages at client side using CSS3
- To utilize java script for event handling and form validation
- To construct dynamic web applications using PHP
- To develop web application using AJAX and XML

UNIT-I HTML5 12

HTML5: Heading, Linking, Images, Lists, Tables, internal linking- Form

SUGGESTED ACTIVITIES:

- Create Websites using HTML 5 tags
- Use Image maps in webpages

UNIT-II CSS3 12

Inline Style sheet- Embedded Style Sheet- External Style Sheet- Positioning Elements: Absolute Positioning, z-index, Relative Positioning, span, Backgrounds, Box Model, Text Flow- Text Shadows, Box Shadows, Animations, Transitions and Transformations.

SUGGESTED ACTIVITIES:

- Design Websites using style sheets
- Create an attractive webpage for any product using Animations, transition and transformation

UNIT-III JAVA SCRIPT 12

Prompt Dialogs – Control Statements – Functions- Arrays – Objects- DOM – Event Handling

SUGGESTED ACTIVITIES:

- Form validation using JavaScript
- Use Event handling and DOM to change content of any tags

UNIT-IV	PHP	12

PHP: Converting between data types, Arithmetic Operators, Arrays, Strings, Regular Expressions, Form Processing, Reading From Databases, Cookies

SUGGESTED ACTIVITIES:

- Validate the form using PHP regular expression.
- Create a web application that uses PHP and MySQL

UNIT-V	XML and AJAX	12

XML Basics – Structuring Data – XML Namespaces – DTD – XSLT transformation – Creating AJAX Applications using XML Http Request Object and JSON

SUGGESTED ACTIVITIES:

- Creating AJAX application using PHP a
- Transforming XML using XSL and XSLT

TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Construct Web pages using HTML5.

CO2: Make use of CSS3 to create interactive webpages.

CO3: Build dynamic web pages with validation using Java Script objects.

CO4: Make use of PHP programming to develop web applications.

CO5: Construct web applications using XML and AJAX.

TEXT BOOKS:

1. Deitel and Deitel and Nieto, "Internet and World Wide Web - How to Program", 5th Edition, Prentice Hall, 2011.
2. Jeffrey C and Jackson, "Web Technologies A Computer Science Perspective", 2nd Edition, Pearson Education, 2011.
3. Gopalan N.P. and Akilandeswari J., "Web Technology, Prentice Hall of India", 2nd Edition, 2011.

REFERENCES:

1. Stephen Wynkoop and John Burke,"Running a Perfect Website", 2nd Edition, QUE, 1999.
2. Chris Bates, "Web Programming – Building Intranet Applications", 3rd Edition, Wiley Publications, 2009.
3. UttamK.Roy, "Web Technologies," 2nd Edition, Oxford University Press, 2011.

21PCS11	CLOUD SERVICES MANAGEMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To enumerate the basic concepts of Cloud services.
- To demonstrate the IaaS with Amazon VPC.
- To illustrate the knowledge of PaaS and SaaS with Google App Engine.
- To summarize the concepts of Cloud security.
- To develop web services with AWS.

UNIT-I	CLOUD SERVICES - INTRODUCTION	12

Understanding Cloud computing – Developing Cloud services – Pros & cons of Cloud service Development, Types of Cloud services development – Cloud services development services and Tools – Cloud services for Everyone.

SUGGESTED ACTIVITIES:

- Explore online Calender Applications using cloud services.

UNIT-II	CLOUD SERVICE MODELS	12

Cloud Ecosystem – Cloud Design Objectives, Cost Model – Importance of Cloud Services- Infrastructure as a Service (Iaas) - Amazon VPC

SUGGESTED ACTIVITIES:

- Use GAE launcher to launch the web applications.

UNIT-III	PLATFORM & SOFTWARE SERVICE MODELS	12

Platform as a Service (PaaS) – Types of PaaS – PaaS Products (Google Cloud, Microsoft Azure, AWS) – Software as a Service (SaaS) – SaaS Applications – Characteristics of SaaS- benefits of SaaS and its Applications – Saleforce , Zoom.

SUGGESTED ACTIVITIES:

- Build a Serverless Web Application using Amazon Web services.

UNIT-IV	CLOUD SECURITY	12

Cloud security Risks – Privacy Impact Assesment – Operating system security – security of virtualization – Security risk posed by Shared images , Management OS

SUGGESTED ACTIVITIES:

- Use Xoar to achieve cloud security.

UNIT-V	CLOUD APPLICATION DEVELOPMENT	12

Amazon Web services: EC2 instances –Connecting clients – security rules – launching EC2, S3 and SQL services - Cloud-Based Simulation of a Distributed Trust Algorithm - A Trust Management Service

SUGGESTED ACTIVITIES:

- Use the AWS Management Console to launch an EC2 instance and connect to an AWS Account.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build Web Applications using cloud

CO2: Make use of IaaS Model in Cloud Ecosystem along with Amazon VPC

CO3: Construct Paas, SaaS Models to meet the real-world challenges.

CO4: Utilize security Tools to avoid the security risk on the web services

CO5: Develop applications using Amazon Web Services

TEXT BOOKS:

1. Micheal Miller,"Cloud Computing, web based applications, That change the way you Work and Collaborate online", Que Publishers,1st Edition, Aug 2008
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things",1st Edition, Morgan Kaufmann Publishers, 2012
3. Dan C.Marinescu, "Cloud computing, Theory and Practice",1st Edition, Morgan Kaufmann, 2103.

REFERENCES:

1. Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, "Mastering Cloud Computing",1st Edition, McGraw Hill,2013
2. Michael Miller, "Cloud Computing : Web-based Applications that change the way you work and collaborate online", 1st Edition, Pearson Education, 2008
3. John W Rittinghouse and James F Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, Hard cover Edition, 2020.

21PCS12	ANDROID APP DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize system requirements for android applications
- To model suitable design using android mobile development frameworks
- To utilize SQLite for mobile applications.
- To make use of Audio, Video, Bluetooth for mobile development.
- To choose Sensors and GPS for location-based services

UNIT-I | **ANDROID BASICS** | **12**

Creating Applications and Activities: Android Application manifest file, Externalizing resources ,Android application life cycle, Android Application class , Activity Life cycle, Activity class

SUGGESTED ACTIVITIES:

- Construct an application that draws basic graphical primitives on the screen
- Develop an application that uses Font and Colours

UNIT-II | **ANDROID USER INTERFACE DESIGN** | **12**

Building User Interfaces: Android user interface fundamentals, Layouts , Fragments , Android widgets – Views, Adapters -Intents and Broadcast Receivers

SUGGESTED ACTIVITIES:

- Develop an application that uses Layout Managers
- Develop an application that uses event listeners

UNIT-III | **ANDROID DATA STORAGE** | **12**

Databases and Content Providers – Introduction to SQLite, Content values and cursors, Working with SQLite Databases, Creating and using content providers, Adding search to the application. Expanding the User Experience: Action bars ,Menus , Dialogs , Toast , Notification

SUGGESTED ACTIVITIES:

- Develop an application that uses GUI components
- Develop an application that makes use of databases.

UNIT-IV | **ANDROID NATIVE CAPABILITIES** | **12**

Audio, Video and Using the Camera: Playing Audio and Video, Using camera for taking pictures, Recording Video- Bluetooth, NFC, Networks and WIFI : Using Bluetooth, Managing Network and Internet Connectivity, Managing WiFi, Near Field Communication- Telephony and SMS.

SUGGESTED ACTIVITIES:

- Develop an application that plays Audio and Video
- Develop an application that sends SMS to a user

UNIT-V | **SENSORS AND GPS** | **12**

Hardware Sensors – Maps, Geo Coding and Location based Services: Using Emulator for Location based services, selecting a location Provider, Finding Your Current Location, Using the Geocoder, creating Map based activities.

SUGGESTED ACTIVITIES:

- Develop a native application that uses GPS location information
- Develop an application that uses Google Maps

TOTAL:60 PERIODS

COURSE OUTCOMES
At end of the course, learners will be able to: CO1: Sketch the basics of Android applications. CO2: Build user interface for mobile applications. CO3: Make use of database to store mobile data of android applications. CO4: Examine native capabilities of android applications. CO5: Utilize Sensors and GPS for Android applications

TEXT BOOKS:

1. Reto Meier, "Professional Android 4 Development", 1st Edition, John Wiley and Sons, 2012
2. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", 2nd Edition, Wrox, 2012
3. Valentino Lee, Heather Schneider, and Robbie Schell, "Mobile Applications: Architecture, Design, and Development", 2nd Edition, Prentice Hall, 2004.

REFERENCES:

1. Brian Fling,"Mobile Design and Development",2nd Edition, O"Reilly Media,2009
2. Maximiliano Firtman , "Programming the Mobile Web ", 2nd Edition, O"Reilly Media, 2010.
3. Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, "Android SDK3 for Dummies", 2nd Edition, Wiley 2011.

21PCS13	WEB APPLICATION SECURITY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize the common Web application Security vulnerabilities.
- To outline the capabilities of various browser proxies.
- To demonstrate the SQL Injection Vulnerabilities.
- To explain the principles of file security.
- To illustrate the security of a large scale web application

UNIT-I	INTRODUCTION	12

Introduction - The OWASP Top Ten List - Security Fundamentals: Input Validation, Attack Surface Reduction, Classifying and Prioritizing Threats – Authentication.

SUGGESTED ACTIVITIES:

Installation of rootkits and examine the variety of options available, IP Address and Port Scanning, Service Identity Determination: Nmap - IP scanning in Windows

UNIT-II	BROWSER SECURITY PRINCIPLES	12

Defining the Same-Origin Policy - Exceptions to the Same-Origin Policy - Cross-Site Scripting - Cross-Site Request Forgery – CSRF.

SUGGESTED ACTIVITIES:

Perform reconnaissance to find all the relevant information on selected website, Exploit MS web server, attacking vulnerabilities.

UNIT-III	DATABASE SECURITY PRINCIPLES	12

Database Security Principles - Structured Query Language (SQL) Injection - Setting Database Permission - Stored Procedure Security

SUGGESTED ACTIVITIES:

Install and configure the virtual machines to perform SQL Injection attack

UNIT-IV	FILE SECURITY PRINCIPLES	12

File Security Principles: Keeping Your Source Code Secret - Security Through Obscurity - Forceful Browsing - Directory Traversal.

SUGGESTED ACTIVITIES:

Experimenting with password-cracking utilities, attempting dictionary, hybrid, and brute-force attacks; Use any tool to find all the vulnerabilities with its level and generate a report for an organization

UNIT-V	SECURE DEVELOPMENT AND DEPLOYMENT	12

Secure Development Methodologies - Baking Security In - The Holistic Approach to Application Security - Industry Standard Secure Development Methodologies and Maturity Models: SDL - CLASP - SAMM - BSIMM

SUGGESTED ACTIVITIES:

Exploit windows to gain access of victim's machine using a penetration testing framework, Perform a study on CLASP Application Security Process.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to:

CO1: Make use of OWASP to understand the need of web application security.

CO2: Discover and prevent web security vulnerabilities

CO3: Examine the various SQL Injections and the possible Vulnerabilities

CO4: Develop the practices of applying the File Security Principles.

CO5: Identify and aid in fixing any security vulnerabilities during the web development process.

TEXT BOOKS:

1. Bryan and Vincent, "Web Application Security, A Beginners Guide", 1st Edition, McGraw-Hill, 2011.
2. Alfred Basta, Melissa Zgola, "Database Security", 1st Edition, Course Technology, 2012.
3. Michael Gertz and Sushil Jajodia, "Handbook of Database Security— Applications and Trends", Springer, 2008.

REFERENCES:

1. Bhavani Thuraisingham, "Database and Applications Security", 1st Edition, Auerbach Publications, 2005.
2. Dafydd Stuttard, and Marcus Pinto, "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws", 2nd Edition, John Wiley & Sons; 2011.
3. W. F. Clocksin, C. S. Mellish, "Programming in Prolog: Using the ISO Standard", 5th Edition, Springer, 2003.

21PCS14	SOFTWARE TESTING AND AUTOMATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain the basics of testing process.
- To interpret the test cases criteria in simple applications.
- To illustrate the design of test cases.
- To summarize the test management and test automation techniques.
- To outline the needs for test metrics and measurements.

UNIT-I	INTRODUCTION	12

Testing axioms, Basic definitions, Software Testing Principles, The Tester's Role in a Software Development Organization, Origins of Defects, Cost of defects, Defect Classes, The Defect Repository and Test Design

SUGGESTED ACTIVITIES:

- Examine the open source testing tool "Selenium"

UNIT-II	TEST CASE DESIGN STRATEGIES	12

Test case Design Strategies, Using Black Box Approach to Test Case Design, Boundary Value Analysis, Equivalence Class Partitioning, Graph based testing-Cause-effect graphing, Using White Box Approach to Test design, Test Adequacy Criteria, Code Coverage Testing

SUGGESTED ACTIVITIES:

- Develop C program for the programming constructs such as if, for, switch, while, do while, if-else, and build the possible test cases.

UNIT-III	LEVELS OF TESTING	12

The need for Levels of Testing, Unit Testing, Integration Testing, API testing, System Testing, Acceptance Testing, Regression Testing, Alpha Testing, Beta Testing, Adhoc Testing

SUGGESTED ACTIVITIES:

- Select any two functionalities in GMAIL and develop the test cases with sample and expected output.
- Plan the test cases for simple calculator in windows application.
- Build a simple website for a user registration and login. Perform all possible levels of testing in the website and validate the results.

UNIT-IV	TEST MANAGEMENT	12

People and organizational issues in testing, Organization structures for testing teams, Test Planning, Test Plan Components, Test Plan Attachments, Introducing the test specialist, Skills needed by a test specialist

SUGGESTED ACTIVITIES:

- Develop a test plan document for Library Management System.

UNIT-V	TEST AUTOMATION	12

Need for Software test automation, Manual to Automated Testing, Tools needed for automation, Design and architecture for automation, Coverage in Test Automation, Types of Test Automation

SUGGESTED ACTIVITIES:

- Examine any one free test automation tool e.g. Katalon Studio.

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Infer the basic concepts and terminologies of testing to test simple applications

CO2: Develop test cases using design strategies by employing suitable techniques

CO3: Utilize the various levels of testing to validate the systems

CO4: Choose suitable organizational structures for managing the issues in testing

CO5: Develop the skills needed for various automation testing techniques

TEXT BOOKS:

1. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", 1st Edition, Pearson Education, 2017.
2. Dr. D. Chitra, A. Kaliappan, "Software Testing", 1st Edition, Technical Publications, 2019
3. Arnon Axelrod, "Complete Guide to Test Automation: Techniques, Practices, and Patterns for Building and Maintaining Effective Software Projects", 1st Edition, Apress Publisher, 2018

REFERENCES:

1. Paul C. Jorgensen, Byron DeVries, "Software Testing A Craftsman's Approach", 5th Edition,Auerbach Publications, 2021
2. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003.
3. Aditya P. Mathur, "Foundations of Software Testing _ Fundamental Algorithms and Techniques", 1st Edition, Pearson Education, 2008.

21PCS15	INTRODUCTION TO DEV-OPS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize the basic concepts of DevOps.
- To construct the Pipeline for development of life cycle.
- To demonstrate and develop DevOps code.
- To make use of continuous integration and continuous deployment Pipeline.
- To build the applications using Docker and Kubernetes.

UNIT-I | DEVOPS: AN OVERVIEW | 12

DevOps: Origins, Roots: Addressing Dev versus Ops Practices: Continuous Integration, Continuous Delivery, Supporting Practices, Culture, Containerization Tools.

SUGGESTED ACTIVITIES:

- To study and install Version Control System / Source Code Management, install git and create a GitHub account.
- To implement various GIT operations on local and Remote repositories using GIT Cheat-Sheet

UNIT-II | ESTABLISHING DEVOPS | 12

Embracing the New Development Life Cycle: Inviting Everyone to the Table, Changing Processes, Shifting Ops "Left": Thinking about Infrastructure. Planning Ahead: Moving beyond the Agile Model, Forecasting Challenges, Gathering Requirements, Designing an MVP.

SUGGESTED ACTIVITIES:

- To build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server.

UNIT-III | DESIGNING AND DEVELOPING DEVOPS CODE | 12

Designing: Constructing Your Design, Designing for DevOps, Architecting Code for the Six Capabilities of DevOps, Documenting Design Decisions, Avoiding Architecture Pitfalls. Developing Code Engineering for Error, Writing Maintainable Code, Programming Patterns, Choosing a Language Avoiding Anti-Patterns, DevOpsing Development, Establishing Good Practices.

SUGGESTED ACTIVITIES:

- To implement Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.

UNIT-IV | DEVOPS CI/CD PIPELINE | 12

Overviewing Git and its command lines, Understanding the Git process and GitFlow pattern. The CI/CD principles, Using a package manager Using Jenkins, Using Azure Pipelines.

SUGGESTED ACTIVITIES:

- To develop Software Configuration Management and provisioning using Puppet Blocks(Manifest, Modules, Classes, Function)

UNIT-V | CONTAINERIZED APPLICATIONS WITH DOCKER AND KUBERNETES | 12

Installing Docker, Creating a Dockerfile, Building and running a container on a local machine, Pushing an image to Docker Hub, Deploying a container to ACI with a CI/CD pipeline. Installing Kubernetes, First example of Kubernetes application deployment, Using HELM as a package manager, Using AKS, Creating an AKS service.

SUGGESTED ACTIVITIES:

- To implement a LAMP/MEAN Stack using Puppet Manifest.

TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:
CO1: Utilize the basic concepts of DevOps.
CO2: Make use of the development life cycle using pipelining.
CO3: Develop the DevOps code by applying the basic concepts.
CO4: Model the continuous integration and continuous deployment Pipeline in GIT.
CO5: Construct the real time applications for given scenario using Docker and Kubernetes.

TEXT BOOKS:

1. Sanjeev Sharma," The DevOps Adoption Playbook", 1st Edition, Wiley Publication, 2017.
2. Emily Freeman,"DevOps for Dummies", 1st Edition, 2020.
3. Mikael Krief,"Learning DevOps" 1st Edition, Packt Publishing, 2019.

REFERENCES:

1. James Turnbull, Sid Orlando, "The Art of Monitoring", 1st Edition, 2016.
2. Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", 1st Edition, 2015.
3. David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", 2nd Edition, 2016.

21PCS16	PYTHON APPLICATION PROGRAMMING INTERFACE DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To show the prospects of application programming interface in web development.
- To build a Restful API service using the Flask-Restful package
- To utilize Python APIs to build and access database.
- To construct an authentication and security services with JWT
- To develop a function to send out mails using Mailgun API and upload image using Flask-Uploads

UNIT-I | INTRODUCTION TO API — 12

Understanding API - Open API -The Flask Web Framework - Building a Simple Recipe Management Application - Using curl or httpie to Test All the Endpoints – Postman

SUGGESTED ACTIVITIES:

- Build a Simple Recipe Management Application using FLASK

UNIT-II | FLASK-RESTFUL — 12

Flask-RESTful - Virtual Environment - Creating a Recipe Model - Configuring Endpoints - Making HTTP Requests to the Flask API using curl and httpie

SUGGESTED ACTIVITIES:

- Build a basic web application using Flask Web Framework

UNIT-III | DATABASE MANIPULATION WITH SQLALCHEMY — 12

Databases – SQL – ORM - Defining Models - Password Hashing

SUGGESTED ACTIVITIES:

- Build a Database using Flask-Migrate

UNIT-IV | AUTHENTICATION SERVICES AND SECURITY WITH JWT — 12

JWT - Flask-JWT-Extended - Designing the Methods in the Recipe Model - Refresh Tokens - The User Logout Mechanism

SUGGESTED ACTIVITIES:

- Develop a user login function using Flask-JWT Extended package

UNIT-V	MAILGUN API	12

Mailgun API- Mailgun API to Send Out Emails - User Account Activation Workflow - HTML Format Email – Working with images

SUGGESTED ACTIVITIES:

- Develop an Email activation function using Mailgun API
- Develop an image uploading API using Flask-Uploads

TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Demonstrate the concept of APIs to interface the web services with the backend.
CO2: Build a Restful API service using the Flask-Restful package.
CO3: Make use of Python APIs for database management.
CO4: Develop a user login/logout function using JWT
CO5: Utilize Python APIs for sending mails and working with image.

TEXT BOOKS:

1. Jack Chan, Ray Chung, Jack Huang, "Python API Development Fundamentals", 1st Edition, Packt Publishing, 2019.
2. Kunal Relan, Building REST APIs with Flask, 1st Edition, APress, 2019
3. Gaston C. Hillar, Hands-On RESTful Python Web Services, 2nd Edition, Packt Publishing, 2018

REFERENCES:

1. Python Development Team, Guido Van Rossum, "Python 3.5 C API", 1st Edition, Samurai Media Limited, 2015
2. Jose Haro Peralta, "Micro service APIs Using Python, Flask, Fast API, Open API and More", 1st Edition, Manning, 2022
3. William S. Vincent, "Django for APIs: Build web APIs with Python and Django", 1st Edition, Welcome To Code publisher, 2022

VERTICAL 3-DATA CENTRE TECHNOLOGIES

21PCS17	DATA WAREHOUSING CONCEPTS AND IMPLEMENTATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To identify the scope and components of Data Warehousing.
- To explain the issues in Data Warehousing.
- To solve the real time problems using Source integration tools..
- To develop various algorithms based for Multidimensional Data Models.
- To choose various Query Processing and Optimization techniques for Reporting.

UNIT-I	DATA WAREHOUSE - AN OVERVIEW	12

Data Warehouse Components- Designing the Data Warehouse- Building a Data warehouse -Getting Heterogeneous Data into the Warehouse -Getting Multidimensional Data out of the Warehouse-Physical Structure of Data Warehouses-Metadata Management-Data Warehouse Project Management.

SUGGESTED ACTIVITIES:

- Build a Data Warehouse/Data Mart (using open-source tools like Pentaho Data Integration tool)

UNIT-II | DATA WAREHOUSE - ISSUES AND PROJECTS | **12**

Data Extraction and Reconciliation-Data Aggregation and Customization-Query Optimization-Update Propagation- Modeling and Measuring Data Warehouse Quality- Interestingness of Patterns -Three Perspectives of Data Warehouse Metadata.

SUGGESTED ACTIVITIES:

- Explore visualization features of the tool for analysis like identifying trends etc.

UNIT-III | SOURCE INTEGRATION | **12**

Schema Integration - Data Integration - Virtual - Materialized - Architecture for Source Integration - data integration workflows -Methodology for Source Integration.

SUGGESTED ACTIVITIES:

- Design multi-dimensional data models namely Star, snowflake and Fact constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, Manufacturing, Automobile, etc.).

UNIT-IV | MULTIDIMENSIONAL DATA MODELS AND AGGREGATION | **12**

Multidimensional View of Information- ROLAP Data Model - MOLAP Data Model- Logical Models for Multidimensional Information-Conceptual Models for Multidimensional Information-Inference Problems for Multidimensional Conceptual Modeling, Multidimensional versus Multirelational OLAP.

SUGGESTED ACTIVITIES:

- Perform various OLAP operations such slice, dice, roll up, drill down and pivot.

UNIT-V | QUERY PROCESSING AND OPTIMIZATION | **12**

Queries at the Back End-Queries at the Front End- Queries in the Core-Transactional Versus Data Warehouse Queries -Canned Queries Versus Ad-hoc Queries-Multidimensional Queries - Reporting and Query tools and Applications -Extensions of SQL

SUGGESTED ACTIVITIES:

- Perform various Query Operations (Canned Queries, Ad-hoc Queries).

TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Identify the warehousing components and tools for organizing large database

CO2: Outline the issues for Modeling and measuring data warehousing Quality.

CO3: Classify various Source integration tools to solve the real time problems.

CO4: Determine the Multidimensional Data Models and Aggregation to analyze Multidimensional Information.

CO5: Develop Multidimensional Queries for process and Optimization.

TEXT BOOKS:

1. MatthiasJarke, MaurizioLenzerini, YannisVassiliou, PanosVassiliadis,"Fundamentals of Data Warehouse", 2nd Edition, Springer 2022.
2. Alex Petrov ,**"**Database Internals: A Deep-Dive Into How Distributed Data Systems Work**"**, 1st Edition, O'Reilly Media 2019.
3. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", 10th Edition, Tata McGraw – Hill, 2016.

REFERENCES:

1. Ralph Kimball, Margy Ross," The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling", 3rd Edition, Wiley 2015.
2. Alan Beaulieu, "Learning SQL: Generate, Manipulate, and Retrieve Data", 1st Edition, O'Reilly Media 2020.

3. Dan Linstedt , Michael Olschimke,"Building a Scalable Data Warehouse with Data Vault 2.0", Elsevier Science & Technology ,2015.

21PCS18	DATA STORAGE TECHNOLOGIES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To enumerate the information and data storage concepts.
- To demonstrate the different approaches of data storage.
- To show the concepts of Data Storage Devices.
- To summarize the architecture of storage system.
- To choose the concept of Networked Attached Storage and Storage Area Networks.

UNIT-I	INTRODUCTION TO INFORMATION AND DATA STORAGE	12

Information and Data, Data in business Environments, Data life cycle Management, Data Storage Models, Creating Structured Data, Data Base management systems, Challenges in Data Storage Management, Data Centre Environment.

SUGGESTED ACTIVITIES:

- Review and understand the components and Systems in a Data Centre Environment

UNIT-II	DATA STORAGE APPROACHES	12

Types of Data Storage, File Based Storage, Block Level Data Storage, Object Based Data Storage, Working on stored data, Storage Performance Tuning.

SUGGESTED ACTIVITIES:

- Block Level Data Storage, Object Based Data Storage

UNIT-III	DATA STORAGE DEVICES	12

Data Storage Units, Primary And Secondary Storages, Hard Disk Drives, Magnetic Tapes, Optical Storage Discs, Solid State Drives, Storage Arrays, Selecting Storage Devices, Improving Data Storage Efficiency.

SUGGESTED ACTIVITIES:

- Storage Devices

UNIT-IV	STORAGE SYSTEM ARCHITECTURE	12

Storage Architecture basics, storage logical components, Direct attached storage, Intelligent Storage systems, Storage consolidation, Tiered storage.

SUGGESTED ACTIVITIES:

- Explore the management interface and general task to be performed within an Intelligent Storage system

UNIT-V	NETWORKED STORAGE SYSTEMS	12

Review of Enterprise Networking Options, Towards Networked Storage, Networked Attached storage, Storage Area Networks, Choosing NAS or SAN, Multi-protocol Arrays, Implementing Storage Solutions.

SUGGESTED ACTIVITIES:

- Explore the management interface and general task to be performed within the fibre channel SAN
- Configure the interface and provision storage within an IP SAN

TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Discuss the challenges in data Storage Management for business Environment.

CO2: Select a suitable data storage for an application.

CO3: Identify the efficiency for improving the data storage

CO4: Develop the Storage system architecture for data storage

CO5: Build the different network storage area systems for real time scenario.

TEXT BOOKS:

1. K.L.James, "Data Storage Technologies", 1st Edition, independently Published, 2019.
2. G.Somasundaram, Alok Shrivastava, "Information Storage and Management", EMC Education Series, 2nd Edition, Wiley, Publishing Inc., 2012.
3. R.Marc Farley, "Building Storage Networks", 1st Edition, Tata McGraw Hill, Osborne, 2001.

REFERENCES:

1. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel, Libor Miklas,"Introduction to Storage Area Networks", 9th Edition, IBM Corp, 2017.
2. Robert Spalding,"Storage Networks: The Complete Reference", 1st Edition, Tata McGraw Hill Osborne, 2003.
3. Meeta Gupta, "Storage Area Network Fundamentals", 1st Edition, Pearson Education Limited, 2002.

21PCS19	SOFTWARE DEFINED NETWORKS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To illustrate the separation of data plane and control plane in software defined networks.
- To demonstrate the functions and components of the SDN architecture.
- To examine the role of SDN in data center networks.
- To develop programs to interface different applications with SDN.
- To utilize SDN controllers for improved network management and application performance.

UNIT-I | INTRODUCTION TO SDN — **12**

History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Need for SDN: Evolution of switches and control planes, data center innovation and needs –SDN Working – Centralized and Distributed Control and Date Planes.

SUGGESTED ACTIVITIES:

- Installation of Mininet and Open Day Light controller

UNIT-II | OPEN FLOW & SDN CONTROLLERS — **12**

Open Flow Specification: Openflow 1.0 and Open Flow Basics - Drawbacks of Open SDN - SDN via APIs, SDN via Hypervisor Based Overlays – SDN via Opening up the Device – SDN Controllers: General Concepts.

SUGGESTED ACTIVITIES:

- Configuring Open Flow switches and capture the data flow

UNIT-III | DATA CENTERS — **12**

Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE

SUGGESTED ACTIVITIES:

- Build and emulate network protocols using Mininet

UNIT-IV	SDN PROGRAMMING	
		12

Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV)

SUGGESTED ACTIVITIES:

- ONOS deployment and Northbound – Southbound Interfacing

UNIT-V	SDN APPLICATION AND USECASES	
		12

Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration

SUGGESTED ACTIVITIES:

- Setting up the Environment and Implementation of Open day light Controllers in Mininet

TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Distinguish between the features of Software Defined Network with traditional network

CO2: Outline the various components and functionalities of SDN

CO3: Examine the role of SDN in data centers

CO4: Make use of SDN Northbound APIs to communicate between the SDN Controller and the services

CO5: Experiment with the applications and use cases of SDN

TEXT BOOKS:

1. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann, 2017
2. Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks", 1st Edition, O'Reilly Media, 2013
3. Vivek Tiwari, "SDN and Open Flow for Beginners, Amazon Digital Services", 1st Edition, M.M.D.D. Multimedia LLC., 2013

REFERENCES:

1. SiamakAzodolmolky, "Software Defined Networking with Open Flow", 1st Edition, Packet Publishing, 2013.
2. Fei Hu (Editor), "Network Innovation through Open Flow and SDN: Principles and Design", 1st Edition, CRCPress, 2014.
3. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud", 1st Edition, Addison-Wesley Professional, 2015

21PCS20	CLOUD COMPUTING AND VIRTUALIZATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the concept of cloud computing.
- To summarize the various issues in cloud computing.
- To express the emergence of cloud as next generation computing paradigm
- To describe the novel concepts of virtualization
- To understand Server, desktop and storage virtualization

UNIT-I	INTRODUCTION TO CLOUD COMPUTING	
		12

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing -Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics

SUGGESSTED ACTIVITIES:

• Install virtual box/VM ware workstation • Implementation of virtual machine using Ubuntu OS		
UNIT-II	**CLOUD ARCHITECTURE, SERVICES AND STORAGE**	**12**
NIST- Service Oriented Architecture – REST -Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3 **SUGGESSTED ACTIVITIES:** • Case study:-Azure Cloud,Open stack		
UNIT-III	**CLOUD ENABLING TECHNOLOGIES**	**12**
Web Services – Publish-Subscribe Model – Hadoop – MapReduce – Google App Engine-Federation of cloud **SUGGESSTED ACTIVITIES:** • Install Google App Engine • Install Hadoop		
UNIT-IV	**INTRODUCTION TO VIRTUALIZATION**	**12**
Basics of Virtualization: Characteristics – Taxonomy of Virtualization Techniques – Hardware Level Virtualization – Operating System Level Virtualization **SUGGESSTED ACTIVITIES:** • Case study: Types of virtualization		
UNIT-V	**SERVER ,DESKTOP AND STORAGE VIRTUALIZATION**	**12**
Microsoft virtual server -Server virtualization platforms -Desktop Virtualization: Installing (PC, Windows, Linux)-Deploying and managing VMs-Storage Virtualization-overview-Appliances-services **SUGGESSTED ACTIVITIES:** • Microsoft virtual PC		
		TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Complete in-depth and comprehensive knowledge of the Cloud Computing fundamentals

CO2: Discover the architecture of cloud computing and storage in cloud

CO3: Relate the cloud knowledge and enabling technologies that help in the development of cloud

CO4: Illustrate the various types of virtualizations and its importance

CO5: Demonstrate the server, desktop and storage virtualization concepts.

TEXT BOOKS:

1. Rajkumar Buyya, Christian Vecchiola and Thamari Selvi S, "Mastering in Cloud Computing", 1st Edition, Tata McGraw Hill Education Private Limited, 2017.
2. David Marshall, Wade A. Reynolds, "Advanced Server Virtualization: VMware and Microsoft Platform in the Virtual Data Center", 1st Edition , Auerbach Publications ,2006,
3. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", 1st Edition ,A Press 2005

REFERENCES:

1. Tom Clark, "Storage Virtualization: Technologies for Simplifying Data Storage and Management", 1st Edition, Pearson Education, 2018.
2. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel, Libor Miklas, "Introduction to Vivek Tiwari, "SDN and Open Flow for Beginners", 1st Edition, Amazon Digital Services, Inc., 2017.
3. James E. Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann,1st Edition 2005.

21PCS21	INFORMATION STORAGE AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the components and functions of information storage systems.
- To demonstrate the functionalities of storage networking.
- To develop the storage for the given specification.
- To demonstrate the process of backup and replication.
- To identify the storage components and security mechanism for the storage networking models.

UNIT-I	STORAGE SYSTEM	9

Introduction - Evolution of storage architecture - Key Data center elements – Host, connectivity, storage, and application in both classic and virtual environments – RAID implementations – techniques - RAID levels - impact of RAID on application performance -Components of Intelligent Storage Systems - Provisioning and Intelligent Storage System

UNIT-II	STORAGE NETWORKING TECHNOLOGIES	9

Fibre Channel SAN - components - Connectivity options - topologies - Access protection mechanism – zoning - FC protocol stack – Addressing – SAN based virtualization – VSAN - IP SAN - iSCSI and FCIP protocols for Storage access over IP network - FCoE and its components - Network Attached Storage (NAS)– NAS Hardware devices– NAS Software Components – NAS Connectivity options - NAS operations – Applying the NAS Solution – File level virtualization in NAS – Integration of NAS and SAN - CAS –Object based storage - Unified Storage platform.

UNIT-III	BUSINESS CONTINUITY	9

Information availability and Business Continuity - Business Continuity terminologies - Business Continuity Planning Life cycle– Failure Analysis: Single Points of Failure, solution, - Clustering and Multipathing software –Business Impact Analysis –Practice : EMC powerpath –Features, Dynamic Load balancing – Automatic powerpath Failover/

UNIT-IV	BACKUP AND RECOVERY	9

Backup purpose, Methods, targets and topologies - Data Deduplication: Method, implementation- backup in virtualized environment – Fixed Content and Data Archive and solution – Replication - Local Replication - Remote Replication (local host, storage array & Network based replication)- Three-Site Remote Replication - Continuous Data Protection

UNIT-V	SECURING AND MANAGING STORAGE	9

Information security framework – Storage Security Domains – Implementation in storage networks: FC-SAN, NAS, IP-SAN – securing Cloud Service Environments - Monitoring the storage infrastructure - Parameters, components – Storage infrastructure management activities - Information lifecycle management (ILM) and Storage Tiering .

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Categorize the components and functions of information storage systems

CO2: Illustrate the functionalities of storage networking.

CO3: Demonstrate the process of business continuity for storage networking system

CO4: Show the process of backup and replication

CO5: Choose the storage components and security mechanism for the storage networking models

TEXT BOOKS:

1.John Wiley and Sons, "Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments", EMC Education Services, 2nd Edition, 2012.

2.Robert Spalding, "Storage Networks: The Complete Reference", McGraw Hill Education, 1st Edition, 2017.

3.Shanmuganathan Kumaravel, Libor MiklasTata, Jon Tate, Pall Beck, Hector Hugo Ibarra," Introduction to Storage Area Networks", IBM Redbooks,9th Edition, 2017.

REFERENCES:

1. Gerardus Blokdyk ,"Storage Virtualization A Complete Guide",5 STAR Cooks, 2019.
2. Thejendra BS,"Disaster Recovery and Business Continuity", IT Governance Publishing, 3rd Edition, 2016.
3. James O'Reilly, "Network Storage: Tools and Technologies for Storing Your Company's Data", Morgan Kaufmann, 2016.

21PCS22	STREAM PROCESSING FRAMEWORK	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES :

- To describe concepts and challenges of distributed stateful stream processing.
- To demonstrate Flink's system architecture, event-time processing mode and fault-tolerance model.
- To explain the fundamentals and building blocks of the DataStream API.
- To identify data from and write data to external systems with exactly-once consistency.
- To indicate the continuous running streaming applications.

UNIT-I FUNDAMENTALS OF STATEFUL STREAM PROCESSING **12**

Traditional Data Infrastructures-Stateful Stream Processing-The Evolution of Open Source Stream Processing-Introduction to Dataflow Programming-Processing Streams in Parallel-Time Semantics-State and Consistency Models

SUGGESTED ACTIVITIES:

- Install Oracle Virtual box and create two VMs on your laptop.
- Develop a Hello World application using Google App Engine.

UNIT-II THE ARCHITECTURE OF APACHE FLINK **12**

Introduction to Dataflow Programming-Processing Streams in Parallel-Time Semantics-The Architecture of Apache Flink-Event-Time Processing-State Management-Checkpoints-Save points, and State Recovery.

SUGGESTED ACTIVITIES:

- Use Azure Cloud Shell within the Azure portal to run the file creation simulator located on GitHub.

UNIT-III THE DATASTREAM API (V1.7) **12**

Set Up the Execution Environment-Transformations-Setting the Parallelism-Supported Data Types-Defining Keys and Referencing Fields-Implementing Functions-Including External and Flink Dependencies

SUGGESTED ACTIVITIES:

- Implementation of Para-Virtualization using VM Ware's Workstation/ Oracle's Virtual Box.

UNIT-IV TIME-BASED AND WINDOW OPERATORS **12**

Configuring Time Characteristics-Process Functions-Window Operators-Joining Streams on Time-Handling Late Data.

SUGGESTED ACTIVITIES: • Create an application (Ex: Word Count) using Hadoop Map/Reduce.		
UNIT-V	**Stateful Operators and Applications**	**12**
Implementing Stateful Functions-Enabling Failure Recovery for Stateful Applications-Ensuring the Maintainability of Stateful Applications-Performance and Robustness of Stateful Applications-Evolving Stateful Applications-Queryable State. **SUGGESTED ACTIVITIES:** • Clone the Starter Project from GitHub and Perform a Test Run. • Implementation of Single-Sing-On.		
TOTAL :60 PERIODS		
COURSE OUTCOMES: At the end of the course, learners will be able to CO1: Illustrate the concepts of distributed stateful stream processing. CO2: Demonstrate the architecture of Apache Flink for event-time processing mode and fault-tolerance model. CO3: Build the fundamentals of DataStream API. CO4: Experiment with time-based and window operators. CO5: Evaluate and implement the Stateful Operators and Applications		
TEXT BOOKS: 1. Fabian Hueske, Vasiliki Kalavri,,"Stream Processing with Apache Flink,"1st Edition,O'Reilly Media,2019. 2. Idan Gabrieli, "Cloud Computing for Beginners-Database Technologies and Infrastructure as a Service" Packt Publishing, 2021. 3. Michael Miller, "Cloud Computing: Web-based Applications that change the way you work and collaborate "1st Edition, Pearson Education, 2008.		
REFERENCES: 1. Rajkumar Buyya, Christian Vacchiola, S Thamarai Selvi, Mastering Cloud Computing, 1st Edition, McGraw Hill, 2013. 2. IBM, Introduction to Storage Area Networks and System Networking, 5th Edition, November 2012. 3. Robert Spalding, Storage Networks: The Complete Reference, Tata McGraw Hill, Osborne, 6th reprint 2003.		

21PCS23	**FOG AND EDGE COMPUTING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES: • To infer the concept of fog and edge computing • To paraphrase the Edge computing Architecture • To relate the fog and edge computing in Internet of things • To summarize the improved performance of network slicing in enabling technologies • To describe the concept of optimization in fog and edge computation					
UNIT-I	**INTERNET OF THINGS (IOT) AND NEW COMPUTING PARADIGMS**				**9**
Introduction- Relevant Technologies- Fog and Edge Computing Completing the Cloud- Hierarchy of Fog and Edge Computing - Business Models- Opportunities and Challenges- Networking Challenge-Management Challenge					
UNIT-II	**INTEGRATING IOT , FOG , CLOUD INFRASTRUCTURES**				**9**

Introduction-Methodology-Integrated C2F2T Literature by Modeling Technique-Integrated C2F2T Literature by Use-Case Scenarios-Integrated C2F2T Literature by Metrics-Future Research Directions	
UNIT-III **MANAGEMENT AND ORCHESTRATION OF NETWORK SLICES**	**9**
Introduction-Background-Network Slicing-Network Slicing in Software-Defined Clouds-Network Slicing Management in Edge and Fog- Internet of Vehicles : Architecture, Protocol and Security-Seven layered model architecture for Internet of Vehicles- IoV: Network Models, Challenges and future aspects	
UNIT-IV **OPTIMIZATION PROBLEMS IN FOG AND EDGE COMPUTING**	**9**
Preliminaries-The Case for Optimization in Fog Computing-Formal Modeling Framework for Fog Computing-Metrics-Further Quality Attributes-Optimization Opportunities along the Fog Architecture-Optimization Opportunities along the Service Life Cycle-Toward a Taxonomy of Optimization Problems in Fog Computing	
UNIT-V **APPLICATIONS AND ISSUES**	**9**
Exploiting Fog Computing in Health Monitoring-Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking-Fog Computing Model for Evolving Smart Transportation Applications-Testing Perspectives of Fog-Based IoT Applications-Legal Aspects of Operating IoT Applications in the Fog- Case Study: Technologies in Fog Computing	
	TOTAL: 45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Illustrate the concept of fog and edge computing for relevant business models

CO2: Use the integration modelling techniques for IOT and FOG infrastructure

CO3: Relate the orchestration of slicing concept in different network models

CO4: Solve the issues of formal modeling framework using optimization

CO5: Demonstrate the technologies of fog and edge computing for a given real time scenarios

TEXT BOOKS:

1.Rajkumar Buyya, Satish Narayana Srirama," Fog and Edge Computing: Principles and Paradigms" ,1st Edition,Wiley publication, 2019

2.John Mutumba Bilay , Peter Gutsche, Mandy Krimmel and Volker Stiehl ,"SAP Cloud Platform Integration: The Comprehensive Guide", 2nd Edition, Rheinwerg publishing, 2019

3.Perry Lea ,"IoT and Edge Computing for Architects",2nd Edition, Packt Publishing, 2020

REFERENCES: :

1. Bahga, Arshdeep, and Vijay Madisetti. Cloud computing: A hands-on approach, 1st Edition, CreateSpace Independent Publishing Platform, 2013.

2.Ovidiu Vermesan, Peter Friess, Internet of Things –From Research and Innovation to Market Deployment, 1st Edition, River Publishers, 2014

3. Michael Missbach, Thorsten Staerk, Cameron Gardiner, Joshua McCloud, Robert Madl, Mark Tempes, George Anderson, SAP on Cloud, 1st Edition, Springer, 2016

21PCS24	CLOUD DATA CENTRE NETWORK ARCHITECTURES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To outline the basics of Cloud DCNs.
- To interpret the Architecture and Technology Evolution of DCNs.
- To relate the Interaction Technologies between Cloud DCN components.

- To summarize the concept of Cloud DCN Security.
- To express the Cutting -Edge Technologies for cloud Application.

UNIT-I	INTRODUCTION TO CLOUD DCNs	12

Cloud computing -Virtualization Technologies in cloud computing-SDN for cloud computing-DCN Prospects-DCN Challenges.

SUGGESTED ACTIVITIES:

- Implementation of Para-Virtualization using VM Ware's Workstation/ Oracle's Virtual Box and Guest O.S.
- Place the application and its datasets into a VM cloud environment connecting to existing enterprise applications and datasets on-premises as required.

UNIT-II	ARCHITECTURE AND TECHNOLOGY EVOLUTION OF DCNs	12

Physical Architecture of DCNs-Technology Evolution of DCNs-Service models of cloud DCNs-Interaction between components in the Cloud DCN solution.

SUGGESTED ACTIVITIES:

- Create a Cloud Plat form using Python for Cloud DNS API.
- Set up a Development Environment using Python libraries.

UNIT-III	INTERACTION TECHNOLOGIES BETWEEN CLOUD DCN COMPONENTS	12

Components of Cloud DCN solutions-Physical cloud engine switches-Cloud Engine Virtual Switches; Interaction Technologies - OpenFlow- NETCONF-OVSDB-YANG.

SUGGESTED ACTIVITIES:

- Develop a Case study application and store the application data in cloud datastore.
- Store Image and video files in cloud storage using python.

UNIT-IV	CLOUD DCN SECURITY	12

Cloud DCN Security Challenges-Cloud DCN Security Architectures-Benefits of Cloud DCN Security Solution.

SUGGESTED ACTIVITIES:

- Find a procedure to transfer the files from one virtual machine to another virtual machine.

UNIT-V	CUTTING -EDGE TECHNOLOGIES AND APPLICATION	12

Container-Hybrid Cloud-AI Fabric; Application Scenarios-Advanced Content Security Defense.

SUGGESTED ACTIVITIES:

- Find a procedure to launch virtual machine using trystack
- Create a Cloud Storage bucket using Amazon Simple Storage Service

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the basis of Cloud DCNs.

CO2: Make use of Architecture and Technology Evolution of DCNs.

CO3: Utilize the Interaction Technologies between Cloud DCN components.

CO4: Develop the knowledge on Cloud DCN Security.

CO5: Build the cloud applications using Cutting -Edge Technologies.

TEXT BOOKS:

1. Lei Zhang and Le Chen, "Cloud Data Center Network Architectures and Technologies" 1st Edition, CRC Press, 2021.
2. Dinesh G.Dutt, "Cloud Native Data Center Networking Architecture, Protocols, and Tools", 1st Edition, O'Reilly Media, 2020.

3. Yang Liu, Jogesh K.Muppala, Malathi Veeraraghavan, Dong Lin, Mounir Hamdi, "Data Center Networks Topologies, Architectures and Fault -Tolerance Characteristics", 1st Edition, Springer, 2013.

REFERENCES:

1.Thomas Erl, Ricardo Puttini, Zaigham Mahmood, "Cloud Computing Concepts, Technology & Architecture", 1st Edition, Pearson Education, 2013.

2.James Bond, "The Enterprise Cloud Best Practices for Transforming Legacy IT", 1st Edition, O'Reilly Media, 2015.

3. Gary Lee, "Cloud Networking Understanding Cloud-based Data Center Networks", 1st Edition, Elsevier Science, 2014.

VERTICAL 4: CYBER SECURITY AND DATA PRIVACY

21PIT01	CRYPTOGRAPHIC TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate various encryption techniques.
- To experiment with various symmetric key models.
- To utilize the principles of public key cryptosystems for privacy.
- To build systems using the principles of hash functions and digital signature.
- To summarize the various aspects of Modern cryptography techniques.

UNIT-I INTRODUCTION **9**

Basics of Number theory – Integers and Operations on Integers – Modular arithmetic – Prime Numbers – Primality related properties and Algorithms – Pseudo Random Number Generation. Classical Cryptography: Basic conventions and Terminology – Substitution Ciphers -Transposition ciphers – Rotor machines – Cryptanalysis.

UNIT-II SYMMETRIC KEY CRYPTOGRAPHY **9**

Mathematics Of Symmetric Key Cryptography: Algebraic structures – Modular arithmetic-Euclid"s algorithm- Congruence and matrices – Groups, Rings, Fields- Finite fields- Symmetric Key Ciphers: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis – Evaluation criteria for AES – Advanced Encryption Standard – RC4 -Key distribution.

UNIT-III PUBLIC KEY CRYPTOGRAPHY **9**

Mathematics Of Asymmetric Key Cryptography: Primes – Primality Testing -Factorization – Eulers totient function, Fermats and Eulers Theorem – Chinese Remainder Theorem – Exponentiation and logarithm – Asymmetric Key Ciphers: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange -ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.

UNIT-IV MESSAGE AUTHENTICATION AND INTEGRITY **9**

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509

UNIT-V MODERN ASPECTS OF CRYPTOGRAPHY **9**

Modern Cryptography - Principles - Perfectly Secret Encryption - Shannon's Theorem - Constructing CPA-Secure Encryption Schemes - CPA-Secure Encryption from Pseudorandom Functions

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1: Explain the fundamentals of classical encryption techniques.
CO2: Apply the different operations of symmetric cryptographic algorithms.
CO3: Make use of different cryptographic operations of public key cryptography.
CO4: Build the various authentication schemes to simulate different applications.
CO5: Summarize the various aspects of Modern Cryptography principles.

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security principles-and-practice", 7th Edition, Pearson publication, 2017.
2. Jonathan Katz and Yehuda Lindell, "Introduction to Modern Cryptography", 2nd Edition, CRC press, 2015.
3. Padmanabhan T R, Shyamala C K and Harini N, "Cryptography and Security", 1st Edition, Wiley Publications, 2011.

REFERENCES :

1. William Stallings, "Cryptography and Network Security", 4th Edition, Pearson Education Asia, Prentice Hall, 2000.
2. Forouzan B. A., "Cryptography and Network Security", 7th Edition, Pearson Education, 2017.
3. Wen Bo Mao, "Modern Cryptography-Theory and Practice", 1st Edition, Prentice Hall, USA, 2003.

21PIT02	PARADIGMS OF NETWORK SECURITY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain various security attacks, services and mechanisms.
- To identify various encryption techniques for authentication.
- To develop sniffing solutions using public key cryptography.
- To apply the fundamentals of IP security for Email authentication.
- To construct model for dealing security issues.

UNIT I — SECURITY ATTACKS ,SERVICES AND MECHANISMS — 12

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Understanding Session Hijacking, TCP session hijacking, ARP attacks, route table modification, UDP hijacking.

SUGGESTED ACTIVITIES :

- **Prevention from XSS Attack and ARP Poisoning.**

UNIT II — CONVENTIONAL ENCRYPTION AND HARDWARE HACKING — 12

Symmetric Encryption Principles, Symmetric encryption algorithms, cipher block modes of operation, Understanding Brute Force, Understanding Amateur Cryptography Attempts, Understanding Hardware Hacking, Housing and Mechanical Attacks, External Interfaces , Protocol Analysis.

SUGGESTED ACTIVITIES :

- Implementation of DES Algorithm, substitution techniques and Transposition Techniques.

UNIT III — PUBLIC KEY CRYPTOGRAPHY AND SNIFFING — 12

Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service, Popular Sniffing Software, Advanced Sniffing Techniques. **SUGGESTED ACTIVITIES :** • Implementation of RSA algorithm. • Configuration of a mail agent to support Digital Certificates.		
UNIT IV	**EMAIL PRIVACY AND IP SECURITY**	**12**
Internet Mail Architecture, E-mail Formats, E-mail Threats and Comprehensive, E-mail Security, Pretty Good Privacy (PGP) and S/MIME. IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations. **SUGGESTED ACTIVITIES :** • Authentication of Email.		
UNIT V	**VIRUSES AND THREATS**	**12**
Introduction, Types of Malicious Software, Dealing with Cross-platform Issues, How to Secure against Malicious Software, Intrusion Detection Systems, Password Management, Firewall Design principles. **SUGGESTED ACTIVITIES :** • Detection Method of IDS.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the security attacks, services and mechanisms.

CO2: Make use of encryption techniques for authentication.

CO3: Apply public key cryptography algorithm for authentication.

CO4: Experiment with Email privacy and security.

CO5: Build a model of Firewall and test the security issues.

TEXT BOOKS:

1. William Stallings,"Network Security Essentials (Applications and Standards)" 6th Edition, Pearson Education, 2018.
2. Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W.Manzuik and Ryan Permeh and Wiley Dreamtech, "Hack Proofing your network", 2nd Edition, Syngress publications, March 1, 2002.
3. Matt Bishop, "Computer Security: Art and Science," Addison Wesley, 2nd Edition, 2019.

REFERENCES:

1. Charlien Kaufman, Radia Perlman and Mike Speciner "Network Security – Private Communication in a Public World",1st Edition, Pearson education, 2011.
2. Michael Whitman and Herbert Mattord,"Principles of Information Security", 6th Edition, Cengage Learning, 2017.
3. William Stallings,"Cryptography and network Security", 6th Edition, Pearson education, 2015.

21PIT03	**ENGINEERING SECURE SOFTWARE SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To compare various critical and non-critical systems.
- To illustrate software requirements document and formal specification for a software system.
- To outline distributed system design and architectures.

- To identify the system security failures.
- To build a framework for highly secure software.

UNIT I	SECURITY A SOFTWARE ISSUE	9
Introduction, the problem, Software Assurance and Software Security, Threats to software security, Sources of software insecurity, Benefits of Detecting Software Security,What Makes Software Secure: Properties of Secure Software, Influencing the security properties of software, Asserting and specifying the desired security properties.		
UNIT II	**REQUIREMENTS ENGINEERING FOR SECURE SOFTWARE**	**9**
Introduction, Misuse and Abuse Cases, The SQUARE process Model, SQUARE sample outputs, Requirements elicitation and prioritization.		
UNIT III	**SECURE SOFTWARE ARCHITECTURE AND DESIGN**	**9**
Introduction, software security practices for architecture and design: architectural risk analysis, software security knowledge for architecture and design: security principles, security guidelines and attack patterns Secure coding and Testing: Code analysis, Software Security testing, Security testing considerations throughput the SDLC.		
UNIT IV	**SECURITY AND COMPLEXITY**	**9**
System Assembly Challenges: introduction, security failures, functional and attacker perspectives for security analysis, system complexity drivers and security.		
UNIT V	**GOVERNANCE AND MANAGING FOR MORE SECURE SOFTWARE**	**9**
Governance and security, Adopting an enterprise software security framework, Risk Management Framework for software security, Security and project management, Maturity of Practice.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Compare and contrast the critical and non-critical systems.

CO2: Explain the software requirements document and formal specification for a software system.

CO3: Summarize the distributed system architectures and design.

CO4: Identify the system security failures.

CO5: Build a framework for highly secure software.

TEXT BOOK:

1. Julia H. Allen, "Software Security Engineering: A Guide for Project Managers", Addison-Wesley Professional, Pearson Education, 1st Edition, May 2008.
2. Asoke K. Talukder and Manish Chaitanya, "Architecting Secure Software Systems", CRC Press, 1st Edition, Auerbach Publications, 2019.
3. Mark S. Merkow and Lakshmikanth Raghavan, "Secure and Resilient Software", CRC Press, 1st Edition, 2019.

REFERENCES:

1. Gary McGraw, "Software Security Building Security in", 1st Edition, Addison Wesley, 2006.
2. Jason Grembi, "Secure Software Development A Security Programmer's Guide", 1st Edition, Cengage Learning, 2009.
3. Nancy R. Mead, Julia H. Allen,et.al., "Software Security Engineering A Guide for Project Managers",1st Edition, Pearson Education, 2004.

21PIT04	DIGITAL AND MOBILE FORENSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basic digital forensics techniques.
- To interpret well-trained computer crime investigators.
- To apply the knowledge for processing evidence using forensic tools.
- To identify the various tools involved in forensic investigation.
- To outline the various phases of mobile forensics extraction.

UNIT-I FUNDAMENTALS OF DIGITAL FORENSICS **9**

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues- Introduction to computer crime Investigations& its types– Assess the situation – Acquire the data – Analyze the data – Report the investigation.

UNIT-II DATA ACQUISITION AND TOOLS **9**

Digital evidence, First responder tool kit, techniques of digital forensics, recovery of deleted files, stochastic forensics, steganography, Acquisition methods, The Booting Process, web attack forensics, web application forensic tool.

UNIT-III PROCESSING EVIDENCE **9**

Types of digital evidence, Evidence gathering consideration, data security requirement, Preservation stratergies, seizure, acquisition and examination analysis, Rules of evidence, Good forensic practices.

UNIT-IV FORENSICS INVESTIGATION TOOLS **9**

Current computer forensics tools- software, hardware tools, validating and testing forensic software, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

UNIT-V MOBILE FORENSICS **9**

Mobile forensics- Mobile forensic & its challenges- Mobile phone evidence extraction process: The evidence intake phase- The identification phase, The preparation phase, The isolation phase, The processing phase, The verification phase, The document and reporting phase , The presentation phase- Mobile forensic tool leveling system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Summarize forensic analysis tools to recover important evidençe for identifying Computer crime.
CO2: Demonstrate as well-trained computer crime investigators.
CO3: Apply the knowledge for processing evidence using forensic tools.
CO4: Make use of the various tools involved in forensic investigation.
CO5: Explain the various phases of mobile forensics extraction.

TEXT BOOKS:

1. Dr. Jeetendra Pande and Dr. Ajay Prasad, "Digital forensics", 1st Edition, Uttarakhand Open University, 2016.
2. Jason sachouski, "Computer Forensics and Investigations", 2nd Edition, CRC press, 2018.
3. Satish Bommisetty, Rohit Tamma and Heather Mahalik, "Practical Mobile Forensics", 2nd Edition, Packt Publishing Ltd., 2014.

REFERENCES :

1. Vacca, J, "Computer Forensics, Computer Crime Scene Investigation", 2nd Edition, Charles River Media, 2005.
2. IosifI.Androulidakis, "Mobile phone security and forensics: A practical approach", 1st Edition, Springer publications, 2012.
3. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", 1st Edition, Addison Wesley, 2002.

21PIT05	ETHICAL HACKING EXPLOIT DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To infer various security tools to assess the computing system.
- To identify publicly available tools used to gather information on potential targets.
- To apply scanning techniques used to identify network system open ports.
- To classify network system vulnerabilities and confirm their exploitability.
- To construct flawless wireless network and apply security patches.

UNIT-I	INTRODUCTION TO HACKING	12

Introduction to Hacking – Important Terminologies – Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement –Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary –Reports.

SUGGESTED ACTIVITIES:

- Setup a honey pot and monitor the honey pot on network.

UNIT-II	INFORMATION GATHERING AND SCANNING	12

Information Gathering Techniques –Active Information Gathering –Passive Information Gathering–Sources of Information Gathering-Tracing the Location-Traceroute-ICMP Trace route –TCP Trace route and its Usage – UDP Trace route –Enumerating and Fingerprinting the Webservers –Google Hacking – DNS Enumeration –Enumerating SNMP –SMTP Enumeration – Target Enumeration and Port Scanning Techniques–Advanced Firewall/IDS Evading Techniques.

SUGGESTED ACTIVITIES:

- Create a social networking website login page using phishing techniques.

UNIT-III	NETWORK ATTACKS	12

Vulnerability Data Resources – Exploit Databases – Network Sniffing – Types of Sniffing –Promiscuous and Non promiscuous versus Mode – MITM, ARP, Denial of Service and Hijacking Session with MITM Attacks – SSL Strip: Stripping HTTPS Traffic –DNS, ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing –Remote Exploitation – Attacking Network Remote Services – Overview of Brute Force and Traditional Brute Force – Attacking SMTP, SQL Servers – Testing for Weak Authentication.

SUGGESTED ACTIVITIES:

- Demonstration of DoS attacks.

- Install jcrypt tool (or any other equivalent) and demonstrate Asymmetric, Symmetric Crypto algorithm, Hash and Digital/PKI signatures studied in theory Network Security and Management.

UNIT-IV	EXPLOITATION	12

Introduction to Metasploit–Reconnaissance with Metasploit –Port Scanning with Metasploit, Compromising a windows Host with Metasploit –Client Side Exploitation Methods –Creating a Custom Executable and a Backdoor with SET – PDF Hacking– Social Engineering Toolkit– Browser and Post Exploitation– Acquiring Situation Awareness– Hashing and Windows Hashing Methods –Cracking the Hashes– Brute force Dictionary attacks – Password Salts– Rainbow Tables– John the Ripper– Gathering OS Information–Harvesting Stored credentials.

SUGGESTED ACTIVITIES:

- Install rootkits and study variety of options.
- Study of Techniques uses for Web Based Password Capturing

UNIT-V	WIRELESS AND WEB HACKING	12

Wireless Hacking – Introducing Air crack – Cracking a WEP – Cracking a WPA/WPA2 Wireless Network Using Air cracking – Evil Twin Attack – Causing Denial of Service on the Original AP.
Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks –Further Reading–Crawling Restricted Links–Testing for the Vulnerability –Authentication Bypass with Insecure Cookie Handling– SQL Injection Attacks –Cross-Site Scripting and it types.

SUGGESTED ACTIVITIES:

- Demonstration of SQL injection attacks.
- Implement passive scanning, active scanning, session hizaking, cookies extraction using Burp suit tool.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Summarize the various security tools to assess the computing system.
CO2: Experiment with the vulnerabilities across any computing system using penetration testing.
CO3: Make use of prediction mechanism to prevent any kind of attacks.
CO4: Utilize the various techniques to protect the system from malicious software and worms.
CO5: Identify the wireless network flaws and apply security patches.

TEXT BOOKS:

1. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 1st Edition, 2015.
2. Allen Harper, Ryan Linn, Stephen Sims, Michael Baucom and Moses Frost, "Gray Hat Hacking: The Ethical Hacker's Handbook", 5th Edition, McGraw Hill, 2018.
3. Stefano Novelli, Marco Stefano Doria and Marco Silvestri, "Hacklog Volume 1 Anonymity: IT Security & Ethical Hacking Handbook", 1st Edition, BW / Inforge, 2019.

REFERENCES:

1. Alana Maurushat, "Ethical Hacking",1st Edition, University Of Ottawa Press,2019.
2. Kevin Beaver, "Ethical Hacking for Dummies",6th Edition, Wiley publications, 2018.
3. Mohuya Chakraborty, Satyajit Chakrabarti and ValentinaE.Balas, "Proceedings of International Ethical Hacking Conference 2019", 1st Edition, Springer Singapore, 2020.

21PIT06	SOCIAL NETWORK SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the components of the social network analysis.
- To infer about the privacy in social networks.
- To explain about data mining and text mining.
- To interpret the knowledge about web mining.
- To build the real time application systems.

UNIT-I	INTRODUCTION	9

Social Network Analysis – Basic concepts – Design, Theorization, Data Processing – Tensor Decomposition - Characteristics of Online Communication - Rich Media Communication Patterns – Applications of SNA.

UNIT-II	PRIVACY IN SOCIAL NETWORKS	9

Privacy breaches – definitions for publishing data – Privacy preserving mechanisms - Trust Network Analysis - Trust Transitivity Analysis - The Dirichlet Reputation System.

UNIT-III	DATA MINING AND TEXT MINING	9

Data Mining in a Nutshell - Social Media - Motivations for Data Mining in Social Media - Data Mining Methods for Social Media - Related Efforts. Text Mining: Keyword Search - Classification Algorithms - Clustering Algorithms - Transfer Learning in Heterogeneous Networks.

UNIT-IV	WEB MINING	9

Web Community - Web Data Model - Information Retrieval Performance Evaluation Metrics - Web Content Mining - Web Linkage Mining: Web Graph Measurement and Modeling - Web Linkage Mining.

UNIT-V	APPLICATIONS	9

Analysis of Communities and Their Evolutions in Dynamic Networks - Socio-Sense: A System for Analyzing the Societal Behavior from Web Archive - A Hybrid User-based and Item-based Web Recommendation System - User-based and Item-based Collaborative Filtering Recommender Systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the components of the social network analysis.

CO2: Interpret knowledge about the privacy in social networks.

CO3: Illustrate about data mining and text mining.

CO4: Demonstrate web mining in social network.

CO5: Develop the application related to real time systems.

TEXT BOOKS:

1. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition, Springer, 2010.
2. Guandong Xu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", 1st Edition, Springer, 2012.
3. Brij B. Gupta and Somya Ranjan Sahoo, "Online Social Networks Security: Principles, Algorithm, Applications, and Perspectives", 1st Edition, CRC Press Publishers, 2021.

REFERENCES :

1. Charu C. Aggarwal, "Social Network Data Analytics", 1st Edition, Springer, 2014.

2. Przemyslaw Kazienko and Nitesh Chawla, "Applications of Social Media and Social Network Analysis", 1st Edition, Springer, 2015.
3. Nilanjan Dey, Samarjeet Borah, Rosalina Babo, Amira S. Ashour, "Social Network Analytics", 1st Edition, Academic Press Publishers, 2018.

21PIT07	SECURITY AND PRIVACY IN CLOUD	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the concept of cloud computing.
- To explain the architecture and services of cloud.
- To identify the need of security in cloud computing.
- To outline the privacy in cloud computing.
- To illustrate cloud security polices for audit and compliance.

UNIT-I	INTRODUCTION	9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On demand Provisioning.

UNIT-II	CLOUD ARCHITECTURE, SERVICES AND STORAGE	9

Basics of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms- Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage.

UNIT-III	CLOUD SECURITY STANDARDS	9

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud, Key privacy issues in the cloud.

UNIT-IV	PRIVACY IN CLOUD	9

Privacy- Data Life Cycle- Key privacy concerns in cloud- Responsibility for protecting privacy-Changes to privacy Risk Management and Compliance in Relations to cloud computing- Legal and Regularity Implications- Laws and Regulations.

UNIT-V	AUDIT AND COMPLIANCE	9

Audit and Compliance -Internal Policy Compliance -Governance, Risk, and Compliance (GRC) - Illustrative Control Objectives for Cloud Computing -Incremental CSP-Specific Control Objectives - Additional Key Management Control Objectives- Control Considerations for CSP Users - Regulatory/External Compliance - Auditing the Cloud for Compliance.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Interpret the concept of cloud computing.
CO2: Summarize the architecture and services of cloud.
CO3: Experiment with IAM practices in cloud computing.
CO4: Explain the privacy issues in cloud computing.
CO5: Outline cloud security polices for audit and compliance.

TEXT BOOKS:
1. Tim Mather, Subra Kumaraswamy, and Shahed Latif," Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice)", 1st Edition, O'Reilly Publications, September 2009. 2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things",1st Edition, Morgan Kaufmann Publishers, 2012. 3. Liliana F. B. Soares, Diogo A. B. Fernandes and Joao V. Gomes," Security ,privacy and trust in cloud systems",1st Edition, Springer-Verlag Berlin Heidelberg publications,2014.
REFERENCES :
1.Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, "Mastering Cloud Computing", 1st Edition, Tata Mcgraw Hill, 2013. 2. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach", 1st Edition, Tata Mcgraw Hill, 2009. 3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 2009.

21PIT08	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To infer the basic concepts of Blockchain technologies.
- To identify Ethereum basics and its applications.
- To outline Bitcoin basics and its challenges.
- To apply the fundamentals of crypto currencies.
- To develop the applications of Blockchain technologies and deal with privacy issues.

UNIT I	INTRODUCTION OF BLOCKCHAIN	12

Peer-to-Peer (P2P) Networking, Blockchain Architecture, Blocks in Blockchain, Types of Block chain, the Logical Components of Blockchain, Core Components of Blockchain Architecture, Smart contracts and their applications.

SUGGESTED ACTIVITIES :

- Study of Basic Cryptography Concepts for Blockchain

UNIT II	ETHEREUM BASICS	12

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

SUGGESTED ACTIVITIES :

- Creating and Building up Ethereum Wallet.
- Building a Private Ethereum Network and Deploying Smart Contract

UNIT III	INTRODUCTION OF BITCOIN	12

Bitcoin features, Blockchain and Bitcoin, Bitcoin Security, Bitcoin Transaction, Transaction Lifecycle, Consensus Protocol, Role of Bitcoin Crimes, Dark Side of Bitcoin Crimes, Open Challenges to Bitcoin Crimes.

SUGGESTED ACTIVITIES :

• Creating and Building a Bitcoin Wallet.		
UNIT IV	**FUNDAMENTALS OF CRYPTOCURRENCIES**	**12**

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Foundations – Bitcoin Limitations – Name Coin – Prime Coin – Zcash – Smart Contracts – Ricardian Contracts.

SUGGESTED ACTIVITIES :

- Study of Hyperledger
- Creating a Business Ledger using Hyperledger

UNIT V	**SECURITY AND PRIVACY ISSUES OF BLOCKCHAIN TECHNOLOGY**	**12**

Introduction, Blockchain - Aspects for Consideration, Security of block chain, Privacy of blockchains, Security Issues of Blockchain Technology, Privacy Issues of Blockchain Technology, Types of Attack, Security Enhancement to Blockchain Systems, Applications of Blockchain in Health care, Finance.

SUGGESTED ACTIVITIES :

- Building and deploying multichain private Blockchain

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the concepts of Blockchain technologies.

CO2: Develop Ethereum block chain contract.

CO3: Make use of the concepts of Bitcoin and their usage.

CO4: Experiment with the basic principles of Cryptocurrencies.

CO5: Utilize the knowledge of blockchain technologies to develop various applications.

TEXT BOOKS:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", 2nd Edition, Packt Publishing, 2018.
2. Pethuru Raj, Kavita Saini and Chellammal Surianarayanan," Blockchain Technology and Applications", 1st Edition, CRC Press, 2021.
3. Elad Elrom, "The Blockchain Developer – A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchian-based Projects", 1st Edition, Apress, 2019.

REFERENCES:

1. Saravanan Krishnan, Raghvendra Kumar, S. Balaji, , Valentina Emilia Balas and Y. Harold Robinson , "Handbook of Research on Blockchain Technology", 1st Edition, Academic Press, 2020.
2. Merunas Grincalaitis, "Mastering Ethereum: Implement Advanced Blockchain Applications using Ethereum-supported Tools, Services, and Protocols", 1st Edition, Packt Publishing, 2019.
3. Melanie Swan," Blockchain Blueprint for a New Economy", 1st Edition, O'Really Media Inc, 2015.
4. Shiho Kim and Ganesh Chandra Deka," Advanced Applications of Blockchain Technology", 1st Edition, Springer, 2019.

VERTICAL 5: CREATIVE MEDIA

21PIT09	MULTIMEDIA AND ANIMATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To infer multimedia system design.
- To utilize multimedia file handling, various software programs used in creation and implementation of multimedia.
- To identify various types of animation.
- To make use of strong knowledge about the fundamental principles of animation.
- To model various types of drawings.

UNIT I	MULTIMEDIA SYSTEM DESIGN	12

Multimedia basics – Multimedia applications – Multimedia system architecture – Evolving technologies for multimedia – Defining objects for multimedia systems – Multimedia data interface standards – Multimedia databases. Compression and decompression – Binary, color, gray scale and still video image compression, Video image compression, audio compression.

SUGGESTED ACTIVITIES:

- Study the notes of a piano and stimulate them using the keyboard and store them in file
- Devise a routine to produce the animation effect of a square transforming to a triangle and then to a circle.

UNIT II	MULTIMEDIA FILE HANDLING & HYPERMEDIA	12

Data and file format standards – Multimedia I/O technologies – Digital voice and audio – Video image and animation – Full motion video – Storage and retrieval technologies. Multimedia authoring systems- User interface design - Hypermedia messaging -Mobile messaging – Hypermedia message component – Creating hypermedia message – Integrated multimedia message standards – Integrated document management – Distributed multimedia systems.

SUGGESTED ACTIVITIES:

- Write a program to play "wave" or "midi" format sound files

UNIT III	ANIMATION BASICS	12

Animation: Stop Motion Photo Animation- Cel and Paper Animation- Cel Animation, Stop Motion Animation, Computer Animation, 2-D Animation, 3-D Animation.

SUGGESTED ACTIVITIES:

- Designing Flipbook.
- Drawing Basic Shapes.

UNIT IV	ANIMATION PRACTICES	12

Squash and Stretch, slow in and slow out, timing and placement, Generic walk, Double bounce and sneak, Full rigged character, Character walk

SUGGESTED ACTIVITIES:

- Designing Characters with Wax and Oil Based Clay.
- Using characters in stop motion animation.

UNIT V	DRAWINGS	12

Audio record and breakdown, Story Board, Key Pose animation, Key Drawings and in Betweens Clean ups, Background art- Light and shade, Light and Shadow, Depth layering, Inking and colouring, Digital colouring

SUGGESTED ACTIVITIES:

- Experimental Work with different mediums like sand, stones, grass, hard board, pen and Ink , water colors, poster colors, dry brush etc.
- Draw all kinds of facial expressions.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Outline the design of Multimedia System Design.

CO2: Develop various types of Multimedia File handing methods and experiments with various shapes and hypermedia files.

CO3: Make use of various types of animation in developing applications.

CO4: Identify various techniques in animation.

CO5: Experiment with types of drawings.

TEXT BOOKS:

1. Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", 1st Edition, Pearson Education India, 2015.
2. Chris Patmore ," The Complete Animation Course: The Principles, Practice, and Techniques of Successful Animation", 1st Edition, Baron's Educational Series, 2003.
3. Tony White, "Animation Masterclasses from Pencils to Pixels- A Complete Course in Animation & Production", 1st Edition, CRC Press, 2022.

REFERENCES :

1. Judith Jeffcoate, "Multimedia in practice: Technology and Applications", 1st Edition, PHI, 1998.
2. Richard Williams, "The Animator's Survival Kit", 1st Edition, Faber and Faber Publications, 2009.
3. Chris Webster, "Animation The Mechanics of motion", 1st Edition, Focal Press, 2005.

21PIT10	MULTIMEDIA DATA COMPRESSION AND STORAGE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the fundamentals of compression techniques.
- To illustrate the various coding and algorithms of Text and Image compression.
- To apply the compression techniques in multimedia processing applications.
- To learn about standards and techniques of video compression.
- To explain the basics of multimedia communication and retrieval that is commonly used in industry.

UNIT-I	FUNDAMENTALS OF COMPRESSION	9

Introduction To multimedia – Graphics, Image and Video representations — Storage requirements of multimedia applications – Need for compression – Taxonomy of compression Algorithms - Elements of Information Theory – Error Free Compression – Lossy Compression.

UNIT-II	TEXT AND IMAGE COMPRESSION	9

Huffman coding – Adaptive Huffman coding – Arithmetic coding – Shannon-Fano coding-Dictionary techniques – LZW family algorithms - Image Compression – JPEG Standard –JPEG 2000 standards – JBIG and JBIG2 standards.		
UNIT-III	**AUDIO COMPRESSION**	**9**
Audio compression Techniques – ADPCM in speech coding– Phase Insensitivity – Chanel Vocoder – Formant vocoder – G.726 ADPCM – MPEG audio – CELP vocoders – Linear Predictive coding.		
UNIT-IV	**VIDEO COMPRESSION**	**9**
Video compression – MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-4 – Motion compensation techniques –H.261 Standard –H.263 Standard.		
UNIT-V	**MULTIMEDIA COMMUNICATION AND RETRIEVAL**	**9**
Basics of computer and multimedia network – Multiplexing Technologies –Quality of Multimedia Data Transmission –Multimedia over ATM Networks – Media on Demand– Radio propagation channel –Trends in Wireless Interactive Multimedia.		
		TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Outline the fundamentals of multimedia compression techniques.

CO2: Summarize the various algorithms of Text and Image compression.

CO3: Apply the various compression techniques for multimedia processing applications.

CO4: Compare various video compression techniques.

CO5: Explain the basic concepts of multimedia communication and retrieval.

TEXT BOOKS:

1. Darrel Hankerson, Greg A Harris and Peter D Johnson, "Introduction to Information Theory and Data Compression", 2nd Edition, Chapman and Hall, CRC press, 2003.
2. Khalid Sayood," Introduction to Data Compression", Morgan Kauffman Harcourt India, 5th Edition, 2020.
3. Mark S. Drew, Ze-Nian Li, "Fundamentals of Multimedia", 1st Edition, Pearson education, 2004.

REFERENCES :

1. David Solomon, "Data Compression – The Complete Reference", 4th Edition, Springer Verlog, New York, 2006.
2. Brusilovsky, Peter et.al, "The Adaptive Web: Methods and Strategies of Web Personalization", 1st Edition, Springer, 2007.
3. David Salomon, "Handbook of Data Compression", 5th Edition, Springer publication, 2010.

21PIT11	UI AND UX DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To outline the design of graphical user interfaces.
- To illustrate the user interfaces design process.
- To demonstrate the concepts and principles of UX.
- To develop an UX plane for an application.

- To build a simple application with UI and UX.

UNIT I	INTRODUCTION TO THE USER INTERFACE	12

The importance of User Interface (UI) – The importance of Good Design – A Brief Historical Overview of Interface Design – Characteristics of Graphical and Web User Interface – Interaction Styles – The Graphical User Interface – Web User Interface – Principles of UI Design – The Merging of Graphical Business Systems and the Web.

SUGGESTED ACTIVITIES:

- GUI Basics – Building an Interface.

UNIT II	USER INTERFACE DESIGN PROCESS	12

Know Your User or Client - Understand the Business Function - Understand the Principles of Good Interface and Screen Design - Develop System Menus and Navigation Schemes - Select the Proper Kinds of Windows - Select the Proper Interaction Devices - Choose the Proper Screen-Based Controls - Create Meaningful Graphics, Icons, and Images - Choose the Proper Colors - Organize and Layout Windows and Pages.

SUGGESTED ACTIVITIES:

- Graphics – The Canvas.

UNIT III	INTRODUCTION TO THE USER EXPERIENCE	12

The Tao of UXD Basics- What Is User Experience Design? - The Broad Definition - The Project Ecosystem - Identify the Type of Site - Choose Your Hats - Understand the Company Culture - Proposals for Consultants and Freelancers - UX Design Guidelines.

SUGGESTED ACTIVITIES:

- Widget Events – Binding Actions.

UNIT IV	UX PLANE	12

The Strategy Plane - The Scope Plane - The Structure Plane - The Skeleton Plane - The Surface Plane - The Elements Applied - User Experience and the Web - Meet the Elements.

SUGGESTED ACTIVITIES:

- Improving the User Experience.

UNIT V	UI/ UX Design Tools	12

Invaders Revenge - An Interactive Multi-touch Game - Invaders Revenge – An animated multi-touch game- Atlas – An efficient management of images-Boom – simple sound effects - Ammo – simple animation- Invader – transitions for animations - Dock – automatic binding in the Kivy language - Fleet – infinite concatenation of animations - Scheduling events with the clock- Shooter – multi-touch control- Invasion – moving the shooter with the keyboard - Combining animations with '+' and '&'.

SUGGESTED ACTIVITIES:

Develop sound effect and shooter for a simple game.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the design of graphical user interfaces.

CO2: Summarize the User Interfaces to design a good product.

CO3: Relate the concepts and principles of UX.

CO4: Experiment with UX plane.
CO5: Develop a simple application incorporating UI and UX.

TEXT BOOKS:

1. Wilbert O. Galitz, "The Essential Guide to User Interface Design An Introduction to GUI Design Principles and Techniques", 3rd Edition, Wiley Publishing, Inc., 2017.
2. Russ Unger and Carolyn Chandler, "A Project Guide to UX Design: For user experience designers in the field or in the making", 2nd Edition, New Riders Publishing, 2012.
3. Roberto Ulloa, "Kivy – Interactive Applications and Games in Python", 2nd Edition, Packt Publishing, 2015.

REFERENCES:

1. Jesse James Garrett, "The Elements of User Experience: User-Centered Design for the Web and Beyond", 2nd Edition, Pearson Education. 2011.
2. Rex Hartson and Pardha S. Pyla, "The UX Book Process and Guidelines for Ensuring a Quality User Experience", Elsevier, 2012.
3. Pamala Deacon, "UX and UI Strategy: A step by step Guide on UX and UI design", 1st Edition, Packt Publishing, 2020.

21PIT12	VIDEO PROCESSING AND ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of video processing.
- To identify the moving objects using motion estimation techniques.
- To experiments with video processing tools for analytics.
- To utilize data streams for categorization of videos.
- To construct application for video analytics.

UNIT-I	VIDEO FUNDAMENTALS	9

Basic Concepts and Terminology – Analog Video Standards – Digital Video Basics – Analog to Digital Conversion – Color Representation and Chroma Sub Sampling – Video Sampling Rate and Standards Conversion – Digital Video Formats – Video Features – Colour, Shape and Textural features.

UNIT-II	MOTION ESTIMATION	9

Fundamentals of Motion Estimation – Optical Flow – 2D and 3D Motion Estimation – Block Based Methods – Phase Correlation Methods – Block Matching Methods – Hierarchical Motion Estimation – Genaralized Block Motion Estimation

UNIT-III	VIDEO SEGMENTATION AND ANALYTICS	9

Direct Methods – Optical Flow Segmentation – Simultaneous Estimation and Segmentation: Motion Field Model – The Algorithm – Relationship to other algorithms.

UNIT-IV	MINING DATA STREAMS	9

Introduction to Streams Concept – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Video Database – Categorization of Videos – Video Query Categorization.

UNIT-V	EMERGING TRENDS	9

Affective Video Content Analysis – Parsing a Video into Semantic Segments – Video Indexing and Abstraction for Retrieval – Automatic Video Trailer Generation– Video in painting– Forensic Video Analysis.
TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the basic video processing functions.

CO2: Experiment with optical flow and motion estimation.

CO3: Make use of segmentation techniques for video analytics.

CO4: Select techniques to index and retrieve videos for faster access

CO5: Develop applications for video analytics.

TEXT BOOKS:

1. A. Murat Tekalp, "Digital Video Processing", 2nd Edition, Prentice Hall, 2015.
2. Oges Marques, "Practical Image and Video Processing Using MATLAB", 1st Edition, Wiley and Sons (IEEE Press), 2011.
3. Anand Rajaraman, Jeffrey David Ullman, "Mining of Massive Datasets", 1st Edition, Cambridge University Press, 2012.

REFERENCES :

1. Alan C. Bovik, "Handbook of Image and video processing", 2nd Edition, Academic Press, 2005.
2. Al Bovik, "The Essential Guide to Video Processing", 1st Edition, Academic Press, 2009.
3. Suhel Dhanani and Michael Parker, "Digital Video Processing for Engineers: A Foundation for Embedded Systems Design", 1st Edition, Newnes publishers, 2012.

21PIT13	TECHNIQUES FOR VISUAL EFFECTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the basics of visual effects.
- To summarize basic compositing theory.
- To experiment with intermediate compositing techniques.
- To make use of advanced compositing methods.
- To build applications with advanced effects.

UNIT-I	INTRODUCTION	9
Digital Image Basics – Resolution – Color – Packing it in – File formats – Video and Film – Film to Computer – Video to Computer – Image Quality – Desktop Hardware options – Telecine – Film Scanners.		
UNIT-II	**BASIC COMPOSITING AND TOOLS**	**9**
Basic Compositing theory – Channels – Mattes – Filters – Geometric transformation – Basic tools – Compositing with alpha channel – Simple keying – Filters and Effects – Geometric Transformations.		
UNIT-III	**INTERMEDIATE COMPOSITING**	**9**
Rig removal with a clean plate – Rotoscoping – Tracking – Stabilizing – Destabilizing – Tracking for animation.		
UNIT-IV	**ADVANCED COMPOSITING**	**9**

Tweaking Colors – Color tools – Matte painting for the moving camera – Reserving footage – Changing speed – Motion blur – Stretching time.

UNIT-V	QUALITY AND ADVANCED SPECIAL EFFECTS	9

Quality and Efficiency – Minimizing data loss – Consolidating operations – Beyond black and white – Non linear color spaces – working with 3D elements – Related 2D disciplines – case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the concept of Visual Effects.
CO2: Outline about various compositing and tools.
CO3: Utilize the concepts of Intermediate compositing for animation.
CO4: Make use of advanced compositing techniques.
CO5: Experiment with 2D and 3D animation techniques.

TEXT BOOKS:

1. Doug Kelly, " Digital Compositing In Depth: The Only Guide to Post Production for Visual Effects in Film",1st Edition, Coriolis Group Books,2000.
2. Ron Brinkmann, "The art and science of digital compositing: Techniques for visual effects, Animation and Motion Graphics",2nd Edition, Morgan Kaufmann,2008.
3. Jeffrey Okun , Susan Zwerman ,"The VES Handbook of Visual Effects: Industry Standard VFX Practices and Procedures",Routledge,3rd Edition,2020.

REFERENCES :

1. Angie Taylor," Creative After Effects 7: Workflow Techniques for Animation, Visual Effects and Motion Graphics", 1st Edition, Focal press, 2006.
2. Charles Finance and Susan Zwerman, "The Visual Effects Producer: Understanding the Art and Business of VFX,Routledge, 1st Edition, 2015.
3. Gress Jon, "[digital] Visual Effects and Compositing, 1st Edition, New Riders publications, 2014.

21PIT14	GAME DESIGN AND DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To illustrate the basic concepts of game programming.
- To experiment with 3D graphics concepts.
- To apply the terminologies like sound, physics and cameras for developing simple games.
- To choose user interfaces and scripting for developing games.
- To make use of gaming concepts for game development.

UNIT I	INTRODUCTION TO GAME PROGRAMMING	12

Game Programming Overview: Evolution of Video Game Programming - The Game Loop - Time and Games – Game Objects. 2D Graphics: 2D Rendering Foundations - Sprites – Scrolling - Tile Maps. Linear Algebra for Games.

SUGGESTED ACTIVITIES:

- Installation of Pygame and Pygame Zero and Implementation of colour models and shading models in Python.

UNIT II	3D GRAPHICS	12

Basics - Coordinate Spaces - Lighting and Shading – Visibility - World Transform, Revisited - Input Devices - Event-Based Input Systems - Mobile Input.

SUGGESTED ACTIVITIES:

- Experiment with game script in natural language for story creation.
- Practical problems in game level design.

UNIT III	SOUND, PHYSICS AND CAMERAS	12

Basic Sound - 3D Sound - Digital Signal Processing - Planes, Rays, and Line Segments. - Collision Geometry - Collision Detection - Physics-Based Movement - Types of Cameras - Perspective Projections - Camera Implementations - Camera Support Algorithms.

SUGGESTED ACTIVITIES:

- Implementation of simple animations in Pygame and Processing.py

UNIT IV	USER INTERFACES AND SCRIPTING	12

Menu Systems - HUD Elements - Other UI Considerations - Scripting Languages - Implementing a Scripting Language - Data Formats.

SUGGESTED ACTIVITIES:

- Installation of Unity scripts routines for character rendering, transformations and sound processing.

UNIT V	GAME DEVELOPMENT	12

Side-Scroller for iOS - Tower Defense for PC/Mac - Tetris game.

SUGGESTED ACTIVITIES:

- Implementation of Sudoku Game
- Implementation of Tic Tac Toe Game

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the basic concepts of game programming.

CO2: Experiment with 3D graphics concepts.

CO3: Make use of the concepts of sound, physics and cameras to develop simple games.

CO4: Apply the concepts of user interfaces and scripting to develop games.

CO5: Utilize the gaming concepts to develop games in various platforms.

TEXT BOOKS:

1. Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach", Addison-Wesley Professional, 2nd Edition, 2014.
2. K. Patinson, "Game Development: Gaming Design and Programming", Code Academy Publishers, 1st Edition, 2021.
3. James R Parker and J R Parker, "Introduction to Game Development:", Mercury Learning & Information Publishers, 1st Edition, 2015.

REFERENCES:

1. Will McGugan, "Beginning Game Development with Python and Pygame: From Novice to Professional", Apress Publishers, 1st Edition, 2007.
2. Paul Vincent Craven, "Program Arcade games", Apress Publishers, 4th Edition, 2016.
3. Steve Rabin, "Introduction to Game Development", Charies River Media Publishers, 2nd Edition, 2009.

21PIT15	CONCEPTS OF AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate various augmented reality methods.
- To explain the scientific, technical and engineering aspects of augmented reality.
- To explain the scientific, technical and engineering aspects of virtual reality.
- To develop applications based on AR and VR technologies.
- To summarize the applications of AR and VR.

UNIT-I	INTRODUCTION	9

Introduction to Augmented Reality, Other Enhancements, The Relationship between Augmented Reality and Other Technologies, Virtual and Mixed Reality, Cyber Space, Virtuality and the Virtuality Continuum, The Reality Continuum, The Metaverse and the Metaverse Roadmap, Introduction to VR – The three I's of VR, Early commercial VR technology, VR becomes an Industry, Five classic components of VR system

UNIT-II	AUGMENTED REALITY HARDWARE	9

The Two-Step Process of Augmented Reality Applications, Hardware Components For AR - Sensors, Processors, Displays, Augmented Reality System.

UNIT-III	VIRTUAL REALITY HARDWARE	9

Input Devices: Trackers, Navigation and Gesture Interfaces, Output Devices: Graphics, Three-Dimensional Sound, and Haptic Displays, Computing Architecture for VR, Modeling.

UNIT-IV	AR AND VR SOFTWARE DEVELOPMENT	9

Software involved directly in the Augmented Reality application- Environmental acquisition, Sensor integration, Application engine, Rendering software, Augmented Reality libraries, Software used to create content for the Augmented Reality Application, VR Programming – Toolkits and Scene graphics, World toolkit, Java 3D, General Haptics Open Software Toolkit (GHOST).

UNIT-V	APPLICATIONS	9

AR Applications – Magic books, Magic Mirrors, Magic Windows and Doors, Magic Lens, Navigation Assistance, Non referential augmentation, Objective view augmented reality, Traditional VR applications – Medical Applications of VR, Virtual anatomy, Triage and Diagnostic, Surgery, Rehabilitation, Education, arts and Entertainment, Military VR Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the basic knowledge of AR and VR.

CO2: Outline the scientific, technical and engineering aspects of AR.

CO3: Outline the scientific, technical and engineering aspects of VR.

CO4: Experiment with technologies related to AR and VR software development.

CO5: Summarize the applications of AR and VR engineering.

TEXT BOOKS:

1. Burdea, G. C. and P. Coffet, "Virtual Reality Technology", 2nd Edition, Wiley-IEEE Press, 2006.
2. Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", 1st Edition, Morgan Kaufmann, 2013.

3. John Vince, “Virtual Reality Systems”, 1st Edition, Pearson Education, 2002.

REFERENCES :

1. Alan Craig, William Sherman and Jeffrey Will, “Developing Virtual Reality Application, Foundations of Effective Design”, 1st Edition, Morgan Kaufmann, 2009.
2. George Mather, “Foundations of Sensation and Perception”,3rd Edition, Psychology Press, 2009.
3. Chetankumar G Shetty, “Augmented Reality - Theory, Design and Development”, 1st Edition, McGraw Hill 2020.

21PIT16	STRATEGIES OF DIGITAL MARKETING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of Digital Marketing.
- To outline the optimization of search engine.
- To utilize the most popular social media platforms to grow business.
- To experiment with various tools for digital marketing.
- To plan case studies for understanding real world scenarios.

UNIT-I **INTRODUCTION TO DIGITAL MARKETING** **9**

Introduction- From Traditional to model marketing-Premise of Traditional Marketing-Evolution of Digital Marketing-Rise of the Internet- Growth and Impact of Search Technologies- Understanding e models-Digital -The next wave of Marketing.

UNIT-II **SEARCH ENGINE OPTIMIZATION (SEO)** **9**

SEO tools-Picking a product-Picking a domain name-Domain Registration & Hosting-Page Optimization-Home Page Optimization-Site Optimization-Registering with Directories-Link Building-Common SEO Abuse Techniques-Appearing Natural-SEO as a Standalone Product-The Social Elements of Relevancy-Interactive Elements-Choosing a Domain Name-Hosting-Copywriting.

UNIT-III **SOCIAL MEDIA OPTIMIZATION (SMO)** **9**

Blogging-API-Widget-Likes-Groups-Application-Open Graph-Traditional Marketing
Elucidation of out bound tactics-Inbound Marketing- Magnet, Sledgehammer Concept-Content Marketing-Get Found Tactics -Convert Tactics-Analyze Tactics.

UNIT-IV **SEARCH ENGINE MARKETING** **9**

Emergence of Digital Marketing as a tool- Pull and Push Marketing-Media consumption drivers for new marketing environment-Digital Marketing Channel-Digital Marketing Frame work -Digital Marketing application and benefits-Critical Success Factors for Digital Marketing.

UNIT-V **CASE STUDIES** **9**

Google Analytics -Website Analysis and Quality Control-A Microlevel Elucidation of Lead Generation Strategy-Content Formats for Mobile-Lead Nurturing-SEO Next-Social Media Monitoring Strategy-Google Algorithms-Steps to increase Google Page Rank.

TOTAL :45 PERIODS

COURSE OUTCOMES:
At the end of the course, learners will be able to: CO1: Explain the fundamentals of Digital Marketing. CO2: Summarize about search engine optimization techniques. CO3: Make use of most popular social media platforms to grow business. CO4: Apply the knowledge about various online advertisement techniques. CO5: Plan case studies for understanding real world scenarios.
TEXT BOOKS:
1. Puneet Singh Bhatia," Fundamentals of Digital Marketing," 1st Edition, Pearson Education, 2017. 2. Aaron Matthew Wall, "Search Engine Optimization Book", 1st Edition, 2005. 3. Dave Chaffey and Fiona Ellis, "Digital Marketing: Strategy, Implementation & Practice", 7th Edition, Pearson Education, 2019.
REFERENCES:
1. Rob Stokes, "eMarketing: the essential guide to digital marketing", 6th Edition, The Red & Yellow Creative School of Business, 2008. 2. Jayakumar K, "IT Business Process Management and Strategic Marketing", 2nd Edition, 2014. 3. Vandana Ahuja, "Digital Marketing", 1st Edition, Oxford University Press, 2015.

VERTICAL 6: PROGRESSIVE TECHNOLOGIES

21PIT17	TECHNIQUES OF ROBOTIC PROCESS AUTOMATION	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES: • To explain the fundamentals of Robotic Process Automation. • To model the basics of Robotic Process Automation tool. • To outline the automation techniques of Robotic Process Automation. • To experiment with bot using triggering concept. • To develop and maintain the bot.					
UNIT-I	**INTRODUCTION TO ROBOTIC PROCESS AUTOMATION**				**9**
History of Automation - What is RPA - RPA vs Automation - Benefits of RPA - Components of RPA - RPA platforms - About UiPath - UiPath Robot - Record and Play-UiPath stack - Learning UiPath Studio-Task recorder-Step-by-step examples using the recorder.					
UNIT-II	**RPA TOOL**				**9**
What is a Sequence? - Using activities with workflows – Flowchart - Control Flow, Sequencing the workflow - Control flow, various types of loops, and decision making - Step-by-step example using Sequence and Flowchart-Step-by-step example using Sequence and Control flow.					
UNIT-III	**DATA MANIPULATION**				**9**
Variables and scope–Collections -Arguments – Purpose and use - Data table usage with examples - Clipboard management - File operation with step-by-step example - CSV/Excel to data table and vice versa.					
UNIT-IV	**TAKING CONTROL OF THE CONTROLS**				**9**

Taking Control of the Controls - Implementing the Attach Window activity -Finding the control - Techniques for waiting for a control - Act on controls – mouse and keyboard activities -Working with UiExplorer - Handling events - Handling events - Screen Scraping-When to use OCR-Types of OCR available - Avoiding typical failure points-SAP automation-Java plugin-Citrix automation.		
UNIT-V	**HANDLING USER EVENTS AND ASSISTANT BOTS**	**9**
What are assistant bots? - Monitoring system event triggers - Monitoring image and element triggers -Launching an assistant bot on a keyboard event- Common exceptions and ways to handle them - Logging and taking screenshots - Debugging techniques - Collecting crash dumps - Error reporting -Nesting workflows -Reusability of workflows.		
		TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the fundamentals of Robotic Process Automation.

CO2: Identify the different Robotic Process Automation tools and its usage.

CO3: Outline the automation techniques of Robotic Process Automation.

CO4: Apply the various triggering concept for monitoring bots.

CO5: Plan, develop and deploy bots.

TEXT BOOKS:

1. Alok Mani Tripathi, "Learning Robotic Process Automation", 1st Edition Packt Publishing, 2018.
2. Nandan Mullakara, Arun Kumar and Asokan, "Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere", 1st Edition, Packt Publishing, 2020.
3. Robert Fantina, Andriy Storozhuk and Kamal Goyal, "Introducing Robotic Process Automation to Your Organization", 1st Edition, Apress Publication, 2021.

REFERENCES :

1. Christian Czarnecki, Peter Fettke, "Robotic Process Automation: Management, Technology, Applications", 1st Edition, Walter de Gruyter Publishing, 2021.
2. Tom Taulli "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", 1st Edition, Apress Publication, 2020.
3. Husan Mahey "Robotic Process Automation with Automation Anywhere", 1st Edition, Packt Publishing LTD, 2021.

21PIT18	CYBER SECURITY ESSENTIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the basics of cyber security.
- To outline the security aspects of operating systems and networks.
- To make use of cryptographic techniques in network security.
- To explain the privacy principles and policies.
- To illustrate the security management and incidents.

UNIT-I	INTRODUCTION TO CYBER SECURITY	9
Introduction -Computer Security - Threats -Harm - Vulnerabilities - Controls – Authentication Access Control and Cryptography - Web-User Side - Browser Attacks - Web Attacks- Targeting Users - Obtaining User or Website Data - Email Attacks.		
UNIT-II	**SECURITY IN OPERATING SYSTEM & NETWORKS**	**9**
Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack-Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service		
UNIT-III	**DEFENCES: SECURITY COUNTER MEASURES**	**9**
Cryptography in Network Security - Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity - Database Disclosure - Data Mining and Big Data.		
UNIT-IV	**PRIVACY IN CYBERSPACE**	**9**
Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining - Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies.		
UNIT-V	**MANAGEMENT AND INCIDENTS**	**9**
Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster - Emerging Technologies - The Internet of Things - Economics - Electronic Voting - Cyber Warfare- Cyberspace and the Law – Information and Laws - Cyber crime - Cyber Warfare and Home Land Security.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the basic concepts of computer security.

CO2: Illustrate methods for Security in operating system and networks.

CO3: Identify the various security counter measures.

CO4: Summarize the privacy principles and policies.

CO5: Interpret the management strategies of cyber space.

TEXT BOOKS:

1. Charles P. Pfleeger, Shari Lawrence Pfleeger and Jonathan Margulies, "Security in Computing", 5th Edition, Pearson Education, 2015.
2. MarttiLehto and Pekka Neittaanmäki, "Cyber Security: Analytics, Technology and Automation edited", Springer International Publishing Switzerland, 2015.
3. George K. Kostopoulous, "Cyber Space and Cyber Security", 2nd Edition, CRC Press, 2017.

REFERENCES :

1. Jan L.Harrington,"Network Security A Practical Approach", 1st Edition, Morgan Kaufmann Publishers, 2005.
2. Edward Amoroso, "Cyber Security", 1st Edition, Silicon Press, 2006.
3. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations",1st Edition, CBS publishers, New Delhi, 2004.

21PIT19	3D PRINTING AND DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the importance of 3D printing in manufacturing.
- To compare different 3D printing technologies.
- To select a suitable material for 3D printing.
- To choose different methods for Post-processing of 3D printing parts.
- To develop the applications of 3D printing.

UNIT-I	INTRODUCTION AND BASIC PRINCIPLES	9

3D Printing, Generic 3D Printing Process, Benefits of 3D Printing, Distinction Between 3D Printing and CNC Machining, Other Related Technologies Development of 3D Printing Technology: Introduction, Computers, Computer-Aided Design Technology, Other Associated Technologies, The Use of Layers, Classification of 3D Printing Processes, Metal Systems, Hybrid Systems, Milestones in 3D Printing Development, 3D Printing around the World.

UNIT-II	3D PRINTING PROCESS CHAIN & PHOTOPOLYMERIZATION PROCESSES	9

Eight Steps in Additive Manufacture, Variations from One 3D Printing Machine to Another, Metal Systems, Maintenance of Equipment, Materials Handling Issues, design for 3D printing. Introduction to Photopolymerization Processes: Photopolymerization Materials, Reaction Rates, Vector Scan SL, SL Resin Curing Process, SL Scan Patterns, Vector Scan Micro stereolithography, Mask Projection Photo polymerization Technologies and Processes, Two-Photon SL.

UNIT-III	POWDER BED FUSION PROCESSES & EXTRUSION-BASED SYSTEMS	9

Powder Bed Fusion Processes: Introduction, SLS Process Description, Powder Handling, Approaches to Metal and Ceric Part Creation, Variants of Powder Bed Fusion Processes, Process Par 3D Printingeters, Applied Energy Correlations and Scan Patterns, Typical Materials and Applications, Materials - Capabilities and Limitations. Extrusion-Based Systems: Introduction, Basic Principles, Plotting and Path Control, Materials, Limitations of FDM, Bioextrusion, Other Systems.

UNIT-IV	DESIGN, GUIDELINES FOR PROCESS SELECTION & SOFTWARE ISSUES	9

Design for 3D Printing - Design for Manufacturing and Assembly, Core DFM for 3D Printing Concepts and Objectives, 3D Printing Unique Capabilities, Exploring Design Freedoms, Design Tools for 3D Printing. Guidelines for Process Selection - Selection Methods for a Part, Challenges of Selection, Preliminary Selection, Production Planning and Control.

Software Issues for 3D Printing - Preparation of CAD Models – the STL File, Problems with STL Files, STL File Manipulation, Beyond the STL File, Additional Software to Assist 3D Printing.

UNIT-V	MEDICAL APPLICATIONS & FUTURE DIRECTIONS FOR 3D PRINTING	9

Medical Applications for 3D Printing - Use of 3D Printing to Support Medical Applications, Software Support for Medical Applications, Limitations of 3D Printing for Medical applications, Further Development of Medical 3D Printing Applications. Use of Multiple Materials in 3D Printing - Discrete Multiple Material Processes, Porous Multiple Material Processes, Blended Multiple Material Processes, Embedded Component 3D Printing, Commercial Applications Using Multiple Materials, Future Directions, Business Opportunities and Future Directions

	TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the basics of 3D printing.

CO2: Explain different 3D printing Technologies.

CO3: Identify suitable materials for 3D printing.

CO4: Make use of different methods for Post-processing of 3D printing parts.

CO5: Plan 3D printing for medical applications and commercial applications.

TEXT BOOKS:

1. Ian Gibson, David W Rosen and Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", 2nd. Edition, Springer, 2010.
2. Ben Redwood, Filemon Schoffer and Brian Garret, "The 3D Printing Handbook: Technologies, design and applications", 1st Edition, 3DHubs publications, 2017.
3. Dorling Kindersley, "3D printing projects: Amazing ideas to print and make", 1st Edition, DK publishing, 2017.

REFERENCES :

1. Chua Chee Kai and Leong Kah Fai, "Rapid Prototyping: Principles &Applications", 3rd Edition, World Scientific publisher, 2010.
2. Ali K. Kamrani and EmandAbouel Nasr, "Rapid Prototyping: Theory &Practice", 1st Edition, Springer, 2006.
3. D.T. Pham, S.S. Dimov, "Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling", 1st Edition, Springer 2012.

21PIT20	EMBEDDED SYSTEM DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To infer the architecture and programming of ARM processor.
- To illustrate the design and analysis of embedded computing platform.
- To develop the basic concepts and overview of real time Operating system and the processes involved.
- To compare the general purpose system with real time operating system.
- To apply embedded systems concepts in various domains.

UNIT I	INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS	12

Embedded Computing - Complex Systems and Microprocessors, Characteristics of embedded computing applications, Challenges in embedded system design, Embedded system Design process. ARM Processor, Processor and Memory Organization, Data Operations, Flow of Control, TI C55x DSP - Processor and Memory Organization, Addressing Modes, Data Operations, Flow of Control.

SUGGESTED ACTIVITIES:

- Study of ARM evaluation system

UNIT II	EMBEDDED COMPUTING PLATFORM DESIGN	12

The CPU Bus–Memory devices and I/O devices–Models of programs– Assembly, linking and loading – Basic Compilation Techniques – Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size– Program validation and testing.

SUGGESTED ACTIVITIES:

- Interfacing ADC and DAC & Interfacing LED and PWM.

UNIT III	PROCESSES AND OPERATING SYSTEMS	12

Introduction – Kernel, Threads –Multiple tasks and multiple processes – Multirate systems– Preemptive real–time operating systems– Priority based scheduling– Inter process communication mechanisms, Evaluating Operating System Performance, Power Management and Optimization for Processes.

SUGGESTED ACTIVITIES:

- Interfacing real time clock and serial port.
- Interfacing keyboard and LCD.

UNIT IV	NETWORKS	12

Distributed Embedded Architectures – Networks for embedded systems: I2C, Ethernet, Field bus– Network based Design, Internet Enabled Systems.

SUGGESTED ACTIVITIES:

- Interfacing of servo motor and DC motor.
- Interfacing stepper motor and temperature sensor.

UNIT V	APPLICATIONS OF EMBEDDED SYSTEMS	12

Telephone Answering Machine - Cell Phones – Compact DISCs and DVDs — Audio Players– Video Accelerator – Digital Still Cameras – Elevator Controller.

SUGGESTED ACTIVITIES:

- Implementing zigbee protocol with ARM.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the architecture and programming of ARM processor.

CO2: Outline the concepts of embedded systems.

CO3: Make use of system design techniques to develop software for embedded systems.

CO4: Compare the general purpose system with real time operating system.

CO5: Model real-time consumer/industrial applications using system concepts.

TEXT BOOK:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", 4th Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2016.
2. Jane W.S.Liu , "Real Time Systems" Pearson Education, 3rd Indian Reprint, 2018.
3. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", 3rd Edition, Cengage Learning, 2012.

REFERENCES:

1.. Sriram V Iyer and Pankaj Gupta, "Embedded Real Time Systems Programming", 1st Edition, TataMcGrawHill, 2017.
2. Geoffrey Brown,"Discovering the STM32 Micro controller", 1st Edition, Indiana University press, 2016.
3. David. E. Simon, "An Embedded Software Primer", 1st Edition, Fifth Impression, Addison Wesley Professional, 2007.
4. C.M. Krishna and Kang G. Shin, "Real-Time Systems", 1st Edition, Tata McGraw-Hill Education, 2010.
5. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design and Programming", 1st Edition, Dream Tech Press, 2005.

21PIT21	PRINCIPLES OF QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the foundation of traditional computing.
- To interpret the knowledge on the modeling of quantum circuit.
- To summarize the knowledge of basic quantum algorithms.
- To outline the knowledge of advanced quantum algorithms.
- To interpret the quantum computational complexity and error correction methods.

UNIT I	INTRODUCTION AND BACKGROUND	9

Overview of traditional computing – Computers and the Strong Church–Turing Thesis - The Circuit Model of Computation- A Linear Algebra Formulation of the Circuit Model - Reversible Computation - A Preview of Quantum Physics - Quantum Physics and Computation

UNIT II	DIRAC NOTATION AND QUANTUM MECHANICS	9

The Dirac Notation and Hilbert Spaces - Dual Vectors – Operators - The Spectral Theorem- Functions of Operators - Tensor Products - The Schmidt Decomposition Theorem - Some Comments on the Dirac Notation. The State of a Quantum System - Time-Evolution of a Closed System - Composite Systems - Measurement - Mixed States and General Quantum Operations - Mixed States, Partial Trace, General Quantum Operations.

UNIT III	A QUANTUM MODEL OF COMPUTATION	9

The Quantum Circuit Model - Quantum Gates - 1-Qubit Gates, Controlled-U Gates, Universal Sets of Quantum Gates - Efficiency of Approximating Unitary Transformations - Implementing Measurements with Quantum Circuits.

UNIT IV	INTRODUCTORY QUANTUM ALGORITHMS	9

Probabilistic Versus Quantum Algorithms - Phase Kick-Back - The Deutsch Algorithm - The Deutsch–Jozsa Algorithm - Simon's Algorithm.

UNIT V	QUANTUM ERROR CORRECTION	9

Classical Error Correction - The Error Model, Encoding, Error Recovery - The Classical Three-Bit Code - Fault Tolerance - Quantum Error Correction - Error Models for Quantum Computing, Encoding, Error Recovery.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the foundations of traditional computing

CO2: Interpret the knowledge on the modeling of quantum circuit
CO3: Infer the knowledge of basic quantum computing.
CO4: Extend the knowledge of advanced quantum algorithms.
CO5: Summarize the quantum computational complexity and error correction methods.

TEXT BOOK:

1. Jack Hidary, "Quantum Computing: An Applied Approach" Springer, 2019.
2. Chris Bernhardt "Quantum Computing for Everyone" 1st Edition, The MIT Press, 2019.
3. Wolfgang Scherer, "Mathematics of Quantum Computing: An Introduction Hardcover" Springer, 2019.

REFERENCES:

1. Maria Luisa Dalla Chiara, Roberto Giuntini, Roberto Leporini, Giuseppe Sergioli, "Quantum Computation and Logic: How Quantum Computers Have Inspired Logical Investigations", 1st Edition, Springer, 2018.
2. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", 10th Edition, Cambridge University Press, 2010.
3. P. Kaye, R. Laflamme, and M. Mosca, "An introduction to Quantum Computing",1st Edition, Oxford University Press, 2007.

21PIT22	AUTONOMOUS GROUND VEHICLE SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the fundamentals of autonomous driving.
- To identify the different ways of sensing internal states of Autonomous Ground Vehicles (AGVs).
- To model the environment perception for autonomous driving.
- To develop the navigation techniques of AGVs.
- To utilize the fundamentals of vehicle control systems and connected vehicles.

UNIT I — INTRODUCTION TO AUTONOMOUS DRIVING — 9

Autonomous Driving Technologies Overview – Autonomous Driving Algorithms –Autonomous Driving Client System – Autonomous Driving Cloud Platform – Components of autonomy – Difference between Unmanned and Autonomous Vehicles – Introduction to Unmanned Aerial Vehicles (UAVs).

UNIT II — SENSORS FOR AUTONOMOUS GROUND VEHICLES — 9

Sensor Characteristics –Vehicle Internal State Sensing: OEM Vehicle Sensors, GPS, Inertial Measurements, Magnetometer – External World Sensing: RADAR, Lidar, Image Processing Sensors.

UNIT III — ENVIRONMENT PERCEPTION AND MODELING — 9

Road Recognition: Basic Mean Shift Algorithm, Mean Shift Clustering, Mean Shift Segmentation, Mean Shift Tracking, Road Recognition Algorithm –Vehicle Detection and Tracking: Generating ROIs, Multi Resolution Vehicle Hypothesis, Vehicle Validation using Gabor Features and SVM, Boosted Gabor Features – Multiple Sensor Based Multiple Object Tracking.

UNIT IV — NAVIGATION FUNDAMENTALS — 9

Introduction – Navigation: GNSS Overview, GPS, GLONASS, Galileo, Compass – Inertial Navigation Overview: Inertial Sensor Technology – GNSS/INS Integration Overview – Case Study on Kalman Filtering.

UNIT V — VEHICLE CONTROL AND CONNECTED VEHICLE — 9

Vehicle Control: Cruise Control, Antilock Brake Systems, Steering Control and Lane Following, Parking – Connected Vehicles: Vehicle to Vehicle Communication, Vehicle to Infrastructure Communication.

	TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Identify the requirements and design challenges of AGVs.

CO2: Select suitable sensors to sense the internal state and external world of AGVs.

CO3: Make use of lane detection, road detection & vehicle detection algorithms.

CO4: Utilize ground vehicle navigation algorithms.

CO5: Develop ground vehicle control systems.

TEXT BOOKS:

1. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu, Jean-Luc Gaudiot, "Creating Autonomous Vehicle Systems", 1st Edition, Morgan & Claypool, 2018.
2. Umit Ozguner, Tankut Acarman, Keith Redmill, "Autonomous Ground Vehicles", 1st Edition, Artech House, 2011.
3. Sumit Ranjan, "Applied Deep Learning and Computer Vision for Self-Driving Cars: Build autonomous vehicles using deep neural networks and behavior-cloning techniques", 1st Edition, Packt Publishing, 2020.

REFERENCES: -

1. Hong Cheng, "Autonomous Intelligent Vehicles Theory, Algorithms, and Implementation", Springer, 2011.
2. Mohinder S. Grewal, Angus P. Andrews, Chris G. Bartone, "Global Navigation Satellite Systems, Inertial Navigation, and Integration", 3rd Edition, John Wiley & Sons, 2013.
3. Thomas Bräunl, "Embedded Robotics: From Mobile Robots to Autonomous Vehicles with Raspberry Pi and Arduino", Springer, 2022.

21PIT23	E-LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the various E-learning approaches and Components.
- To experiment with Design Thinking.
- To identify the types of design models for E-learning.
- To select various E-learning Authoring tools for development.
- To utilize E-learning courseware for evaluation and management solutions.

UNIT I	INTRODUCTION	9

Need for E-Learning – Approaches of E-Learning – Components of E-Learning – Synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Work Flow to Produce and Deliver E-Learning Content – Design Thinking: Introduction – Actionable Strategy – Act to Learn – Leading Teams to Win.

UNIT II	DESIGNING E-LEARNING COURSE CONTENT	9

Design Models of E-Learning – Identifying and Organizing E-Learning Course Content: Needs Analysis – Analyzing the Target Audience – Identifying Course Content – Defining Learning Objectives – Defining the Course Sequence – Defining Instructional Methods – Defining Evaluation and Delivery Strategies – Case Study.

UNIT III	CREATING INTERACTIVE CONTENT	9

Preparing Content: Tips for Content Development and Language Style – Creating Storyboards: Structure of an Interactive E-Lesson – Techniques for Presenting Content – Adding Examples – Integrating Multimedia Elements – Adding Examples – Developing Practice and Assessment Tests – Adding Additional Resources– Courseware

Development – Authoring Tools – Types of Authoring Tools – Selecting an Authoring Tool.		
UNIT IV	**LEARNING PLATFORMS**	**9**
Types of Learning Platforms – Proprietary Vs. Open – Source LMS – LMS Vs LCMS – Internally Handled and Hosted LMS – LMS Solutions – Functional Areas of LMS.		
UNIT V	**COURSE DELIVERY AND EVALUATION**	**9**
Components of an Instructor-Led or Facilitated Course – Planning and Documenting Activities – Facilitating Learners Activities – E-Learning Methods and Delivery Formats –Using Communication Tools for E-Learning – Course Evaluation.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Compare the phases of activities in models of E-learning

CO2: Identify appropriate instructional methods and delivery strategies

CO3: Choose appropriate E-learning Authoring tools.

CO4: Develop interactive E-learning courseware.

CO5: Organize the E-learning courseware.

TEXT BOOK:

1. Raymundo Solak, "E-Learning Techniques: An Inexpensive Software Application For Developing Learning Solutions", 1st Edition, 2022.
2. Johnny Schneider, "Understanding Design Thinking, Lean and Agile", 1st Edition, O'Reilly Media, 2017.
3. Crews, T. B., Sheth, S. N., Horne, T. M., "Understanding the Learning Personalities of Successful Online Students", 1st Edition, Educause Review, 2014.

REFERENCES:

1. Madhuri Dubey, "Effective E–learning Design, Development and Delivery", 1st Edition, University Press, 2011.
2. Clark, R. C., Mayer, R. E., "E-Learning and the Science of Instruction",3rd Edition, 2011.
3. Rob Philips, Carmel McNaught and Gregor Kennedy, "Evaluating e-Learning Guiding Research and Practice", 1st Edition, Taylor and Francis publishers, 2012.

		L	T	P	C
21PIT24	**NEXT GENERATION NETWORKS**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To outline the fundamentals of 5G internet.
- To develop the concept of small cells in 5G mobile networks.
- To interpret the mobile clouds in 5G network context.
- To select the role of cognitive radios in 5G networks.
- To experiment with security issues in 5G networks.

UNIT I	**PERVASIVE CONNECTED WORLD AND 5G INTERNET**	**9**

Historical Trend of Wireless Communications – Evolution of LTE Technology to Beyond 4G – 5G Roadmap – Ten Pillars of 5G – Internet of Things and Context Awareness –Networking Reconfiguration and Virtualization Support – Mobility – Quality of Service Control – Emerging Approach for Resource over Provisioning.

UNIT II	**SMALL CELLS FOR 5G MOBILE NETWORKS**	**9**

Introduction to Small Cells – Capacity Limits and Achievable Gains with Densification – Mobile Data Demand – Demand vs. Capacity – Small Cell Challenges.

UNIT III	**COOPERATION FOR NEXT GENERATION WIRELESS NETWORKS**	**9**

Introduction – Cooperative Diversity and Relaying Strategies: Cooperation and Network Coding, Cooperative ARQ MAC Protocols – PHY Layer Impact on MAC Protocol Analysis: Impact of Fast Fading and Shadowing on Packet Reception for QoS Guarantee, Impact of Shadowing Spatial Correlation – Study: NCCARQ, PHY Layer Impact.

UNIT IV	**MOBILE CLOUDS AND COGNITIVE RADIO**	**9**

Introduction – The Mobile Cloud – Mobile Cloud Enablers – Network Coding – Overview of Cognitive Radio Technology in 5G Wireless – Spectrum Optimization using Cognitive Radio – Relevant Spectrum Optimization Literature in 5G – Cognitive Radio and Carrier Aggregation – Energy Efficient Cognitive Radio Technology.

UNIT V	**SECURITY AND SELF ORGANISING NETWORKS**	**9**

Overview of Potential 5G Communications System Architecture – Security Issues and Challenges in 5G Communications Systems – Self Organising Networks: Introduction, Self Organising Networks in UMTS and LTE, The Need for Self Organising Networks in 5G, Evolution towards Small Cell Dominant HetNets.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Compare the 5G network with older generations of networks.

CO2: Identify suitable small cells for different applications in 5G networks.

CO3: Explain 5G network scenarios.

CO4: Develop applications to mobile cloud.

CO5: Utilize applications with 5G network support.

TEXT BOOKS:

1. Mahmoud Elkhodr, "Enabling Technologies and Architectures for Next-Generation Networking Capabilities", IGI Global, 2019.
2. Athanasios G. Kanatas, Konstantina S. Nikita, Panagiotis (Takis) Mathiopoulos, "New Directions in Wireless Communications Systems: From Mobile to 5G", CRC Press, 2017.
3. Yin Zhang, Min Chen, "Cloud Based 5G Wireless Networks – Springer Briefs in Computer Science", Springer, 2016.

REFERENCES:

1. Thierry Van de Velde, "Value-Added Services for Next Generation Networks", Auerbach Publications, 2019.
2. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley, 2015.
3. Byrav Ramamurthy, "Next-Generation Internet: Architectures and Protocols", Cambridge University Press, 2011.

VERTICAL 7: COGNITIVE COMPUTING

21PCS25	ETHICS AND ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the need for ensuring ethics in AI.
- To outline ethical issues with the development of AI agents.
- To interpret the ethical considerations in different AI applications.
- To demonstrate the relation of ethics with nature.
- To summarize the risk for Human rights and other fundamental values.

UNIT-I	INTRODUCTION TO ETHICS AND AI	9

Role of Artificial Intelligence in Human Life, Understanding Ethics, Why Ethics in AI? Ethical Considerations of AI, Current Initiatives in AI and Ethics, Ethical Issues with our relationship with artificial Entities.

UNIT-II	FRAMEWORK AND MODELS	9

AI Governance by Human-right centered design, Normative models, Role of professional norms, Teaching Machines to be Moral.

UNIT-III	CONCEPTS AND ISSUES	9

Accountability in Computer Systems, Transparency, Responsibility and AI. Race and Gender, AI as a moral right-holder.

UNIT-IV	PERSPECTIVES AND APPROACHES	9

Perspectives on Ethics of AI, Integrating ethical values and economic value, Automating origination, AI a Binary approach, Machine learning values, Artificial Moral Agents.

UNIT-V	CASES AND APPLICATION	9

Ethics of Artificial Intelligence in Transport, Ethical AI in Military, Biomedical research, Patient Care, Public Health, Robot Teaching, Pedagogy, Policy, Smart City Ethics.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the ethical issues in the development of AI agents.

CO2: Illustrate the ethical considerations of AI with perspectives on ethical values.

CO3: Experiment with the ethical policies in AI based applications and Robot development.

CO4: Make use of the AI concepts for addressing societal problems by adapting the legal concepts and securing fundamental rights.

CO5: Choose the AI concepts to overcome the evil genesis.

TEXT BOOKS:

1. Markus D. Dubber, Frank Pasquale, Sunit Das, "The Oxford Handbook of Ethics of AI", 1st Edition, Oxford University Press, 2020
2. Paula Boddington, "Towards a Code of Ethics for Artificial Intelligence", 1st Edition, Springer, 2018
3. S. Matthew Liao, "Ethics of Artificial Intelligence", 1st Edition, Oxford University Press, 2020

REFERENCES:

1. N. Bostrom and E. Yudkowsky. "The ethics of artificial intelligence". In W. M. Ramsey and K. Frankish, Editors, The Cambridge Handbook of Artificial Intelligence. Cambridge University Press, Cambridge, 2014.
2. Wallach, W., & Allen, C, "Moral machines: Teaching Robots right from wrong", 1st Edition, Oxford University Press, 2010.

3. Mark Coeckelbergh, “AI Ethics”, 1st Edition, MIT Press, 2020

21PCS26	INTRODUCTION TO KNOWLEDGE ENGINEERING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To illustrate the differences between data, information and knowledge.
- To infer the various techniques for knowledge based systems.
- To demonstrate object oriented knowledge.
- To interpret knowledge organization.
- To contrast knowledge based system design

UNIT-I	INTRODUCTION	12

Data, Information and Knowledge - Knowledge Engineer Skills - Knowledge-Based Systems Introduction – Knowledge Reuse – Knowledge Engineering Techniques.

SUGGESTED ACTIVITIES:

- Data pre-processing and annotation
- Creation of datasets

UNIT-II	KNOWLEDGE ACQUISITION	12

Knowledge and Intelligence – Applications of Knowledge Reuse – Ethical Model of Knowledge – Stages, challenges, Approaches of Knowledge Acquisition – Techniques

SUGGESTED ACTIVITIES:

- Learn existing datasets
- Implementing Treebank's

UNIT-III	KNOWLEDGE REPRESENTATION	12

Roles of Knowledge Representation – Classification of Knowledge – Relationship Between Attributes – Object Oriented Knowledge Representation – Advanced Knowledge Representation Techniques

SUGGESTED ACTIVITIES:

- Implementation of object oriented representation
- Design the classification of knowledge

UNIT-IV	KNOWLEDGE MANIPULATION	12

Knowledge Organization – Indexed Organization – Knowledge Management Platform –Reasoning – Knowledge Codification – Testing of Knowledge Based Systems

SUGGESTED ACTIVITIES:

- Implementation of Knowledge organization
- Testing of knowledge based systems

UNIT-V	KNOWLEDGE BASED SYSTEM DESIGN	12

Semantic Web - Role Played by Social Networking Site – Representation of Design Knowledge - Knowledge Acquisition and Documentation Structuring - UML Notations in KADS

SUGGESTED ACTIVITIES:

- Representation of UML notations
- Scientific distributions used in python for Knowledge Acquisition.

TOTAL:60 PERIODS

COURSE OUTCOMES
At the end of the course, learners will be able to: CO1: Summarize the concept of Data, Information and knowledge. CO2: Identify the concepts of knowledge acquisition for an expert system CO3: Model the knowledge using object oriented representation for real-world phenomena. CO4: Make use of knowledge organization to index and design knowledge. CO5: Construct Semantic Web using the knowledge based system design practices.
TEXT BOOKS: 1. Ela Kumar, "Knowledge Engineering", 1st Edition, I.K International Publishing ,2018 2. Hamed Fazlallahtabar, "Knowledge Engineering: The Process Paradigm", 1st Edition, CRC Press,2020 3. Simon Kendal and Malcolm Creen, "An Introduction to Knowledge Engineering", 1st Edition, Springer, 2007
REFERENCES: 1. Emilia Mendes, "Practitioner's Knowledge Representation -A Pathway to Improve Software Effort Estimation", 1st Edition, Springer, 2014. 2. Michael Gelfond, Yulia Kahi, " Knowledge Representation, Reasoning, and the Design of Intelligent Agents", 1st Edition, Cambridge University Press, 2014. 3. Lucja M. Iwariska and Stuart C. Shapiro, "Natural Language Processing and Knowledge Representation Language for Knowledge and Knowledge for Language", 1st Edition,AAAI Press/MIT Press,2000

21PCS27	PRINCIPLES OF SOFT COMPUTING	L	T	P	C
		2	0	2	3
COURSE OBJECTIVES: • To summarize the basic concepts of neural network. • To compare various techniques in neural networks. • To outline the basic concepts of fuzzy logic. • To relate the fuzzy systems and its applications. • To identify soft computing and integrated soft computing techniques to solve problems.					
UNIT-I	**NEURAL NETWORKS**				**12**
Basic Concepts of Neural network, Model of an artificial neuron, neural Network architecture: single layer and multilayer feed forward networks, recurrent networks, Characteristics, Learning Methods, Applications. **SUGGESTED ACTIVITIES:** • Classify upper case letters and lower case letters using perceptron network					
UNIT-II	**BACKPROPAGATION NETWORK**				**12**
Architecture : perceptron model – solution - single layer artificial neural network - multilayer perception model - back propagation learning methods - effect of tuning parameters - selection of parameters, applications. **SUGGESTED ACTIVITIES:** • Build BPN for training a single hidden layer back propagation network with bipolar sigmoidal units.					
UNIT-III	**FUZZY LOGIC**				**12**
Basic concepts of fuzzy logic - Fuzzy sets and Crisp sets - Fuzzy set theory and operations - Properties of fuzzy sets - Fuzzy and Crisp relations - Fuzzy to Crisp conversion. **SUGGESTED ACTIVITIES:** • Develop fuzzy logic methodology to analyze lading of an aircraft					

UNIT-IV	FUZZY SYSTEMS	
		12

Crisp logic - predicate logic - fuzzy logic - fuzzy rule based system – defuzzification - Applications

SUGGESTED ACTIVITIES:

- Construct genetic algorithm to solve a traveling salesman problem.

UNIT-V	GENETIC ALGORITHM	
		12

Fundamentals of genetic algorithm - genetic modeling - Integration of neural network - fuzzy and genetic algorithms.

SUGGESTED ACTIVITIES:

- Use neural network and fuzzy logic to control the motion of an inverted pendulum.

TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Identify neural network techniques and their roles in building intelligent machines

CO2: Make use of Backpropagation network for real world problems

CO3. Experiment with fuzzy logic and reasoning to handle uncertainty

CO4: Examine fuzzy systems for solving complex problem

CO5: Compare various soft computing approaches for a given problem

TEXT BOOKS:

1. S. Rajasekaran & GA Vijayalakshmi Pai "Neural Networks, Fuzzy Logic, and Genetic Algorithms synthesis and application", 1st Edition, PHI, 2013
2. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", 1st Edition, PHI, Pearson Education 2004.
3. Vojislav Kecman, "Learning & Soft Computing Support Vector Machines, Neural Networks, and Fuzzy Logic Models", 1st Edition, Pearson Education, 2006.

REFERENCES:

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications," 3rd Edition, Wiley India, 2004
2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", 1st Edition, Addison Wesley, N.Y., 2002.
3. Stamatios V. Kartalopoulos "Understanding Neural Networks and Fuzzy Logic Basic concepts & Applications", 1st Edition, IEEE Press, PHI, New Delhi, 2004.

21PCS28	OPTIMIZATION TECHNIQUES AND APPLICATIONS	L	T	P	C
		2	0	2	3

COURSEOBJECTIVES:

- To describe the basics of Optimization Techniques.
- To relate the knowledge of numerical methods for Liner Programming.
- To utilize the concept of Non-linear programming with Equality and Inequality Constraint.
- To construct dynamic programming models using sequential Optimization.
- To illustrate various meta heuristic solutions for the real time problems.

UNIT-I	INTRODUCTION TO OPTIMIZATION TECHNIQUES	
		12

Introduction to Optimization Techniques-Need for Optimization-Historical Perspective-Optimization Parameters-Types of Optimization-Advanced Optimization Techniques-Applications of Optimization Techniques -Limitations of Optimization Techniques -Optimization methods in Engineering.

SUGGESTED ACTIVITIES:

- Evaluate the Optimization function on Optimization Techniques.

UNIT-II	LINEAR PROGRAMMING	12

Formulation - Graphical Method and Simplex Method – Primal vs Dual relationships - Sensitivity Analysis-Dual Simplex Method.

SUGGESTED ACTIVITIES:

- Construct and Solve Linear Programming Problem by Simplex method.
- Construct and Solve Linear Programming Problem by Dual Simplex method.

UNIT-III	NON LINEAR PROGRAMMING	12

Nonlinear Programming (with Equality Constraints): Lagrangian Multiplier - Equality constrained optimization -Projected Gradient Methods with equality constraints.

Nonlinear Programming (Inequality Constraints): Khun concept - Khun Tucker conditions.

SUGGESTED ACTIVITIES:

- Construct and nonlinear optimization problems by using numerical optimization methods (indirect) - Newtons methods.
- Construct and solve nonlinear optimization problems using with equality constraints using Lagrangian Multiplier.
- Construct and solve nonlinear optimization problems using with inequality constraints using using Khun Tucker conditions.

UNIT-IV	SEQUENTIAL OPTIMIZATION	12

Representation of multi stage decision process -Types of multi stage decision problems- Concept of sub optimization and the principle of optimality- Recursive equations –Forward and backward recursions.

SUGGESTED ACTIVITIES:

- Case study on Multistage Decision Making Under Uncertainty.
- Case study on Principle on Optimality with Forward recursion and Backward Recursion.

UNIT-V	META-HEURISTIC OPTIMIZATION TECHNIQUES	12

Classification of heuristic solution techniques - Heuristic and Meta Heuristic Programming: Simulated Annealing, Genetic Algorithm, Particle Swarm Optimization algorithm - Applications of optimization problems.

SUGGESTED ACTIVITIES:

- Exemplifying the optimization of real-world problem using Simulated Annealing.
- Exemplifying the optimization of real-world problem using Genetic Algorithm.
- Exemplifying the optimization of real-world problem using Particle Swarm Optimization Algorithm.

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the basics of Optimization Techniques.

CO2: Make use of Linear Programming for solving optimization problems.

CO3: Identify the usage of Non Linear Programming for solving optimization problems.

CO4: Express the multi stage decision problems using sequential optimization

CO5: Develop the knowledge of various metaheuristic algorithms for real world problems.

TEXT BOOKS:

1.Vikrant Sharma, Vinod Kumar Jain and Atul Kumar, "An Introduction to Optimization Techniques",1st Edition, CRC Press, Taylor and Francis Group, 2021.

2. Rardin, R. L., "Optimization in Operations Research", 2nd Edition, Pearson 2019.
3. Xin-she Yang, "Optimization Techniques and Applications with Examples" 1st Edition, Wiley Publishers, 2018.

REFERENCES:

1. Jeeva Jose, "Introduction to Machine Learning", 1st Edition, Khanna Book Publishing, 2020.
2. Nayak, S., "Fundamentals of Optimization Techniques with Algorithms", 1st Edition, Elsevier Science, 2020.
3. Foulds, L. R. "Optimization Techniques: An Introduction". 1st Edition, United States, Springer New York, 2012.

21OMA01	GRAPH THEORY AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss the fundamentals of graph theory.
- To calculate the graph coloring, matching and covering number.
- To identify the types of graphs and operation on graphs.
- To explain the concepts of trees.
- To discuss the concepts of directed graphs and its properties.

UNIT I INTRODUCTION 9

Basic definitions in graphs – walk – path – circuits - Isomorphism.

UNIT II MATRICES AND COLORING 9

Adjacency matrix and its properties - incidence matrix and its properties - Chromatic number – Chromatic partitioning – Chromatic polynomial – Matching – Covering.

UNIT III TYPES OF GRAPHS 9

Connected and disconnected graph - Operation on graphs - Eulerian graph – Hamiltonian graph.

UNIT IV TREES (CONNECTIVITY) PLANARITY 9

Properties of trees – distance and centers in tree –Algorithms (Kruskal's and Dijkstra Algorithm) - Rooted and binary trees - Spanning trees – Planar graphs: Definition and Properties.

UNIT V DIRECTED GRAPHS 9

Directed graphs – Types of directed graphs – digraphs & its properties and binary relations – directed paths and connectedness – Euler graphs. (Theorems Statement only)

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate the nature of graphs and illustrate isomorphism on graphs.

CO2: Construct the adjacent matrix and incident matrix for the given graph and also develop the chromatic polynomial for the given graph.

CO3: Apply various types of graphs and determine the existence of Eulerian, Hamiltonian path & circuits.

CO4: Interpret the planarity of graphs and the classes of trees with properties.

CO5: Identify the types of directed graphs with its properties.

TEXT BOOKS:

1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", 1st Edition, Dover Publications, IAC, 2016.
2. J.A.Bondy and USR.Moorthy, "Graph Theory with Applications", 2nd Edition, Indian

A. P. Pushpalai

Reprint, Springer Publishers, 2015.
3. Frank Harary, "Graph Theory", Narosa Publishers, New Delhi, 2013.

REFERENCES:

1. William Kocay & Donald.L,.Kreher, "Graphs, Algorithm and Optimization", CRT Press, 2005.
2. Krishnaiyan "KT" Thulasiraman, "Handbook of Graph Theory, Combinatorial Optimization, and Algorithms", CRC Press Taylor & Francis Group, 2016.
3. R. Diestel, "Graduate Texts in Mathematics, Graph theory", 5th Edition, Springer 2017.

21PCS29	INTRODUCTION TO GAME THEORY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize the novel concepts of game theory including cooperative games,
- To describe the non-cooperative games.
- To extend the games beyond normal and extensive form.
- To identify the problems in mechanism design.
- To express several auctions in games

UNIT-I	INTRODUCTION TO GAME THEORY	12

Strategic form- Perfect information extensive-form games-Imperfect-information extensive-form games.

SUGGESSTED ACTIVITIES:

CASE STUDY :Gametheory Explorer

UNIT-II	NON-COOPERATIVE GAMES	12

Self-interested agents-Games in normal form-analysing games-solutions.

SUGGESSTED ACTIVITIES:

Implement the winner Nim-game

UNIT-III	GAMES BEYOND NORMAL AND EXTENSIVE FORMS	12

Repeated Games- The Prisoner's Dilemma-Stochastic Games-Bayesian Games-Congestion Games-Graphical Games -Communication Games

SUGGESSTED ACTIVITIES:

Implementation of Tic-Tac-Toe game

UNIT-IV	MECHANISM DESIGN	12

Mechanism design with unrestricted preferences - Quasilinear preferences - Efficient mechanisms - VCG Mechanisms

SUGGESSTED ACTIVITIES:

Implement prisoners dilemma

UNIT-V	AUCTIONS	12

Auctions, Mechanism design for Sponsored search auctions- Single-good auctions- Multiunit auctions-Combinatorial auctions- Exchanges

SUGGESSTED ACTIVITIES:

Finding the Second price auction

TOTAL :60 PERIODS

A. P. Pushpalai

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate the game theory concepts.

CO2: Illustrate the various types of non-cooperative game theory concepts.

CO3: Relate the normal and extensive games

CO4: Discover the various mechanism design concepts.

CO5: Construct the auctions concepts

TEXT BOOKS:

1. Yoav Shoham and Kevin Leyton-Brown "Multiagent Systems" , 1st Edition ,Cambridge University Press, 2010
2. Giacomo Bonanno "Game Theory" University of California 1st Edition 2015
3. Martin J. Osborne,"An Introduction to Game Theory",1st Edition, The MIT Press 2003

REFERENCES:

1. Roger B. Myerson, "Game Theory: Analysis of Conflict, "Harvard University Press, Cambridge, Massachusetts, USA, 1997.
2. Michael Maschler, Eilon Solan, and Shmuel Zamir,"Game Theory", , 1st Edition Cambridge University Press, 2013
3. Y. Narahari.,"Game Theory and Mechanism Design",1st Edition IISc Press and the World Scientific Publishing Company, 2014.

21PCS30	COGNITIVE SCIENCE THEORY AND APPLICATIONS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To describe the basics of Cognitive Science.
- To associate the concept of the mind and intelligence, embracing psychology, artificial intelligence, neuro science and linguistics.
- To extend the role of neuroscience in the cognitive field.
- To paraphrase advanced analytics with cognitive computing.
- To express various applications of cognitive computing life problems.

UNIT-I FOUNDATION OF COGNITIVE SCIENCE 12

What is Cognitive Science-Cognitive Psychology: The Architecture of the Mind, Cognitive Psychology: Future Explorations, Philosophy: Foundations of Cognitive Science Artificial Intelligence: Knowledge Representation, Artificial Intelligence: Search, Control and Learning.

SUGGESTED ACTIVITIES:

- Experiment with data for calculating reaction time in cognitive system.

UNIT-II COGNITIVE PSYCHOLOGY 12

Cognitive Psychology–The Architecture of the Mind-The Nature of Cognitive Psychology-A Global View of the Cognitive Architecture-Propositional Representation-Schematic Representation-Cognitive Processes, Working Memory, and Attention- The Acquisition of Skill- The Connectionist Approach to Cognitive Architecture.

SUGGESTED ACTIVITIES:

- Experimentation on Short-term Memory for cognitive Analysis.
- Experimentation on Semantic Memory for cognitive Analysis.

UNIT-III	COGNITIVE NEUROSCIENCE	12

The Neuroscience Perspective-Methodology in Neuroscience -Techniques for the Study of Brain Image-Evaluating Techniques for the study of Brain Image-Traditional Brain Recording Methods-Modern Brain Imaging Methods-Brain Stimulation Techniques.

SUGGESTED ACTIVITIES:

- Build Neural network models for Cognitive Processes.
- Build Competitive Learning Neural Networks for feature mapping.

UNIT-IV	BIG DATA VS COGNITIVE COMPUTING	12

Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data.

SUGGESTED ACTIVITIES:

- Build cognitive model to improve mental fitness using big data and game play.
- Build a Probabilistic Model for handling Big Data.

UNIT-V	COGNITIVE APPLICATIONS	12

The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing- Building a cognitive health care application and Smarter cities: Cognitive Computing in Government.

SUGGESTED ACTIVITIES:

- Build a cognitive healthcare application.
- Build a cognitive based smart city application.

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the basics of Cognitive Science using python Libraries.
CO2: Make use of knowledge by individual minds, brains, and machines.
CO3: Utilize the knowledge of neuroscience in the cognitive field.
CO4: Interpret advanced analytics to cognitive computing.
CO5: Illustrate various applications of cognitive computing.

TEXT BOOKS:

1. Jay Friedenberg, Gordon Silverman, Michael James Spivey ,"Cognitive Science: an introduction to the study of mind",4th Edition, Sage Publications,2021
2. Judith H Hurwitz, Marcia Kaufman, Adrian Bowles, "Cognitive computing and Big Data Analytics", 1st Edition, Wiley, 2015.
3. Vijay Raghvan, Venu Govindaraju, C.R. Rao, "Cognitive Computing: Theory and applications", 1st Edition, Elsevier publications, 2016.

REFERENCES:

1. Jose Luis Bermudez,"CognitiveScience:An Introduction to the Science of the Mind",1st Edition Cambridge University Press, NewYork, 2014.
2. Mallick, Pradeep Kumar, Borah, Samarjeet, "Emerging Trends and Applications in Cognitive Computing", IGI Global Publishers, 2019.
3. Neil A. Stillingd, Steven E.Weisler, Christopher H.Chase, Mark H. Feinstein, JayL. Garfield and Edwina L. Rissland, "Cognitive Science An Introduction" 2nd Edition, MIT Press, 1998.

21PCS31	STATISTICAL NATURAL LANGUAGE PROCESSING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To familiarize the concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
- To relate mathematical foundations, Probability theory with Linguistic essentials such as syntactic and semantic analysis of text.
- To apply the Statistical learning methods and cutting-edge research models from deep Learning
- To demonstrate the state-of-the-art algorithms and techniques for text-based processing.
- To learn a Statistical Methods for Real World Applications and explore deep learning based NLP

UNIT-I	INTRODUCTION TO NLP	12

Introduction to NLP - Various stages of NLP –The Ambiguity of Language: Why NLP Is Difficult Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language, Cross entropy.

SUGGESTED ACTIVITIES:

- Create CORPUS linguistics based on digestive approach (Text Corpus method)

UNIT-II	TEXT PREPROCESSING AND MORPHOLOGY	12

Introduction to Corpora, Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer

SUGGESTED ACTIVITIES:

- Check a current methods for statistical approaches to machine translation.

UNIT-III	LANGUAGE MODELLING	12

Words: Collocations- Frequency-Mean and Variance –Hypothesis testing: The t test, Hypothesis testing of differences, Pearson's chi-square test, Likelihood ratios.

SUGGESTED ACTIVITIES:

- Perform POS tagging for a given natural language and Select a suitable language modelling technique based on the structure of the language.

UNIT-IV	WORD SENSE DISAMBIGUATION	12

Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurus based disambiguation, Disambiguation based on translations in a second-language corpus.

SUGGESTED ACTIVITIES:

- Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology

UNIT-V	SYNTAX AND SEMANTICS	12

Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Statistical Alignment and Machine Translation, Text alignment, Word alignment, Information extraction

SUGGESTED ACTIVITIES:

- Develop a Statistical Methods for Real World Applications and explore deep learning based NLP.

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the principles and Process of Human Languages such as English and other Indian

Languages using computers.

CO2: Make use of semantics and pragmatics of English language for text processing

CO3: Develop CORPUS linguistics based on digestive approach to check a current methods for statistical approaches to machine translation.

CO4: Build POS tagging for a given natural language for a suitable language modelling technique based on the structure of the language.

CO5: Develop a Statistical Methods for Real World Applications and explore deep learning based NLP.

TEXT BOOKS:

1. Hobson lane, Cole Howard, Hannes Hapke, "Natural language processing in action" ,1st Edition, Manning Publications, 2019.

2.Rajesh Arumugam, Rajalingappa Shanmugamani "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application".1st Edition, PACKT publisher, 2018

3. Alexander Clark, Chris Fox, Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", 1st Edition,Wiley-Blackwell, 2012

REFERENCES:

1.Christopher D. Manning and Hinrich Schutze, " Foundations of Natural Language Processing" , 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003

2. Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd Edition, Prentice Hall, 2009

3.NitinIndurkhya, Fred J. Damerau "Handbook of Natural Language Processing", 2nd Edition, CRC Press, 2010.

VERTICAL 8 - COMPUTING SCIENCES

21PCS32	INTRODUCTION TO C	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain the organization of a digital computer and expose to the number systems
- To describe logically and write pseudo code or draw flow charts for problems.
- To illustrate the syntax of C
- To demonstrate the C programming concepts in trivial problem solving.
- To use arrays, strings, functions, pointers, structures and unions in C.

UNIT-I INTRODUCTION **12**

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

SUGGESTED ACTIVITIES:

- Decision-making constructs: if-else, goto, switch-case, break-continue (exchange the values of two variables, circulate the values of n variables, distance between two points).

UNIT-II C PROGRAMMING BASICS **12**

Problem formulation – Problem Solving - Introduction to C, programming –fundamentals – structure of a C program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in C – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

SUGGESTED ACTIVITIES:

- Loops: for, while, do-while
- Decision Making for Branching

UNIT-III	ARRAYS AND STRINGS	12

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

SUGGESTED ACTIVITIES:

- Arrays: 1D and 2D, Multi-dimensional arrays, traversal
- Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)

UNIT-IV	FUNCTIONS AND POINTERS	12

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

SUGGESTED ACTIVITIES:

- Functions: call, return, passing parameters by (value, reference), passing arrays to function.

UNIT-V	STRUCTURES AND UNIONS	12

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

SUGGESTED ACTIVITIES:

- Identification and solving of simple real life or scientific or technical problems and develop C Program. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.)

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Illustrate the concepts of Computer Organization and Number Systems.

CO2: Develop simple programs using expressions, branching control and looping control statements.

CO3: Execute simple applications in C using arrays and strings.

CO4: Build simple applications in C by employing functions and pointers concepts.

CO5: Prepare small application projects using structures or unions.

TEXT BOOKS:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2016.
2. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", 2nd Edition, Oxford University Press, 2013.
3. Yashavant P. Kanetkar, "Let Us C", 14th Edition, BPB Publications, 2016.

REFERENCES:

1. Byron S Gottfried, "Programming with C", 2nd Edition, Tata McGraw-Hill, 2006
2. Dromey R.G., "How to Solve it by Computer", 4th Edition, Pearson Education, 2007.
3. Kernighan, B.W and Ritchie,D.M, "The C Programming language", 2nd Edition, Pearson Education, 2006.

21PCS33	FUNDAMENTALS OF DATA STRUCTURES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain the concepts of ADTs
- To describe linear data structures like lists, stacks
- To illustrate the linear data structure like queues, circular queue
- To demonstrate nonlinear data structures like Binary tree, Binary search tree
- To infer the representation of graph and its traversals

UNIT-I	LINEAR DATA STRUCTURES – LIST	12

Abstract Data Types (ADTs) -List ADT -Array-based implementation -Linked list implementation -Singly linked lists- Circularly linked lists- Doubly-linked lists - Applications of lists -Polynomial Manipulation - All operations (Insertion, Deletion, Merge, Traversal).

SUGGESTED ACTIVITIES:

- Implementation of Singly Linked List
- Implementation of Doubly Linked List
- Application of Linked List

UNIT-II	LINEAR DATA STRUCTURES – STACKS	12

Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression

SUGGESTED ACTIVITIES:

- Implementation of Stacks
- Application of Stack

UNIT-III	LINEAR DATA STRUCTURES – QUEUES	12

Queue ADT – Operations - Circular Queue – Priority Queue - deQue – applications of queues

SUGGESTED ACTIVITIES:

- Implementation of Queues
- Application of Queues

UNIT-IV	NON LINEAR DATA STRUCTURES – TREES	12

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT

SUGGESTED ACTIVITIES:

- Implementation of Binary Trees and operations of Binary Trees
- Implementation of Binary Search Trees

UNIT-V	NON LINEAR DATA STRUCTURES – GRAPHS	12

Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

SUGGESTED ACTIVITIES:

- Graph representation and Traversal algorithms
- Applications of Graphs

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build abstract data types for linear data structures.

CO2: Utilize the linear data structures like stack for problem solving.

CO3:Choose the different linear data structure like queue to various computing problems

CO4: Select nonlinear tree data structures to resolve the computing problems.

CO5: Make use of data using graph structure and apply their algorithms for problem solving.

TEXT BOOKS:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2010.
2. Reema Thareja, Data Structures Using C, 2nd Edition , Oxford University Press, 2011
3. Richard F Gilberg , A Forouzan ,"Data Structures-A Pseudo code Approach with C", 2nd Edition , Cengage,2005

REFERENCES:

1. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, University Press, 2008.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 2nd Edition, McGraw Hill, 2002.
3. Aho, Hopcroft and Ullman, Data Structures and Algorithms,1st Edition, Pearson Education, 1983.

21PCS34	DATA BASE PROGRAMMING WITH PL/SQL	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain the fundamentals of PL/SQL
- To use the concepts of control and conditional structures.
- To describe the handling of exceptions and usage of cursors.
- To illustrate PL/SQL programming with procedures and functions.
- To develop applications with triggers

UNIT I — PL/SQL FUNDAMENTALS — 12

Introduction to PL/SQL, Benefits of PL/SQL, Creating PL/SQL Blocks, Defining and using Variables and Datatypes, Writing PL/SQL Executable Statements, Nested Blocks, Review of SQL DML, Retrieving Data in PL/SQL, Manipulating Data in PL/SQL, Using Transaction Control Statements

SUGGESTED ACTIVITIES:

Developing simple PL/SQL Programs with defined functions

UNIT II — PROGRAM STRUCTURES TO CONTROL EXECUTION FLOW — 12

Conditional Control: IF Statements, Conditional Control: CASE Statements, Iterative Control: Basic Loops, Iterative Control: WHILE and FOR Loops, Iterative Control: Nested Loops – Case Studies

SUGGESTED ACTIVITIES:

- Apply SQL concepts in PL/SQL Programming
- Develop PL/SQL Programs using control structures and conditional statements

UNIT III — EXCEPTION HANDLING AND CURSORS — 12

Handling Exceptions, Trapping Oracle Server Exceptions, Trapping User-Defined Exceptions, Introduction to Explicit Cursors, Using Explicit Cursor Attributes, Cursor FOR Loops, Cursors with Parameters, Using Cursors for UPDATE, Using Multiple Cursors

SUGGESTED ACTIVITIES:

- Implementation of PL/SQL cursors

UNIT IV	PROCEDURE AND FUNCTIONS	12

Creating Procedures, Using Parameters in Procedures, Passing Parameters, Creating Functions, Using Functions in SQL Statements, Review of the Data Dictionary, Managing Procedures and Functions

SUGGESTED ACTIVITIES:

- Implementation of PL/SQL procedures and functions

UNIT V	TRIGGERS AND PACKAGES	12

Introduction To Triggers, Creating DML Triggers, Creating DDL and Database Event Triggers, Managing Triggers, Creating Packages, Managing Package Concepts, Advanced Package Concepts: Getting the Best out of Packages

SUGGESTED ACTIVITIES:

- Implementation of PL/SQL triggers

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Construct SQL concepts in PL/SQL Programming

CO2: Make use of control and conditional structures in PL/SQL Programming

CO3: Develop PL/SQL Programs with exception handling and cursors

CO4: Utilize procedures and functions in PL/SQL Programming

CO5: Build triggers and packages for a given application

TEXT BOOKS:

1. Steven Feuerstein, Bill Pribyl, "Oracle PL/SQL Programming", 6th Edition, O'Reilly Media, Inc.,2014
2. .RamezElmasri, Shamkant B. Navathe, "Fundamentals of Database Systems", 1st Edtion,Pearson Education, 2011
3. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, ,"Database System Concepts", 6th Edition, Tata McGraw Hill, 2011

REFERENCES:

1. C.J.Date, A.Kannan, S.Swamynathan, "An Introduction to Database Systems", 8th Edition, Pearson Education, 2012.
2. Raghu Ramakrishnan, "Database Management Systems", 4th Edition, McGraw-Hill College Publications, 2015.
3. G.K.Gupta, "Database Management Systems", 1st Edition, Tata McGraw Hill, 2011.

21PCS35	JAVA PROGRAMMING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain the basic concepts of java.
- To describe the concepts of Exceptions and use strings.
- To illustrate Multi-threading and Input/output concepts for developing applications.
- To demonstrate about generics and collections.
- To build GUI using swing components.

UNIT-I	INTRODUCTION TO OOPS AND JAVA	12

Basic OOPs concepts –Characteristics of Java- Data types , Variables and Arrays-Classes – Constructors, Methods – Inheritance- Packages –Interfaces **SUGGESTED ACTIVITIES:** • Develop java program using basic java concepts		
UNIT-II	**EXCEPTION HANDLING AND STRINGS**	**12**
Exceptions - Exception hierarchy - throwing and catching exceptions – Built-in exceptions, creating own exceptions, Stack Trace Elements-Strings-String Comparison-String Methods-String buffer-String Tokenizer **SUGGESTED ACTIVITIES:** • Develop java applications to handle various exceptions.		
UNIT-III	**MULTITHREADING AND INPUT/OUTPUT**	**12**
Multi-threading Vs Multitasking-Java Thread model- Creating single and Multiple threads-isAlive() and Join Methods- Thread Priorities-Input / Output Basics – Reading and Writing Console – Reading and Writing Files **SUGGESTED ACTIVITIES:** • Build java application to support multithreading concepts		
UNIT-IV	**GENERICS AND COLLECTIONS**	**12**
Generic Programming – Generic classes – generic methods – Bounded Types ,Collections-Collection Interfaces-Collection Classes-Accessing a Collection – List – Map **SUGGESTED ACTIVITIES:** • Use collection framework to store and manipulate group of objects		
UNIT-V	**EVENT DRIVEN PROGRAMMING**	**12**
Event handling Mechanisms-Event classes- Event Interfaces- Using Delegation event Model -Introduction to Swing –Swing application-Swing Applets- layout management - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists-Menus – Dialog Boxes **SUGGESTED ACTIVITIES:** • Create window based application using swing components		
		TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Demonstrate java applications using classes, inheritance, interfaces and packages
CO2:Outline java applications using exception handling and strings
CO3:Illustrate java applications using threads and I/O concepts
CO4:Develop an applications using Generics and collections
CO5: Build GUI using swing components.

TEXT BOOKS:

1. Herbert Schildt, "Java The complete reference", 8th Edition, McGraw Hill Education, 2011
2. Cay S. Horstmann, Gary cornell, "Core Java Volume –I Fundamentals", 9th Edition, Prentice Hall, 2013
3. Paul Deitel, Harvey Deitel, ,"Java SE 8 for programmers, 3rd Edition, Pearson, 2015

REFERENCES:

1. Steven Holzner, ,"Java 2 Black book",1st Edition, Dream Tech press, 2011.
2. Timothy Budd,"Understanding Object-oriented programming with Java", Updated Edition, Pearson Education, 2000
3. Gopalan N.P. and Akilandeswari J., Web Technology, 1st Edition, Prentice Hall of India, 2011.

21PCS36	FUNDAMENTALS OF COMPUTER NETWORKS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To describe the state-of-the-art in network architectures and physical layer services.
- To interpret the various Link layer services.
- To demonstrate the concepts of subnetting and routing mechanisms.
- To illustrate the process-to-process delivery models.
- To explain the services of various protocols in application layer.

UNIT-I	INTRODUCTION PHYSICAL LAYER	12

Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model – Physical Layer: Performance – Transmission media.

SUGGESTED ACTIVITIES:

- Make use of various networking commands like tcpdump, netstat, ifconfig, nslookup and traceroute. Capture ping and traceroute PDUs using a network protocol analyzer and examine

UNIT-II	DATA LINK LAYER	12

Introduction – Link-Layer Addressing – Error Detection and Correction– DLC Services-Framing Media Access Control –Random access- Wired LANs: Ethernet -Wireless LANs –IEEE 802.11- Connecting Devices.

SUGGESTED ACTIVITIES:

- Implement the applications using TCP /UDP sockets like: Chat and File transfer

UNIT-III	NETWOK LAYER	12

Network Layer Services– IPV4 Addresses-Classful Addressing-Classless Addressing-Dynamic Host Configuration Protocol (DHCP)- Network Layer Protocols: IP- Unicast Routing Algorithms and Protocols.

SUGGESTED ACTIVITIES:

- Implementation of DNS using UDP sockets.

UNIT-IV	TRANSPORT LAYER	12

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol

SUGGESTED ACTIVITIES:

- Simulation of error correction code (like CRC).

UNIT-V	APPLICATION LAYER	12

WWW and HTTP – FTP – Email –Telnet –SSH – DNS.

SUGGESTED ACTIVITIES:

- Implementation of ARP/RARP protocols.

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the role of each layer in computer networks and physical layer services.
CO2: Utilize the Link layer services in the various standards defined by IEEE standards.
CO3: Apply subnetting to optimize network configuration and various routing algorithms for unicast routing.
CO4: Choose protocols for Process to Process communication in different application.
CO5: Utilize the different application layer protocols for real time application.

TEXT BOOKS:

1. Behrouz A. Forouzan, "Data Communications and Networking", 5th Edition, Tata McGraw Hill, 2013.
2. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", 5th Edition, Morgan Kaufmann Publishers Inc., 2012.
3. William Stallings, "Data and Computer Communication", 10th Edition, Pearson Education, 2013.

REFERENCES:

1. Nader F. Mir, "Computer and Communication Networks", 2nd Edition, Prentice Hall, 2014.
2. Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open Source Approach,"1st Edition, McGraw Hill Publisher, 2011.
3. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", 6th Edition, Pearson Education, 2013.

21PCS37	SOFTWARE TESTING AND TOOLS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To describe the fundamentals of testing process.
- To illustrate the types of testing.
- To identify the steps involved in test cases development.
- To explain the techniques of testing.
- To infer the basics about testing tools.

UNIT-I | TESTING FUNDAMENTALS | 12

Definition, Basics and Types of Software Testing, Software Testing as a Career Path (Skills, Salary, Growth), Software Testing Principles: Learn with Examples, STLC – Software Testing Life Cycle Phases & Entry, Exit Criteria

SUGGESTED ACTIVITIES:

- Examine the open source testing tool "Selenium

UNIT-II | TYPES OF TESTING | 12

Manual Testing, Automation Testing, Unit Testing, Integration Testing, System Testing, Sanity and Smoke Testing, Regression Testing

SUGGESTED ACTIVITIES:

- Create a basic test case in Selenium IDE.

UNIT-III | TESTCASE DEVELOPMENT | 12

Test Documentation, Test Scenario and Template, Test Cases and Template, Test Analysis, Requirements Traceability Matrix (RTM), Test Data Generation

SUGGESTED ACTIVITIES:

- Execute a sample login test in Selenium IDE

UNIT-IV | TESTING TECHNIQUES | 12

Boundary Value Analysis, Equivalence Partitioning, Decision Table Testing, State Transition Testing, Use Case Testing

SUGGESTED ACTIVITIES:

- Perform the testing process for scrolling a web page

UNIT-V | TESTING TOOLS | 12

Need for Tools, Test Management Tools, Defect/Bug Tracking Tools, Automation Testing Tools, Unit Testing Tools, Integration Testing Tools

SUGGESTED ACTIVITIES:

- Examine the API testing tool "Postman".

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the basic concepts of testing.

CO2: Make use of the different types of testing to design simple applications.

CO3: Experiment with various levels of developing a simple test case.

CO4: Choose the testing techniques to simple applications.

CO5: Relate the tools needed for different types of testing.

TEXT BOOKS:

1. Nageshwar Rao Pusuluri, "Software Testing Concepts and Tools", 1st Edition, Dreamtech Press, 2006
2. Dr. D. Chitra, A. Kaliappan, "Software Testing", 1st Edition, Technical Publications, 2019
3. Paul C. Jorgensen, Byron DeVries, "Software Testing A Craftsman's Approach", 5th Edition, Auerbach Publications, 2021

REFERENCES:

1. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2013.
2. Aditya P. Mathur, "Foundations of Software Testing _ Fundamental Algorithms and Techniques", 1st Edition, Pearson Education, 2008.
3. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", 1st Edition, Pearson Education, 2017.

21PCS38	WEB PROGRAMMING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize the fundamentals of web programming.
- To discuss the concepts of PHP.
- To construct web page using CSS.
- To describe the basic concepts in java script.
- To build an interactive webpage using AJAX.

UNIT-I WEB FUNDAMENTALS — 12

Web Fundamentals - Programming Languages for the Web-HTML Basics- the working environment

SUGGESTED ACTIVITIES:

- Develop static web page using HTML

UNIT-II PHP — 12

The PHP language -More on the PHP language -Using HTML with PHP- forms- sessions- cookies

SUGGESTED ACTIVITIES:

- Develop web applications using PHP

UNIT-III CSS — 12

Using CSS and templates - Intro to databases Database manipulation in PHP

SUGGESTED ACTIVITIES:

- Construct web page using CSS and templates

UNIT-IV	JAVASCRIPT	12

Basics of JavaScript Programming the browser and forms with JavaScript Manipulating windows and frames with JavaScript Using dates- timers- string manipulation and regular expressions DHTML

SUGGESTED ACTIVITIES:

- Use java script to design responsive web page

UNIT-V	AJAX	12

AJAX basics - Security pitfalls and basic solutions- SQL injections, HTML/JS injections, X-site scripting, DoS, DDoS, File upload vulnerabilities, Password encryption, Password recovery flaws

SUGGESTED ACTIVITIES:

- Create interactive web application using AJAX

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Demonstrate the fundamentals of web programming

CO2:Develop web application using PHP

CO3:Illustrate the concepts of CSS and templates for web page design

CO4:Construct web applications using java script

CO5: Build an interactive webpage using AJAX.

TEXT BOOKS:

1. Steven A. Gabarro, "Web Application Design and Implementation", 1st Edition, Wiley, 2006
2. John Dean, "Web Programming With HTML5, CSS, And JavaScript", 1st Edition, ones and Bartlett Publishers, Inc 2018
3. Chris Bates,"Web Programming: Building Internet Applications", 3rd Edition ,Wiley, 2016

REFERENCES:

1. Deitel and Deitel and Nieto,"Internet and World Wide Web - How to Program", 5th Edition, Prentice Hall, 2011.
2. StephenWynkoop and John Burke,"Running a Perfect Website", QUE, 2nd Edition, 2019.
3. Chris Bates, "Web Programming -Building Intranet Applications", 3rd Edition, Wiley Publications, 2009

21PCS39	MACHINE LEARNING USING PYTHON	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain the fundamental concepts of machine learning.
- To illustrate the fundamental concepts of Python for machine learning techniques.
- To describe the supervised machine learning (ML) algorithms for model building.
- To identify the unsupervised machine learning (ML) algorithms for model building.
- To summarize the concepts of evaluating, selecting and improving the model performance.

UNIT-I	INTRODUCTION TO MACHINE LEARNING	12

Introduction to Analytics and Machine Learning (ML) – Learning style of machine learning algorithms: Supervised – Classification – Prediction – Unsupervised – Clustering – Association - Evaluating Learning Systems - Process for Building Learning Systems.

SUGGESTED ACTIVITIES:

- Data preprocessing using Python.

UNIT-II	PYTHON FOR MACHINE LEARNING	12

Introduction to Python- Data types and basic operators – Environment setup and essentials – Python libraries: NUMPY for mathematical essentials –Data manipulation using PANDAS – Data visualization by MATPLOTLIB.

SUGGESTED ACTIVITIES:

- Visualizing statistical analysis using Python.

UNIT-III	SUPERVISED MACHINE LEARNING	12

Prediction Categorical: Classification - Decision Tree - Naive Bayes - Support Vector Machine - Neural Network - Prediction Numerical: Linear Regression - Logistic regression.

SUGGESTED ACTIVITIES:

- Predictions in numerical data using Python.
- Classifying the categorical data using Python.

UNIT-IV	UNSUPERVISED MACHINE LEARNING	12

Introduction to Clustering: K-Means clustering – Distance based clustering - Hierarchical Clustering - Association rule mining: APRIORI algorithm.

SUGGESTED ACTIVITIES:

- Clustering using Python.

UNIT-V	MODEL EVALUATION, SELECTION AND IMPROVISATION	12

Model Evaluation and Selection: Metrics for Evaluating Classifier – Sampling - Cross-Validation - Model Selection Using Statistical Tests - ROC Curves - Techniques to Improve Classification Accuracy: Introducing Ensemble Methods - Bagging – Boosting.

SUGGESTED ACTIVITIES:

- Generating association rules using Python.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Examine the different style of machine learning methods.

CO2: Make use of PYTHON for machine learning techniques.

CO3: Choose suitable supervised ML method for categorical and numerical data to build models.

CO4: Select suitable unsupervised ML method to build models for decision making.

CO5: Prepare evaluation metrics to interpret and improve the model performance.

TEXT BOOKS:

1. Manaranjan Pradhan and U Dinesh Kumar, "Machine Learning using Python", 1st Edition, Wiley, 2019.
2. Mark E. Fenner, "Machine Learning with Python for Everyone", 1st Edition, Addison-Wesley, 2020.
3. Müller, Andreas C. and Sarah Guido, "Introduction to machine learning with Python: a guide for data scientists", 1st Edition, O'Reilly Media, Inc., 2016.

REFERENCES:

1. Brett Lantz, "Machine learning with R", 1st Edition, Packt Publishing Ltd, 2013.
2. Wes McKinney, "Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython", 2nd Edition, O'Reilly Media, Inc,, 2017.
3. Jiawei Han, Micheline Kamber, Jian Pei, "Data Mining Concepts and Techniques", 3rd Edition, Elsevier, 2012.

ONE CREDIT COURSE

21OCCS01	ANGULAR JS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To demonstrate the built-in directives offered by Angular.
- To explain how Angular interact with Document Object Model of a web page.

TOPICS TO BE COVERED:

GETTING STARTED

- Introduction to Angular: Angular overview - Single Page Application - Angular CLI - Create an angular project - Angular project files overview.
- Components: Angular components overview - Creating a component - Lifecycle hooks - Lifecycle event sequence - Component interaction - Parent and children communicate using a service - Sharing data between child and parent directives and components.

UNDERSTANDING ANGULAR

- Templates: Understanding templates - Displaying values with interpolation - Data binding overview - Working with binding methods - Understanding Pipes - Using a pipe in a template.
- Directives: Understanding Directives - Working with different types of directives.
- Dependency injection in Angular: Understanding dependency injection - Creating an injectable service - Configuring dependency providers.

ROUTING AND NAVIGATION

- Understanding Angular Routing and Navigation: Defining a basic route - Getting route information - Setting up wildcard routes - Displaying a 404 page - Setting up redirects - Using relative paths - Accessing route parameters - Lazy loading - Working with Link parameters array.

FORMS

- Introduction to forms: Understanding Reactive forms and Template-driven forms - Setup in reactive forms - Setup in template-driven forms - Understand data flow in forms - Form validation - Building dynamic forms.

HTTP CLIENT

- Communicating with backend services using HTTP: What is HTTP? - Setup for server communication - Requesting data from a server - Understand Observe and Response types - Working with JSON Data - Handling request errors - Sending data to a server - Write an interceptor - Tracking and showing request progress - CRUD Operations.

AUTHENTICATION

- Understanding Authentication: What is Authentication? - How Authentication Work? - Introduction to JSON Web Tokens - User Signing up and in - Sending Token & Requiring - Authentication Status.

TOTAL : 15 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Experiment with the built-in directives offered by Angular.

CO2: Build an interactive web application using the Angular framework.

TEXT BOOKS:

1. Felipe Coury, Ari Lerner and Carlos Taborda, "ng-book The Complete Guide to Angular 6", 1st Edition, Fullstack.io publication, 2018.
2. Sukesh Marla, "Journey to Angular Development", 1st Edition, BPB publication, 2021.

REFERENCES :

1. ShyamSeshadri, "Angular: Up and Running: Learning Angular, Step by Step", 1st Edition, Kindle Edition, O'Reilly, 2018.
2. Dhananjay Kumar , "Angular Essentials: The Essential Guide To Learn Angular", 1st Edition, BPB publication, 2019.

21OCCS02	MACHINE LEARNING USING PYTHON	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To solve business analytic problems with Python.
- To demonstrate ML pipelines for solving the business problems.

TOPICS TO BE COVERED:

- Introduction and intuition behind AI and ML.
- Real world problems solved using various ML techniques.
- High level overview of various ML Algorithms.
- Introduction to ML approaches for solving various business problems.
- Supervised vs unsupervised learning
- Introduction to python
  - Pandas, Numpy, SKLearn
  - EDA - Example.
- Regression - intuition, various regression algorithms, evaluation metrics, mini problem solving
- Classification- intuition, various regression algorithms, evaluation metrics, mini problem solving
- Model deployment strategies - introduction to MLOps.
- Labs
  - Project-1: Build an optimized Regression model.
  - Project-2: Build an optimized Classification model.

TOTAL : 15 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Make use of PYTHON libraries for solving business analytic problems.

CO2: Build an optimized Regression and Classification models for business analytics using PYTHON.

TEXT BOOKS:

1. Mark E. Fenner, "Machine Learning with Python for Everyone", 1st Edition, Addision-Wesley (EPUB), 2020.
2. Manaranjan Pradhan and U Dinesh Kumar, "Machine Learning using Python", 1st Edition, Wiley, 2019.

REFERENCES :

1. B. Uma Maheswari, R. Sujatha, "Introduction to Data Science: Practical Approach with R and Python", 1st Edition, Wiley, 2021.
2. Wes McKinney, "Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython", 2nd Edition, O'Reilly Media, Inc, 2017.

21OCCS03	PRACTICAL APPROACH TO DATA WAREHOUSING USING INFORMATICA	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To identify the scope of Data Warehouse modernization
- To illustrate the modern approaches of Data Ware housing

TOPICS TO BE COVERED:

- Data warehouse modernization
- Informatica Intelligent data Services
- Approaches of Data warehousing
- Snowflake schema
- Slowly changing Dimension Concepts
- Dimension table
- Configuring Informatica Repository Server
- Informatica Server Tools
- Constrained Based Loading
- Application Source Qualifier

TOTAL : 15 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1: Demonstrate the slowly changing Dimension concepts to solve the real time problems.

CO2: Develop the Informatica Server tools for Optimization.

TEXT BOOKS:

1. Matthias Jarke, Maurizio Lenzerini, Yannis Vassiliou and Panos Vassiliadis,"Fundamentals of Data Warehouse", 2 nd Edition, Springer 2022.
2. Alex Petrov, "Database Internals: A Deep-Dive Into How Distributed Data Systems Work", 1st Edition, O'Reilly Media 2019.

REFERENCES :

1. Ralph Kimball, Margy Ross," The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modelling", 3 rd Edition, Wiley 2015.
2. Alan Beaulieu, "Learning SQL: Generate, Manipulate, and Retrieve Data", 1 st Edition, O'Reilly Media 2020.

21OCCS04	HEALTHCARE AUTOMATION USING MACHINE LEARNING	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To develop better diagnostic tools to analyse Healthcare data.

- To adapt Machine learning-enabled automation for healthcare organizations to improve resource management.

TOPICS TO BE COVERED:

- Machine Learning Concepts
- Healthcare Automation
- Patient Risk Identification
- Pattern Imaging Analytics
- Clinical Trial Research
- Predicting Epidemics
- Maintaining Healthcare Records
- Personalized Treatment
- Robotic Surgery
- Improved Radiotherapy

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Implement wide range of healthcare use cases using Machine Learning algorithms

CO2: Build Machine Learning Models for driving massive improvement and innovation in the healthcare industry

TEXT BOOKS:

1. Amiya Ranjan Panda, Hrudaya Kumar Tripathy, Pradeep Kumar Mallick, Sushruta Mishra , "Technical Advancements of Machine Learning in Healthcare", 1st Edition, Springer Singapore, 2021.
2. Achyuth Sarkar, G. Nalinipriya, Om Prakash Jena, Sachi Nandan Mohanty, "Machine Learning for Healthcare Applications", 1st Edition, Wiley, 2021.

REFERENCES :

1. Arjun Panesar, "Machine Learning and AI for Healthcare- Machine Learning and AI for Healthcare Big Data for Improved Health Outcomes", 1st Edition, Apress, 2020.
2. Jitendra Kumar Verma, Prashant Johri, Sudip Paul , "Applications of Machine Learning", 1st Edition, Springer Singapore, 2020.

21OCCS05	FOUNDATION OF NOSQL DATABASE	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To describe the origins of NoSQL databases and the characteristics that distinguish them from Traditional relational database management systems.
- To discuss the criteria that decision makers should consider when choosing between relational and non-relational databases and techniques for selecting the NoSQL database that best addresses specific use cases.

TOPICS TO BE COVERED:

- Definition and need of NoSQL Database
- Types of Databases
- Document-oriented Databases
- Key Value Pair Databases

- Column-oriented Databases
- Graph Databases
- Introducing MongoDB - An Open-Source NoSQL Database
- Introducing Apache Cassandra - An Open-Source NoSQL Database
- Introducing IBM Cloudant - A NoSQL DBaaS

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Differentiate and identify right database models for real time applications

CO2: Choose and implement advanced data model functions for the real time applications

TEXT BOOKS:

1.Pramod J. Sadalage, Martin Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", 1st Edition, Pearson Publications, 2012

2. Eric Redmond, "Seven Databases in Seven Weeks: A Guide to Modern Databases and the Nosql Movement", 1st Edition, O Reilly Publications, 2012.

REFERENCES :

1.Christopher D.manning, Prabhakar Raghavan, Hinrich Schutze, "An introduction to Information Retrieval", 1st Edition,Cambridge University Press,2018

2. Daniel Abadi, Peter Boncz and Stavros Harizopoulas, "The Design and Implementation of Modern Column-Oriented Database Systems", 1st Edition, Now Publishers,2017.

21OCCS06	INTRODUCTION TO MAINFRAME SYSTEMS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To summarize the concepts of mainframe computing and its environment.
- To infer mainframe application programming.

TOPICS TO BE COVERED:

- Introduction to the new Mainframe Environment
- Mainframe Hardware systems
- Mainframe Operating system
- TSO ISPF Essentials
- PF Keys and customizing ISPF panel
- Mainframe datasets
- IBM Mainframe Application Programming

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Make use of mainframe environment for solving real time problems.

CO2: Experiment with mainframe programming for various application.

TEXT BOOKS:

1. Taulli,"Modern Mainframe Development: COBOL, Databases, and Next-Generation Approaches", 1st Edition, OReilly, 2019.

2. Mike Ebbers John Kettner Wayne O'Brien Bill Ogden, "Introduction to the New Mainframe z/OS

Basics", 1st Edition,Redbooks,2011

REFERENCES :

1.Gerardus Blokdyk," IBM mainframe",2nd Edition, 5STARCooks,2018

2.Stephen H. Kaisler ,"First Generation Mainframes: The IBM 700 Series", 1st Edition ,Cambridge Scholars Publishing,2018

21OCCS07	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To demonstrate the hardware and software development components of embedded systems.
- To make use of simulating tools for designing and developing embedded systems.

TOPICS TO BE COVERED:

- Embedded System Development Components
- Compilation with GCC and GNU Make
- Memory Types, Segments and Management
- Introduction to STM32 Microcontroller and its architecture
- STM32 timers and interrupts
- GPIO interface in STM32
- Embedded software development for real time applications

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to

CO1: Summarize the hardware and software requirements of embedded system

CO2: Make use of software tools for embedded system development.

TEXT BOOKS:

1. Ivan Cibrario Bertolotti, Tingting Hu, "Embedded Software Development- The Open-Source Approach", 1st Edition, CRC Press, 2020
2. Donald Norris, "Programming with STM32 – Getting started with Nucleo Board C/C++", 1st Edition, McGrow Hill Education, 2018

REFERENCES :

1. Klaus Elk, "Embedded Software Development for the Internet Of Things The Basics, the Technologies and Best Practices", 1st Edition, CreateSpace Independent Publishing, 2016.
2. Mazidi, Muhammad Ali, Chen, Shujen, Ghaemi, Eshragh, "STM32 Arm Programming for Embedded Systems", ist Edition, MicroDigitalEd, 2019.

21OCCS08	INNOVATION AND DESIGN THINKING	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To find a specific social need for the stakeholder's requirements for the societal project
- To show measurable criteria and Select the best design solution among the potential solutions

TOPICS TO BE COVERED:

- Project Identification: Introduction to Human Centered Design
- Identification of Stakeholder Requirements
- Description Problem Environment
- Creation of Stakeholder's Profiles
- Development of Customer Specification
- Development of Evaluation Criteria
- Development of Task-Analysis
- Refinement of design Specification on users 'feedback
- Evaluation of Potential Solutions
- Selection of best design

TOTAL : 15 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to

CO1 : Identify a specific social need for the stakeholder's requirements for the societal project

CO2 : Develop measurable criteria and Select the best design solution among the potential solutions

TEXT BOOKS:

1. Prof. Nigel Cross , "Design Thinking: Understanding How Designers Think and Work", 1st Edition, Bloomsbury Publishing India Private Limited, 2011.
2. Tim Brown, "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation", Harper Business, 1st Edition, 2013

REFERENCES :

1. George Anderson ,"Design Thinking for Tech", 1st Edition, Pearson, 2022.
2. Michael Lewrick , Patrick Link, Larry Leifer , Design Thinking Tool Box, Wiley ,1st Edition, 2020.

COURSE OFFERED TO OTHER DEPARTMENTS

21CS105	C PROGRAMMING	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES :

- To describe the basic programming principles of C language.
- To choose a suitable C-construct to develop C code for a given problem.
- To use the C-language syntax rules to correct the bugs in the C program.
- To develop simple C programs to illustrate the applications of different data types such as arrays, pointers, functions.
- To illustrate the concepts of Structures and Unions

UNIT I	BASICS OF C PROGRAMMING	6

Introduction to C- Structure of a C Program- Compiling and Executing C Programs- C tokens- Input/Output Statements in C- Operators in C- Type Conversion and Typecasting

UNIT II	DECISION CONTROL AND LOOPING STATEMENTS	6

Decision Control Statements- Conditional Branching Statements- Iterative Statements- Nested Loops- Break and Continue Statements- Goto Statement

UNIT III	ARRAYS AND STRINGS	6

Introduction to Arrays: Declaration, Accessing the Elements of an Array - Storing Values in Arrays Operations on Arrays - Two dimensional arrays - String operations

UNIT IV	FUNCTIONS AND POINTERS	6
Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion. Pointers – Declaring Pointer Variables- Pointer Expressions and Pointer Arithmetic -Null Pointers — Parameter passing: Pass by value, Pass by reference		
UNIT V	**STRUCTURES AND UNION**	**6**
Structure - Nested structures – Pointer and Structures – Array of structures – Self referential structures – Dynamic memory allocation– Union		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Develop simple applications using basic C components..

CO2: Build applications adopting array and string concepts.

CO3: Develop and implement applications in C using functions and pointers.

CO4:Build applications in C by employing structure and union concepts

CO5: Design simple applications that make use of C construct.

TEXT BOOKS:

1.ReemaThareja, "Programming in C", Oxford University Press, 2nd Edition, 2016.

2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", 2nd Edition, Pearson Education, 2015.

3.Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
2. YashwantKanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4. PradipDey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.

21CS214	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES :

- To describe the fundamentals of object oriented programming in C++.
- To explain the basics of OOP and Object-oriented approach to design software
- To illustrate the concept of data structures through ADT including List, Stack, Queues.
- To demonstrate the concept of Non-Linear Data Structures and their applications.
- To choose the various sorting and searching techniques

UNIT I	BASIC OOPS CONCEPTS	9
Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static ClassMembers – Overloading: Function overloading and Operator Overloading.		
UNIT II	**INHERITANCE & POLYMORPHISM**	**9**

Base Classes and Derived Classes – Protected Members – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes - Class Object To Base – Class Object Conversion – Composition Vs. Inheritance – Virtual functions – This Pointer – Virtual Destructors – Dynamic Binding.		
UNIT III	**LINEAR DATA STRUCTURES**	**9**
Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation — singly linked lists –Polynomial Manipulation - Stack ADT – Queue ADT - Evaluating arithmetic expressions		
UNIT IV	**NON-LINEAR DATA STRUCTURES**	**9**
Trees – Binary Trees – Binary tree representation and traversals – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search - Connected components		
UNIT V	**SORTING AND SEARCHING**	**9**
Sorting algorithms: Insertion sort - Quick sort - Merge sort - Searching: Linear search –Binary Search		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

- CO1: Develop simple applications using Basic OOPS concepts
- CO2: Build C++ programs using inheritance
- CO3: Construct the concept of stack, linked list and memory allocation
- CO4: Solve problems related to trees and Graphs
- CO5: Compare different sorting and searching algorithms

TEXT BOOKS:

1. Herbert Schildt, "C++: The Complete Reference", 4th Edition, McGraw Hill Education,2017
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition, Addison-Wesley, 2014.
3. Ellis Horowitz, SartajSahni and Dinesh Mehta, "Fundamentals of Data Structures in C++", Second Edition, Universities Press, 2008.

REFERENCES:

1. Bhushan Trivedi, "Programming with ANSI C++, A Step-By-Step approach", 1st Edition, Oxford University Press, 2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, "Data Structures and Algorithms in C++", 2nd Edition, Wiley. 2013.
3. Thomas H. Cormen, Charles E.. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, McGraw Hill, 2010.

21CS215	OBJECT ORIENTED PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES :

- To describe the fundamentals of object oriented programming, particularly in C++.
- To use object oriented programming to implement data structures.
- To illustrate linear data structures and their applications
- To demonstrate non-linear data structures and their applications.
- To explain the concept of data structures through ADT

LIST OF EXPERIMENTS

1. Basic Programs for C++ Concepts
2. Array implementation of List Abstract Data Type (ADT)
3. Linked list implementation of List ADT
4. Cursor implementation of List ADT
5. Stack ADT - Array and linked list implementations
6. Implement stack Applications using Stack ADT
7. Queue ADT – Array and linked list implementations
8. Implement Queue Applications using Queue ADT
9. Search Tree ADT - Binary Search Tree
10. Graphs- Breadth first and Depth first search
11. Insertion sort
12. Quick Sort
13. Develop a C++ application to solve real world problem using ADT algorithms

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1: Develop simple applications using Basic OOPS concepts.
CO2: Execute and Implement programs using inheritance and use them in programs.
CO3: Construct the concept of stack, linked list and memory allocation.
CO4:Solve problems related to trees and Graphs
CO5:Compare different sorting and searching algorithms

TEXT BOOKS:

1. Herbert Schildt, "C++: The Complete Reference", 4th Edition, McGraw Hill Education,2017
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition, Addison-Wesley, 2014.
3. Ellis Horowitz, SartajSahni and Dinesh Mehta, "Fundamentals of Data Structures in C++", 2nd Edition, Universities Press, 2008.

REFERENCES:

1. Bhushan Trivedi, "Programming with ANSI C++, A Step-By-Step approach",1st Edition,Oxford University Press,2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, "Data Structures and Algorithms in C++", 2nd Edition, Wiley. 2011.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, McGraw Hill, 2010.
4. BjarneStroustrup, "The C++ Programming Language", 4th Edition, Addison-Wesley, 2013.

21CS308	C AND DATA STRUCTURES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain the concepts of C programming using arrays.
- To describe the concepts of function and structure for problem solving.
- To make use of the concept List, Stack, Queues ADTs.
- To illustrate Tree and Graph data structure for solving real time problems

- To choose different searching and sorting algorithms.

UNIT-I	INTRODUCTION TO C	12

Structure of C Program-Pre-processor Directives-Compilation and Linking Processes-Data types-Storage classes-Constants-Variables-Operators-Expressions-Input/output Statements--Arrays: Declaration-Initilization-1-Dimensional Array-Two Dimensional Arrays.

Suggested Activities:

- Practice of C programming using statements, expressions, decision making and iterative statements
- Practice of C programming using Arrays

UNIT-II	FUNCTIONS, POINTERS AND STRUCTURES	12

Functions: Pass by value-Pass by reference and Recursion-Pointer definition-Initialization-pointer arithmetic-Structures-Definition-Structure with Structure-Programs using structures

Suggested Activities:

- Call by value & Call by reference
- Passing Structure Members as arguments to Function
- Implement C programs using Pointers and Structures

UNIT-III	LINEAR DATA STRUCTURES	12

Abstract Data Type(ADT)-Stacks ADT and Queues ADT -Array- based Implementation-Linked List-Linked List based Implementation of stack and queues-Evaluation of Expression-Linked list based Polynomial Addition.

Suggested Activities:

- Array implementation of List ADT
- Array implementation of Stack and Queue ADTs
- Linked list implementation of List, Stack and Queue ADTs
- Applications of List, Stack and Queue ADTs

UNIT-IV	NON LINEAR DATA STRUCTURE	12

Trees - Binary trees - Binary tree representation and traversals - Binary Search Tree Applications of trees. Graph - Definitions - Representations - Breadth first traversal - Depth first traversal

Suggested Activities:

- Implementation of Binary Trees and operations of Binary Trees
- Implementation of Binary Search Trees

UNIT-V	SEARCHING AND SORTING ALGORITHMS	12

Liner Search-Binary Search- Bubble sort –Insertion Search-Merge sort-Quick Sort-Hash Tables-Overflow Handling.

Suggested Activities:

- Implementation of searching techniques
- Implementation of Sorting algorithms : Insertion Sort, Quick Sort, Merge Sort
- Implementation of Hashing – any two collision techniques

TOTAL:60 PERIODS

COURSE OUTCOMES At end of the course, learners will be able to: CO1: Develop C programs for simple applications using basic constructs and arrays. CO2: Construct C programs involving functions, recursion, pointers & structures. CO3: Build abstract data types for linear data structures. CO4: Categorize the different non-linear data structures to resolve problems. CO5: Solve the problems using various sorting algorithms and hashing techniques.
TEXT BOOKS: 1. ReemaThareja, "Programming in C", 2nd Edition, Oxford University Press, 2016. 2. ReemaThareja, "Data Structures Using C", 2nd Edition , Oxford University Press, 2011 3. Ellis Horowitz, SartajSahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, Universities Press, 2011.
REFERENCES: 1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++,8th Edition, Pearson Education, 2018. 2. Yashwant Kanetkar, "Let us C", 17th Edition, BPB Publications, 2020. 3. Mark Allen Weiss,"Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education, 2010.

VELAMMAL

COLLEGE OF ENGINEERING & TECHNOLOGY, MADURAI – 625 009

(Autonomous)

(Accredited by NAAC with 'A' Grade and by NBA for 5 UG Programmes)

(Approved by AICTE and affiliated to Anna University, Chennai)

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.E. ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM and SYLLABUS

(I to VIII Semesters)

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY, VIRAGANOOR, MADURAI–625009
(AUTONOMOUS)
B. E. ELECTRONICS AND COMMUNICATION ENGINEERING
CHOICE BASED CREDIT SYSTEM
REGULATIONS 2021
CURRICULUM FOR SEMESTERS I TO VIII

SEMESTER I

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
1.	21IP101	Induction Programme *(Common to all B.E./B.Tech. Programmes)*	-	-	-	-	0
THEORY							
2.	21EN101	Professional English– I *(Common to all B.E./B.Tech. Programmes)*	HS	3	2	0	4
3.	21MA101	Matrices and Calculus *(Common to all B.E./B.Tech. Programmes)*	BS	3	2	0	4
4.	21PH101	Engineering Physics *(Common to all B.E./B.Tech. Programmes)*	BS	3	0	0	3
5.	21CH101	Engineering Chemistry *(Common to all B.E./B.Tech. Programmes)*	BS	3	0	0	3
6.	21CS101	Problem Solving and Python Programming *(Common to all B.E./B.Tech. Programmes)*	ES	3	0	0	3
7.	21XXXX	***Cambridge Course**** *(Common to all B.E./B.Tech. Programmes)*	***EE***	***1***	***0***	***0***	***1***
PRACTICAL COURSES							
8.	21CS102	Problem Solving and Python Programming Laboratory *(Common to all B.E./B.Tech. Programmes)*	ES	0	0	4	2
9.	21PC101	Physics and Chemistry Laboratory *(Common to all B.E./B.Tech. Programmes)*	BS	0	0	4	2
TOTAL CREDITS							**22**

***Naan Mudhalvan Scheme Course**

SEMESTER II

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21EN102	English–II *(Common to all B.E./B.Tech. Programmes)*	HS	3	0	0	3
2.	21MA103	Sampling Techniques and Numerical Methods *(Common to B.E. (ECE & CSE) /B.Tech. (IT) Programmes)*	BS	3	2	0	4
3.	21PH104	Physics for Electronics Engineering	BS	3	0	0	3
4.	21ME101	Engineering Graphics *(Common to all B.E./B.Tech. Programmes)*	ES	2	0	2	3
5.	21EC101	Electronic Devices	PC	3	0	0	3
6.	21EC102	Circuit Analysis	PC	3	0	0	3
7.	21CS105	C Programming	ES	2	0	0	2
PRACTICAL COURSES							
8.	21EM101	Engineering Practices Laboratory *(Common to all B.E./B.Tech. Programmes)*	ES	0	0	4	2
9.	21EC103	Electronic Devices and Circuits Laboratory	PC	0	0	4	2
TOTAL CREDITS							**25**

SEMESTER III

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21MA201	Transforms and Partial Differential Equation *(Common to B.E. (CIVIL Engg, ECE & MECH Engg) Programmes)*	BS	3	2	0	4
2.	21EC201	Digital Principles and System Design *(Common to B.E. (ECE & CSE) /B.Tech. (IT) Programmes)*	PC	3	0	0	3
3.	21EC202	Electronic Circuits I	PC	3	0	0	3
4.	21EC203	Signals and Systems	PC	3	0	0	3
5.	21CS214	Object Oriented Programming and Data Structures	ES	3	0	0	3
6.	21XXXX	***Microsoft Office Fundamentals**** *(Common to all B.E./B.Tech. Programmes)*	***EE***	***1***	***0***	***0***	***1***
THEORY WITH PRACTICAL COURSE							
7.	21EC204	Linear Integrated Circuits	PC	3	0	2	4
PRACTICAL COURSES							
8.	21EC205	Analog and Digital Circuits Laboratory	PC	0	0	4	2
9.	21CS215	Object Oriented Programming Laboratory	ES	0	0	4	2
TOTAL CREDITS							**25**

***Naan Mudhalvan Scheme Course**

SEMESTER IV

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21MA206	Probability and Random Processes	BS	3	2	0	4
2.	21CH103	Environmental Science *(Common to all B.E./B.Tech. Programmes)*	BS	2	0	0	2
3.	21EC206	Electronic Circuits II	PC	3	0	0	3
4.	21EC207	Electromagnetic Fields	PC	3	0	0	3
5.	21EC208	Microprocessors and Microcontrollers	PC	3	0	0	3
THEORY WITH PRACTICAL COURSE							
6.	21EC209	Analog Communication	PC	3	0	2	4
PRACTICAL COURSES							
7.	21EC210	Circuit Design and Simulation Laboratory	PC	0	0	4	2
8.	21EC211	Microprocessors and Microcontrollers Laboratory	PC	0	0	4	2
TOTAL CREDITS							**23**

SEMESTER V

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21EC301	Digital Communication	PC	3	0	0	3
2.	21EC302	Transmission Lines and RF Systems	PC	2	2	0	3
3.	21PECXX	**Professional Elective I**	PE	3	0	0	3
4.	21PECXX	**Professional Elective II**	PE	3	0	0	3
5.		**Naan Mudhalvan Scheme Course****	**EE**	**2**	**0**	**0**	**2***
6.	21MCC01	Constitution of India	MC	2	0	0	0
THEORY WITH PRACTICAL COURSE							
7.	21EC303	Digital Signal Processing	PC	3	0	2	4
PRACTICAL COURSES							
8.	21EN301	Professional Communication Laboratory *(Common to all B.E./B.Tech. Programmes)*	HS	0	0	2	1
9.		Internship	EE	0	0	0	1
TOTAL CREDITS							**18**

SEMESTER VI

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21EC304	Antennas and Wave Propagation	PC	2	2	0	3
2.	21EC305	VLSI and Chip Design	PC	3	0	0	3
3.	21PECXX	**Professional Elective III**	PE	3	0	0	3
4.	21OECXX	**Open Elective I**	OE	3	0	0	3
5.		**Naan Mudhalvan Scheme Course****	**EE**	**2**	**0**	**0**	**2***
6.	21MCC02	Essence of Indian Traditional Knowledge	MC	2	0	0	0
THEORY WITH PRACTICAL COURSE							
7.	21EC306	Communication Networks	PC	3	0	2	4
PRACTICAL COURSE							
8.	21EC307	VLSI Design Laboratory	PC	0	0	4	2
TOTAL CREDITS							**18**

****Machine Learning/ML with Application to Object Recognition/ IoT/ Cloud Essentials/ Powering IoT /Cyber Security/Big Data**

SEMESTER VII

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21EC401	Microwave and Optical Engineering	PC	3	0	0	3
2.	21EC402	Mobile Communication	PC	3	0	0	3
3.	21PECXX	**Professional Elective IV**	PE	3	0	0	3
4.	21OECXX	**Open Elective II**	OE	3	0	0	3
5.	21OECXX	**Open Elective III**	OE	3	0	0	3
6.		**Naan Mudhalvan Scheme Course****	**EE**	**2**	**0**	**0**	**2***
7	21OCECXX	One Credit Course	OC	0	0	2	1
PRACTICAL COURSES							
8.	21EC403	Microwave and Optical Laboratory	PC	0	0	4	2
9.	21EC404	Project Work I	EE	0	0	4	2
TOTAL CREDITS							**20**

SEMESTER VIII

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21PECXX	**Professional Elective V**	PE	3	0	0	3
2.	21PECXX	**Professional Elective VI**	PE	3	0	0	3
PRACTICAL COURSE							
3.	21EC405	Project Work II	EE	0	0	20	10
TOTAL CREDITS							**16**

****Machine Learning/ML with Application to Object Recognition/ IoT/ Cloud Essentials/ Powering IoT /Cyber Security/Big Data**

Total Credits: 167

SEMESTERWISE CREDIT DISTRIBUTION

Sem./Cat.	I	II	III	IV	V	VI	VII	VIII	Total Credits
HS	4	3	-	-	1	-	-	-	**8**
BS	12	7	4	6	-	-	-	-	**29**
ES	5	7	5	-	-	-	-	-	**17**
PC	-	8	15	17	10	12	8	-	**70**
PE	-	-	-	-	6	3	3	6	**18**
OE	-	-	-	-	-	3	6	-	**9**
EE	1	-	1	-	1(2*)	(2*)	3(2*)	10	**16**
MC					√	√			**-**
Total	**22**	**25**	**25**	**23**	**18**	**18**	**20**	**16**	**167**

Sl. No.	Category	Type of Course
1.	HS	Humanities and Social Sciences including Management
2.	BS	Basic Sciences
3.	ES	Engineering Sciences including workshop, drawing, basics of electrical/mechanical/computer etc.
4.	PC	Professional Core Courses
5.	PE	Professional Elective : Courses relevant to chosen specialization/ branch
6.	OE	Open Electives : Courses from other technical and/or emerging courses
7.	EE	Employability Enhancement Courses: Project Work, Seminar and Internship in Industry
8.	MC	Mandatory Courses
9.	OC	One Credit Courses

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL – I

RF CIRCUITS AND ANTENNA DESIGN

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21PEC01	RF Transceivers	PE	2	2	0	3
2.	21PEC02	RF MEMS	PE	3	0	0	3
3.	21PEC03	RF Test and Measurement	PE	3	0	0	3
4.	21PEC04	Electromagnetic Interference and Compatibility	PE	3	0	0	3
5.	21PEC05	Electromagnetic Metamaterials	PE	2	2	0	3
6.	21PEC06	Modern Antenna Design	PE	2	2	0	3
7.	21PEC07	Signal Integrity	PE	3	0	0	3

VERTICAL – II

SIGNAL AND IMAGE PROCESSING

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21PEC08	Stochastic Digital Signal Processing	PE	2	2	0	3
2.	21PEC09	Digital Image Processing	PE	2	2	0	3
3.	21PEC10	Speech Processing	PE	3	0	0	3
4.	21PEC11	Software Defined Radio	PE	3	0	0	3
5.	21PEC12	DSP Architecture and Programming	PE	3	0	0	3
6.	21PEC13	Wavelets and Multi Resolution Transforms	PE	2	2	0	3
7.	21PEC14	Multimedia Compression Techniques	PE	3	0	0	3

VERTICAL – III

BIO MEDICAL TECHNOLOGIES

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21PEC15	Wearable Devices	PE	3	0	0	3
2.	21PEC16	Human Assist Devices	PE	3	0	0	3
3.	21PEC17	Therapeutic Equipments	PE	3	0	0	3
4.	21PEC18	Medical Imaging Systems	PE	3	0	0	3
5.	21PEC19	Human Computer Interface	PE	3	0	0	3
6.	21PEC20	Wireless Body Area Networks	PE	3	0	0	3
7.	21PEC21	Bio MEMS	PE	3	0	0	3

VERTICAL – IV

EMBEDDED SYSTEMS AND IOT

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PERWEEK			CREDITS
				L	T	P	
THEORY							
1.	21PEC22	Wireless Sensor Networks	PE	3	0	0	3
2.	21PEC23	MEMS Design	PE	2	2	0	3
3.	21PEC24	Embedded and Real Time Systems	PE	3	0	0	3
4.	21PEC25	IoT Based System Design	PE	2	2	0	3
5.	21PEC26	Control Systems for IoT Applications	PE	2	2	0	3
6.	21PEC27	Industrial IoT and Industry 4.0	PE	3	0	0	3
7.	21PEC28	IoT for Smart Systems	PE	3	0	0	3

VERTICAL – V

SPACE TECHNOLOGIES

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21PEC29	Satellite Communication	PE	3	0	0	3
2.	21PEC30	Avionics	PE	3	0	0	3
3.	21PEC31	Positioning and Navigation Systems	PE	3	0	0	3
4.	21PEC32	Radar Technologies	PE	3	0	0	3
5.	21PEC33	Remote Sensing	PE	3	0	0	3
6.	21PEC34	Unmanned Aerial Vehicles and Drones	PE	3	0	0	3
7.	21PEC35	Rocketry and Space Mechanics	PE	3	0	0	3

VERTICAL – VI

HIGH SPEED COMMUNICATIONS

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21PEC36	Wireless Communication	PE	3	0	0	3
2.	21PEC37	Wireless Broad Band Networks	PE	3	0	0	3
3.	21PEC38	4G/5G Communication Networks	PE	3	0	0	3
4.	21PEC39	Cognitive Radio Networks	PE	3	0	0	3
5.	21PEC40	Space Time Wireless Communication	PE	2	2	0	3
6.	21PEC41	Massive MIMO Systems	PE	3	0	0	3
7.	21PEC42	Millimeter Wave Communication	PE	3	0	0	3

VERTICAL – VII

SEMICONDUCTOR CHIP DESIGN AND TESTING

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21PEC43	Wide Bandgap Devices	PE	3	0	0	3
2.	21PEC44	ASIC Design	PE	3	0	0	3
3.	21PEC45	Low Power IC Design	PE	3	0	0	3
4.	21PEC46	Design for Testability of VLSI Circuits	PE	3	0	0	3
5.	21PEC47	Mixed Signal IC Design	PE	3	0	0	3
6.	21PEC48	System on Chip	PE	3	0	0	3
7.	21PEC49	Network on Chip	PE	3	0	0	3

VERTICAL – VIII

COMPUTATIONAL INTELLIGENCE

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
THEORY							
1.	21PEC50	Artificial Intelligence	PE	2	2	0	3
2.	21PEC51	Pattern Recognition	PE	3	0	0	3
3.	21PEC52	Soft Computing Techniques	PE	2	2	0	3
4.	21PEC53	Machine Learning	PE	2	2	0	3
5.	21PEC54	Deep Learning Techniques	PE	2	2	0	3
6.	21PEC55	Digital Forensics	PE	3	0	0	3
7.	21PEC56	Swarm Intelligence	PE	3	0	0	3

LIST OF ONE CREDIT COURSES

Sl. No.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			CREDITS
				L	T	P	
1.	21OCEC01	A Practical Course on Communication Systems – Signal Generationand Analysis	OC	0	0	2	1
2.	21OCEC02	A Practical Course on RF Measurements	OC	0	0	2	1
3.	21OCEC03	A Practical Course on Antenna Design and Simulation	OC	0	0	2	1
4.	21OCEC04	A Practical Course on Embedded Systems	OC	0	0	2	1
5.	21OCEC05	A Practical Course on UAV System Design	OC	0	0	2	1
6.	21OCEC06	Artificial Neural Networks – A Practical Approach	OC	0	0	2	1
7.	21OCEC07	Remote Sensing Image Analysis using ENVI Package	OC	0	0	2	1
8.	21OCEC08	Arduino for Engineers	OC	0	0	2	1
9.	21OCEC09	IoT for Healthcare Monitoring	OC	0	0	2	1
10.	21OCEC10	Wearable Devices for Medical Applications	OC	0	0	2	1
11.	21OCEC11	Design Thinking	OC	1	0	0	1
12.	21OCEC12	Emotional Intelligence	OC	1	0	0	1

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY, MADURAI-625009
(AUTONOMOUS)

REGULATIONS - 2021

B. E. ELECTRONICS AND COMMUNICATION ENGINEERING
(CHOICE BASED CREDIT SYSTEM)

SYLLABUS FOR SEMESTER I TO VIII

SEMESTER I

21IP101	INDUCTION PROGRAMME *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	0	0

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, as a citizen and as a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. "

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and don’ts, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and **therefore there shall be no tests / assessments** during this programme.

REFERENCE:

Guide to Induction program from AICTE

21EN101	**PROFESSIONAL ENGLISH-I** *(Common to all B.E./B.TECH. Programmes)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To develop learners skills in listening and responding effectively.
- To apply basic grammar for better communication.
- To employ reading passages for understanding vocabulary.
- To construct logical sentences and participate in pair presentation, extempore.
- To organize ideas for various compositions in writing.

UNIT I	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	12

Listening – Listening for general information - Specific details **-** Conversation: Introduction to classmates **-** Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form; **Speaking -** Self Introduction; Introducing a friend; Conversation - Politeness strategies; Telephone conversation; Leave a voicemail; Leave a message with another person; asking for information to fill details in a

form; **Reading -** Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails; **Writing -** Writing emails / letters introducing oneself; **Grammar -** Present Tense (simple, continuous); Question types: Wh/ Yes or No/ and Tags **Vocabulary -** Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).		
UNIT II	**NARRATION AND SUMMATION**	**12**
Listening - Listening to podcast, anecdotes / stories / event narration; documentaries and interviews with celebrities; **Speaking** - Narrating personal experiences / events; Interviewing a celebrity; Reporting / and summarizing of documentaries / podcasts/ interviews; **Reading** - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs; **Writing** - Guided writing - Paragraph writing Short Report on an event (field trip etc.); **Grammar** - Past tense (Simple, continuous); Subject-Verb Agreement; and Prepositions; **Vocabulary** - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.		
UNIT III	**DESCRIPTION OF A PROCESS / PRODUCT**	**12**
Listening - Listen to a product and process descriptions; a classroom lecture; and advertisements about a products; **Speaking** - Picture description; Giving instruction to use the product; Presenting a product; and Summarizing a lecture; **Reading** - Reading advertisements, gadget reviews; user manuals; **Writing** - Writing definitions; instructions; and Product /Process description; **Grammar** - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect, Present and past perfect continuous tenses; **Vocabulary** - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words)		
UNIT IV	**CLASSIFICATION AND RECOMMENDATIONS**	**12**
Listening - Listening to TED Talks; Scientific lectures; and educational videos; **Speaking** – Small Talk; Mini presentations and making recommendations; **Reading** - Newspaper articles; Journal reports - Non Verbal Communication (tables, pie charts etc,) **Writing** - Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode) **Grammar** - Articles; Pronouns - Possessive & Relative pronouns; **Vocabulary** - Collocations; Fixed / Semi fixed expressions		
UNIT V	**EXPRESSIONS**	**12**
Listening - Listening to debates/ discussions; different viewpoints on an issue; and panel discussions; **Speaking** - Group discussions, Debates, and Expressing opinions through Simulations & Role-play; **Reading** - Reading editorials; and Opinion Blogs; **Writing** - Essay Writing (Descriptive or narrative); **Grammar** - Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences; **Vocabulary** - Cause & Effect Expressions - Content vs. Function words.		

	TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Listen and comprehend complex academic texts.

CO2: Read and infer the denotative and connotative meanings of technical texts.

CO3: Write definitions, descriptions, narrations and essays on various topics.

CO4: Speak fluently and accurately in formal and informal communicative contexts.

CO5: Express their opinions effectively in both oral and written medium of communication.

TEXT BOOKS:

1. Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University. English for Science & Technology. Cambridge University Press, 2021.
2. Board of Editors, Department of English, Anna University. English for Engineers & Technologists. Orient Blackswan Private Ltd, 2020.
3. Board of Editors, Department of English, Anna University. Using English Orient Blackswan Private Ltd, 2017.

REFERENCES:

1. Meenakshi Raman & Sangeeta Sharma. Technical Communication – Principles And Practices Oxford University Press, New Delhi, 2016.
2. Lakshminarayanan K.R. A Course Book On Technical English. SciTech Publications (India) Pvt. Ltd., 2012.
3. Ayesha Viswamohan. English For Technical Communication (With CD). McGraw Hill Education, ISBN: 0070264244. 2008.
4. Kulbhusan Kumar, RS Salaria, Effective Communication Skill. Khanna Publishing House. 1st Edition, 2018.
5. Dr. V. Chellammal. Learning to Communicate. Allied Publishing House, New Delhi, 2003.

21MA101	**MATRICES AND CALCULUS** (*Common to all B.E. / B.Tech. Programmes*)	L	T	P	C
		3	**2**	**0**	**4**

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.

- To explain the students about differential calculus.
- To demonstrate the functions of several variables technique to solve problems in many engineering branches.
- To demonstrate the various techniques of integration.
- To prepare the student to use mathematical tools in evaluating multiple integrals and their applications.

UNIT I	**MATRICES**	**12**

Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II	**DIFFERENTIAL CALCULUS**	**12**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.

UNIT III	**FUNCTIONS OF SEVERAL VARIABLES**	**12**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV	**INTEGRAL CALCULUS**	**12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT V	**MULTIPLE INTEGRALS**	**12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use the matrix algebra methods for solving engineering problems.

CO2: Apply differential calculus tools in solving various application problems.

CO3: Make use of differential calculus ideas on several variable functions.

CO4: Identify suitable methods of integration in solving practical problems.

CO5**:** Solve practical problems of areas, volumes using multiple integrals.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
3. James Stewart, "Calculus: Early Transcendentals", 8th Edition, Cengage Learning, New Delhi, 2015.

REFERENCES:

1. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", 7thEdition, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 2009.
2. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", 5th Edition, Narosa Publications, New Delhi, 2016.
3. Ramana. B.V., "Higher Engineering Mathematics", 6th Edition, McGraw Hill Education Pvt. Ltd, New Delhi, 2010.
4. Thomas. G. B., Hass. J and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

21PH101	ENGINEERING PHYSICS (Common to I Year B.E. / B.Tech. Students)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the students effectively to achieve an understanding of mechanics.
- To infer the students to gain knowledge of electromagnetic waves and its applications.
- To explain the basics of oscillations, optics and lasers.
- To outline the importance of quantum physics.

• To relate the students towards the applications of quantum mechanics.		
UNIT I	**MECHANICS**	**9**
Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum– double pendulum –Introduction to nonlinear oscillations.		
UNIT II	**ELECTROMAGNETIC WAVES**	**9**
The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.		
UNIT III	**OSCILLATIONS, OPTICS AND LASERS**	**9**
Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave – sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference– Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.		
UNIT IV	**BASIC QUANTUM MECHANICS**	**9**
Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in an infinite potential well: 1D,2D and 3D Boxes-Normalization, probabilities and the correspondence principle.		
UNIT V	**APPLIED QUANTUM MECHANICS**	**9**
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)-Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.		

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the importance of mechanics.

CO2: Extend their knowledge in electromagnetic waves.

CO3: Illustrate a strong foundational knowledge in oscillations, optics and lasers.

CO4: Interpret the importance of quantum physics.

CO5: Summarize quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow,"An Introduction to Mechanics",First Edition, McGraw Hill Education, 2017.
2. E.M.Purcell and D.J.Morin, "Electricity and Magnetism", Third Edition, Cambridge UniversityPress, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", SeventhEdition, McGraw-Hill, 2017.

REFERENCES

1. R.Wolfson. "Essential University Physics",Volume 1 & 2. , First Edition (Indian Edition) Pearson Education,2009.
2. Paul A. Tipler, "Physics"- Volume 1 & 2, First Edition (Indian Edition), CBS Publishers & Distributors, 2004.
3. K.Thyagarajan and A.Ghatak. "Lasers: Fundamentals and Applications", Second Edition, Laxmi Publications,(Indian Edition), 2019.
4. D.Halliday, R.Resnick and J.Walker,"Principles of Physics", 10th Edition(Indian Edition), Wiley, 2015.
5. N.Garcia, A.Damask and S.Schwarz,"Physics for Computer Science Students",First Edition, Springer Verlag, 2012.

21CH101	**ENGINEERING CHEMISTRY** *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe water quality parameters and water treatment techniques.
- To discuss basic principles and preparatory methods of nanomaterials.
- To demonstrate the basic concepts and applications of phase rule and composites.
- To identify different types of fuels, their preparation, properties and combustion characteristics.
- To illustrate the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I	**WATER AND ITS TREATMENT**	**9**

Water: Sources and impurities, **Water quality parameters:** Definition and significance of- colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination)**.Desalination of brackish water**: Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. **Treatment of boiler feed water**: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II	**NANOCHEMISTRY**	**9**

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials**: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvo thermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. **Applications** of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III	**PHASE RULE AND COMPOSITES**	**9**

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). **Properties and applications of**: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. **Hybrid composites** -

definition and examples.

UNIT IV	FUELS AND COMBUSTION	9

Fuels: Introduction: Classification of fuels; **Coal and coke**: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:** Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Power alcohol and biodiesel.**

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; **Ignition temperature**: spontaneous ignition temperature, Explosive range; **Flue gas analysis** - ORSAT Method. **CO_2 emission and carbon foot print.**

UNIT V	ENERGY SOURCES AND STORAGE DEVICES	9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. **Solar energy conversion:** Principle, working and applications of solar cells**; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H_2-O_2 fuel cell, microbial fuel cell; **Super capacitors:** Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2: Describe the basic concepts of nano science and nanotechnology in designing the synthesis of nano materials for engineering and technology applications.

CO3: Apply the knowledge of phase rule and composites for material selection requirements.

CO4: Identify suitable fuels for engineering processes and applications.

CO5: Demonstrate different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17^{th} Edition, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd,

NewDelhi, 2008.

3. S.S. Dara, “A text book of Engineering Chemistry”, S. Chand Publishing, 12^{th} Edition, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B. B. Rath and James Murday, “Text book of nanoscience and nanotechnology”, Universities Press-IIM Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, “Engineering Chemistry” McGraw Hill Education (India) Private Limited, 2^{nd} Edition, 2017.
3. Friedrich Emich, “Engineering Chemistry”, Scientific International PVT, LTD, New Delhi, 2014.
4. ShikhaAgarwal, “Engineering Chemistry-Fundamentals and Applications”, Cambridge University Press, Delhi, Second Edition, 2019.
5. O.V. Roussak and H.D. Gesser, Applied Chemistry-A Text Book for Engineers and Technologists, Springer Science Business Media, New York, 2^{nd} Edition, 2013.

21CS101	**PROBLEM SOLVING AND PYTHON PROGRAMMING** *(Common to all B.E./B.Tech Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

UNIT-I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.

UNIT-II	DATA TYPES, EXPRESSIONS, STATEMENTS	9
Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.		
UNIT-III	**CONTROL FLOW, FUNCTIONS, STRINGS**	**9**
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-else-if-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		
UNIT-IV	**LISTS, TUPLES, DICTIONARIES**	**9**
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.		
UNIT-V	**FILES, MODULES, PACKAGES**	**9**
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).		
		TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use algorithmic solutions to solve simple computational problems.

CO2: Develop and execute simple Python programs.

CO3: Solve simple programs using conditionals, loops and functions for solving problems.

CO4: Construct compound data using Python lists, tuples, dictionaries etc.

CO5: Prepare read and write data from/to files in Python programs.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher,"Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
3. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc- Graw Hill, 2018.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", 1st Edition, Pearson Education, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", 3rd Edition, MIT Press, 2021.
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019

21CS102	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

LIST OF EXPERIMENTS	
1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.,) 2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points). 3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern) 4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples) 5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.,- operations of Sets & Dictionaries) 6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape) 7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters) 8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy) 9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word) 10. Implementing real-time/technical applications using Exception handling. (divide by zero error,voter's age validity, student mark range validation) 11. Exploring Pygame tool. 12. Developing a game activity using Pygame like bouncing ball, car race etc.,	
	TOTAL:60 PERIODS
COURSE OUTCOMES: At the end of the course, learners will be able to CO1: Develop algorithmic solutions to solve simple computational problems. CO2: Construct simple Python programs. CO3: Build programs using conditionals, loops and functions for solving problems. CO4: Demonstrate compound data using Python data structures. CO5: Utilize Python packages in developing software applications.	

21PC101	**PHYSICS AND CHEMISTRY LABORATORY** *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY

COURSE OBJECTIVES:

- To explain the proper use of various kinds of physics laboratory equipment.
- To extend how data can be collected, presented and interpreted in a clear and concise manner.
- To infer problem solving skills related to physics principles and interpretation of experimental data.
- To summarize error in experimental measurements and techniques used to minimize such error.
- To translate the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS: (Any 7 Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young’s modulus
4. Uniform bending – Determination of Young’s modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle

   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – Determination of the velocity of sound and compressibility of liquids
10. Post office box - Determination of Band gap of a semiconductor**.**
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde’s string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:.Explain the functioning of various physics laboratory equipment.

CO2: Relate the graphical models to analyze laboratory data.

CO3: Interpret mathematical models as a medium for quantitative reasoning and describing physical reality.

CO4: Explain Access, process and analyze scientific information.

CO5:Translate students to solve problems individually and collaboratively.

REFERENCES :

1. Physics Laboratory Manual, Department of Physics, Velammal College of Engineering & Technology, Madurai (2021)
2. P. Mani, Physics Laboratory,1st edition, Dhanam Publications, 2021.

***Each class is divided in to two batches (30 students / batch) and each batch will perform their experiments alternatively per week in physics and chemistry laboratory.

CHEMISTRY LABORATORY

COURSE OBJECTIVES:

- To identify the required glass wares and instruments for chemical analysis.
- To estimate water quality parameters such as hardness, dissolved oxygen and chloride content.
- To relate electrochemical techniques such as pH metry, conductometry and potentiometry.
- To interpret the data collected from the analysis.
- To express the skills to get accurate results.

LIST OF EXPERIMENTS : **(Any seven experiments to be conducted)**

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.
2. Determination of types and amount of alkalinity in water sample. -Split the first experiment into two.
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.

5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration).
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel.
15. Proximate analysis of Coal.

TOTAL: 30 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able to

CO1: Extent the skills to choose and handle appropriate glass wares.

CO2: Interpret the water quality parameters using volumetric method.

CO3: Estimate the conductivity, pH &emf by electro chemical methods.

CO4: Infer the collected data for appropriate chemical analysis.

CO5: Demonstrate systematic approach to obtain accurate results.

TEXT BOOK:

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, Vogel's Textbook of Quantitative Chemical Analysis (2009).

SEMESTER II

21EN102	ENGLISH-II *(Common to all B.E./B.TECH. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.

• To prepare and write convincing job applications and effective reports. • To demonstrate their speaking skills to make technical presentations and participate in group discussions. • To apply their Listening skill which will help them comprehend lectures and talks in their areas of specialization • To choose appropriate soft skills to suit the situation.		
UNIT I	**INTRODUCTION TO TECHNICAL ENGLISH**	**9**
Listening - Factual and Academic speeches; **Speaking** - Asking for and giving directions - **Reading** - Technical texts from - Newspapers /websites; **Writing -** Statements - Definitions - issue based writing instructions - Checklists - Recommendations; **Vocabulary Development-** technical vocabulary; **Grammar** - Error spotting - Compound words; **Soft skills** - Leadership Skills.		
UNIT II	**READING AND STUDY SKILLS**	**9**
Listening - Listening to longer technical talks and completing exercises based on them; **Speaking** - Describing a general process; **Reading** - Reading longer technical texts - Identifying the various transitions in a text - Paragraphing; **Writing** - Interpreting charts, graphs; **Vocabulary Development** - Vocabulary used in formal letters/emails and reports **Grammar -** Impersonal passive voice, numerical adjectives - **Soft skills** - Teamwork		
UNIT III	**TECHNICAL WRITING AND GRAMMAR**	**9**
Listening - Listening to classroom lectures, talks on engineering /technology; **Speaking** - introduction to technical presentations; **Reading** - longer texts both general and technical, practice in speed reading; **Writing** - Describing a technical process; **Vocabulary Development** - Sequence words - Misspelled words; **Grammar** - Embedded sentences ; **Soft skills** - Decision making		
UNIT IV	**JOB APPLICATIONS**	**9**
Listening - Listening to documentaries and making notes. **Speaking** - Mechanics of presentations; **Reading -** Reading for detailed comprehension; **Writing** - Email etiquette - job application - Cover Letter - Resume preparation(via email and hard copy) - Analytical essay writing - **Vocabulary Development -** finding suitable synonyms - paraphrasing; **Grammar** - clauses - If conditionals - **Soft skills** - Time Management		
UNIT V	**GROUP DISCUSSION AND REPORT WRITING**	**9**
Listening - TED talks; **Speaking** - Participating in a group discussion - **Reading** - Reading and understanding technical articles; **Writing** - Writing reports - Survey report, accident report and minutes of a meeting - **Vocabulary Development** - Verbal analogies; **Grammar** - reported speech; **Soft skills** - Conflict Resolution.		

	TOTAL: 45 PERIODS

COURSE OUTCOMES : At the end of the course, learners will be able to:

CO1: Interpret by reading information in technical texts

CO2: Choose appropriate language to write convincing job applications, resume and reports

CO3: Formulate the technical ideas effectively in spoken and written forms

CO4: Analyze and understand spoken language in lectures and talks

CO5: Demonstrate basic soft skills in life

TEXT BOOKS:

1. Board of Editors, Fluency in English-A Course book for Undergraduate Engineers and Technologist. Orient Blackswan Pvt Ltd, Hyderabad: 2018
2. Jawahar, Jewelcy & Rathna.P. Communicative English Workbook. VRB Publishers Pvt Ltd. Chennai. 2018.
3. Board of Editors, Department of English, Anna University, Chennai. Mindscapes-English for Technologists and Engineers. Orient Black Swan Pvt Ltd, Chennai, 2012.

REFERENCES:

1. Verma, Shalini. Technical Communication for Engineers. Vikas Publishing House Pvt Ltd. New Delhi. 2015
2. Raman, Meenakshi & Sharma, Sangeeta. Technical Communication English Skills for Engineers. Oxford University Press. 2008.
3. Rizvi, Ashraf.M. Effective Technical Communication. MC Graw Hill Education Pvt Ltd. New Delhi. 2016.

21MA103	**SAMPLING TECHNIQUES AND NUMERICAL METHODS** *(Common to all B.E. (ECE & CSE)/B.Tech. (IT) Programmes)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To describe the necessary basic concepts in probability.
- To explain the concept of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To use the basic concepts of classification of design of experiments.
- To choose the method for solving algebraic and transcendental equations using numerical techniques.

• To discuss the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.		
UNIT I	**PROBABILITY**	**12**
Introduction-Sample Spaces and Events-Axioms of Probability-Interpretations and Properties of Probabilities-Conditional Probabilities-Baye's theorem- Independence.		
UNIT II	**TESTING OF HYPOTHESIS**	**12**
Large sample test based on Normal distribution for single mean and difference of means – Tests based on t, $\chi 2$ and F distributions for testing means and variances – Contingency table (Test for Independency) – Goodness of fit.		
UNIT III	**DESIGN OF EXPERIMENTS**	**12**
Introduction, aim, basic designs of experiments, one way and two way classifications - Completely randomized design – Randomized block design – Latin square design.		
UNIT IV	**SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**	**12**
Newton Raphson method –Method of False position- pivoting – Gauss Jordan methods – Iterative method: Gauss Seidel – Matrix inversion by Gauss Jordan method – Eigen values of a matrix by power method.		
UNIT V	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION**	**12**
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's 1/3 rules, $3/8^{th}$ rule.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the concepts of Probability in Engineering problems.

CO2: Explain the test of hypothesis for small and large samples by using various test like t-test, F-test, Z-test and $\chi 2$ test.

CO3**:** Apply the basic concepts of classifications of design of experiments.

CO4: Solve the system of equations and the eigen value problems using iterative procedure.

CO5: Calculate the value of an unknown function at any interpolated point of the given tabulated values.

TEXT BOOKS:

1. JAY.L. Devore, “Probability and Statistics for Engineering and the Science”,Nineth Edition, Cengage Learning, 2021.
2. Johnson. R.A., and Irwin Miller, John Freund, "Miller and Freund’s Probability and Statistics for Engineers", 12^{th}Edition, Pearson Education, Asia, 2011.
3. Gerald. C.F., and Wheatley. P.O. "Applied Numerical Analysis", Seventh Edition, Pearson Education, Asia, New Delhi, 2008.

REFERENCES:

1. Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", Eighth Edition, Pearson Education, Asia, 2007.
2. Spiegel. M.R., Schiller. J., and Srinivasan. R.A., "Schaum’s Outlines on Probability and Statistics", Third Edition, Tata McGraw Hill , 2012.
3. Chapra. S.C., and Canale. R.P, "Numerical Methods for Engineers", FifthEdition, Tata McGraw Hill, New Delhi, 2007.
4. Grewal. B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", Nineth Edition, Khanna Publishers, New Delhi, 2007.

21PH104	**PHYSICS FOR ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To make the students to understand the basics of crystallography and its importance in studying materials properties.
- To understand the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To instil knowledge on physics of semiconductors, determination of charge carriers and device applications.
- To establish a sound grasp of knowledge on different optical properties of materials, optical displays and applications.
- To inculcate an idea of significance of nano structures, quantum confinement and ensuing nano device applications.

UNIT I	CRYSTALLOGRAPHY	9
Crystal structures: Crystal lattice - basis - unit cell and lattice parameters -Crystal systems and Bravais lattices - Structure and packing fractions of SC, BCC, FCC structures -Crystal planes, directions and Miller indices -Distance between successive planes -Linear and planar densities - Crystalline and non-crystalline materials - Example use of Miller indices: wafer surface orientation -Wafer flats and notches -Pattern alignment - Imperfections in crystals		
UNIT II	**ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS**	**9**
Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Quantum free electron theory: tunneling -Degenerate states - Fermi-Dirac statistics Density of energy states - Electron effective mass -Concept of hole. Magnetic materials: dia, para and ferromagnetic effects -Domain theory of ferromagnetism-M–H curve -Quantum interference devices - GMR devices.		
UNIT III	**SEMICONDUCTORS AND TRANSPORT PHYSICS**	**9**
Intrinsic Semiconductors - Energy band diagram -Direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors -Extrinsic semiconductors - Carrier concentration in n-type &p-type semiconductors - Variation of carrier concentration with temperature - Carrier transport in Semiconductors: Drift, mobility and diffusion - Hall effect and devices - Ohmic contacts - Schottky diode.		
UNIT IV	**OPTICAL PROPERTIES OF MATERIALS**	**9**
Classification of optical materials - Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells - Optoelectronic devices: light detectors and solar cells -Light emitting diode -Laser diode - Optical processes in organic semiconductor devices - Excitonic state - Electro-optics and nonlinear optics: Modulators and switching devices.		
UNIT V	**NANO DEVICES**	**9**
Density of states for solids - Significance between Fermi energy and volume of the material - Quantum confinement - Quantum structures - Density of states for quantum wells, wires and dots - Band gap of nanomaterials - Tunneling - Single electron phenomena - Single electron Transistor. Conductivity of metallic nanowires - Ballistic transport - Quantum resistance and conductance - Carbon nanotubes: Properties and applications - Spintronic devices and applications - Optics in quantum structures - quantum well laser.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		

At the end of the course, learners will be able to:

CO1: Know basics of crystallography and its importance for varied materials properties.

CO2: Gain knowledge on the electrical and magnetic properties of materials and their applications.

CO3: Understand clearly of semiconductor physics and functioning of semiconductor devices.

CO4: Understand the optical properties of materials and working principles of various optical devices.

CO5: Appreciate the importance of nanotechnology and nano devices.

TEXT BOOKS:

1. S.O. Kasap, Principles of Electronic Materials and Devices, McGraw Hill Education (Indian Edition), 2020.
2. R.F.Pierret, Semiconductor Device Fundamentals. Pearson (Indian Edition), 2006.
3. G.W.Hanson. Fundamentals of Nanoelectronics. Pearson Education (Indian Edition), 2009.

REFERENCES:

1. Laszlo Solymar, Walsh, Donald, Syms and Richard R.A., Electrical Properties of Materials, Oxford Univ. Press (Indian Edition) 2015.
2. Jasprit Singh, Semiconductor Optoelectronics: Physics and Technology, McGraw-Hill Education (Indian Edition), 2019.
3. Charles Kittel, Introduction to Solid State Physics, Wiley India Edition, 2019.
4. Mark Fox, Optical Properties of Solids, Oxford Univ.Press, 2001.
5. N.Gershenfeld. The Physics of Information Technology. Cambridge University Press, 2011.

21ME101	**ENGINEERING GRAPHICS** (Common to all B.E./B.Tech. Programmes)	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To sketch the projection of points, lines and planes.
- To sketch the projection of simple solids.
- To sketch the projection of sectioned solids and development of lateral surfaces.

- To sketch the isometric and perspective views of simple solids.
- To sketch the orthographic projection of various objects free handly.

UNIT I	**PROJECTIONS OF POINTS, LINES AND PLANE SURFACE**	**12**
Importance of graphics in engineering applications – Use of drafting instruments - Lettering and dimensioning. Introduction to Orthographic projections - Principles -Principal planes-First angle projection. Projection of points located in all quadrants. Projection of straight lines inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes (regular polygonal and circular surfaces) inclined to both the principal planes by rotating object method. (Not for Examination)		
UNIT II	**PROJECTION OF SOLIDS**	**12**
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.		
UNIT III	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**	**12**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.		
UNIT IV	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**12**
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .		
UNIT V	**FREEHAND SKETCHING**	**12**
Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects. Introduction to drafting packages and demonstration. (Not for examination).		
		TOTAL: 60 PERIODS
COURSE OUTCOMES:		

At the end of the course, learners will be able to

CO1: Construct the orthographic projections of points, straight lines and plane surfaces.

CO2: Sketch the orthographic projections of simple solids

CO3: Sketch the orthographic projections of sectional solids and lateral surfaces of the solids.

CO4: Construct the isometric projections and perspective projections of simple solids.

CO5: Sketch the orthographic projection of objects using free hand.

TEXT BOOKS:

1. Natarajan K.V., "A text book of Engineering Graphics", 31st Edition, Dhanalakshmi Publishers, Chennai, 2018.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", 15th Edition, New Age International (P) Limited, 2018.
3. Bhatt N.D. and Panchal V.M., "Engineering Drawing", 53rd Edition, Charotar Publishing House, 2014.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", 2nd Edition, Tata McGraw Hill Publishing Company Limited, 2013.
2. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", 2nd Edition, Oxford University, Press, New Delhi, 2015.
3. Shah M.B., and Rana B.C., "Engineering Drawing", 2nd Edition, Pearson, 2009.

21EC101	**ELECTRONIC DEVICES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES :

- To explain about basic semiconductor diodes, their characteristics and applications.
- To impart knowledge on different configurations and models of bipolar junction transistors.
- To demonstrate the construction and working principle of field effect transistors.
- To infer the operations of special semiconductor devices.
- To interpret the theory, construction and operation of power and display devices.

UNIT I	**SEMICONDUCTOR DIODE**	**9**

PN Junction Diode, Current equations, Energy band diagram, Diffusion and Drift current densities, Forward and Reverse bias characteristics, Transition and Diffusion capacitances, Switching characteristics, Breakdown in PN Junction Diodes.		
UNIT II	**BIPOLAR JUNCTION TRANSISTORS**	**9**
NPN -PNP -Operations - Early effect - Current equations – Input and Output characteristics of CE,CB, CC - Hybrid -π model - h-parameter model, Ebers Moll model.		
UNIT III	**FIELD EFFECT TRANSISTORS**	**9**
JFETs – Drain and Transfer characteristics - Current equations - Pinch off voltage and its significance – MOSFET - Characteristics - Threshold voltage - Channel length modulation, D-MOSFET, E-MOSFET- Characteristics – Comparison of MOSFET with JFET.		
UNIT IV	**SPECIAL SEMICONDUCTOR DEVICES**	**9**
Metal semiconductor junction - MESFET, FINFET, DUAL GATE MOSFET,Schottky barrier diode - Zener diode - Varactor diode - Tunnel diode - Gallium Arsenide diode, LASER diode and LDR.		
UNIT V	**POWER DEVICES AND DISPLAY DEVICES**	**9**
UJT, SCR, DIAC, TRIAC, Power BJT- Power MOSFET- DMOS – VMOS, LED, LCD, Photo transistor, Opto coupler, Solar cell and CCD.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the operation and characteristics of semiconductor diode.

CO2: Outline the construction and working of bipolar junction transistors.

CO3: Explain the construction and characteristics of field effect transistors devices.

CO4: Summarize the working principles of special semiconductor devices.

CO5: Illustrate the construction and working of power & display devices.

TEXT BOOKS:

1. Donald A Neaman, "Semiconductor Physics and Devices", 4th Edition, Tata Mc GrawHill Inc, 2012.
2. Salivahanan. S, Suresh Kumar. N, Vallavaraj. A, "Electronic Devices and Circuits", 3rd Edition, Tata McGraw-Hill, 2008.

3. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford Higher education press 2010.

REFERENCES:

1. Robert Boylestad and Louis Nashelsky, “Electron Devices and Circuit Theory”, 10th Edition, Pearson Prentice Hall, July 2008.
2. R. S. Sedha, “A Text Book of Applied Electronics”, S.Chand Publications, 2006.
3. Yang, “Fundamentals of Semiconductor Devices”, McGraw Hill International Edition, 1978.

21EC102	**CIRCUIT ANALYSIS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES :

- To ouline the basic concepts and behaviour of DC and AC circuits.
- To infer about various methods of circuit/ network analysis using network theorems.
- To summarize the steady state response of the circuits subject to DC excitations and AC with sinusoidal excitations.
- To become familiar in transient response of the circuits subject to DC excitations and AC with sinusoidal excitations.
- To gain knowledge on the concept of coupling in circuits and topologies.

UNIT I	**DC CIRCUIT ANALYSIS**	**9**

Basic components of Electric circuits, Charge, Current, Voltage and Power, Voltage and Current sources, Ohms law, Kirchoff‘s current law, Kirchoff‘s voltage law, The single Node – Pair circuit, Series and Parallel connected independent sources, Resistors in series and parallel, Voltage and Current division, Nodal analysis and Mesh analysis.

UNIT II	**NETWORK THEOREM FOR DC CIRCUITS AND DUALITY**	**9**

Circuit analysis techniques - Linearity and Superposition, Thevenin and Norton equivalent circuits, Maximum power transfer, Delta-Wye conversion, Duality, Dual circuits, Analysis using dependent current sources and voltage sources.

UNIT III	**SINUSOIDAL STEADY STATE ANALYSIS**	**9**

Sinusoidal steady – state analysis, Characteristics of sinusoids, Nodal and Mesh analysis, Circuit analysis techniques - Linearity and Superposition, Thevenin and Norton equivalent circuits, Maximum power transfer - AC circuit power analysis, Instantaneous power and Average power.		
UNIT IV	**TRANSIENTS AND RESONANCE IN RLC CIRCUITS**	**9**
Basic RL and RC circuits, The source - free RL circuit, The source-free RC Circuit, The Unit-Step function, Driven RL circuits, Driven RC circuits, RLC circuits, Frequency response, Parallel resonance, Series resonance and Quality factor.		
UNIT V	**COUPLED CIRCUITS AND TOPOLOGY**	**9**
Magnetically coupled circuits, Mutual inductance, Linear transformer, Ideal transformer, An introduction to Network topology, Trees and General nodal analysis, Links and Loop analysis.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Make use of the basic voltage and current laws for analysis of DC and AC circuits.

CO2: Select suitable network theorems to analyze DC and AC circuits.

CO3: Examine the steady state response of R, L and C circuits.

CO4: Identify the transient and frequency response of RLC circuits.

CO5: Solve the various parameters of coupled circuits and infer the network topologies.

TEXT BOOKS:

1. Hayt Jack Kemmerly and Steven Durbin, "Engineering Circuit Analysis", 9th Edition, Mc Graw Hill, 2018.
2. Charles K. Alexander & Mathew N.O.Sadiku, "Fundamentals of Electric Circuits", 2nd Edition, Mc Graw - Hill, 2003.
3. Joseph Edminister and Mahmood Nahvi, “Electric Circuits, Schaum‘s Outline Series”, 5th Edition, Tata McGraw Hill Publishing Company, New Delhi, Reprint 2016.

REFERENCES:

1. Robert.L. Boylestead, "Introductory Circuit Analysis", 12th Edition, Pearson Education India, 2014.
2. David Bell, "Fundamentals of Electric Circuits", 7th Edition, Oxford University press, 2009.
3. John O Mallay, "Basic Circuit Analysis", 2nd Edition, Schaum’s Outlines, Mc Graw

Hill, 2011. 4. Allan H.Robbins, Wilhelm C.Miller, "Circuit Analysis Theory and Practice", 5^{th} Edition, Cengage Learning, 1st Indian Reprint 2013.

21CS105	**C PROGRAMMING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES :

- To describe the basic programming principles of C language.
- To choose a suitable C-construct to develop C code for a given problem.
- To use the C-language syntax rules to correct the bugs in the C program.
- To develop simple C programs to illustrate the applications of different data types such as arrays, pointers, functions.
- To illustrate the concepts of Structures and Unions.

UNIT I	**BASICS OF C PROGRAMMING**	**6**

Introduction to C- Structure of a C Program- Compiling and Executing C Programs- C tokens- Input/Output Statements in C- Operators in C- Type Conversion and Typecasting

UNIT II	**DECISION CONTROL AND LOOPING STATEMENTS**	**6**

Decision Control Statements- Conditional Branching Statements- Iterative Statements- Nested Loops- Break and Continue Statements- Goto Statement

UNIT III	**ARRAYS AND STRINGS**	**6**

Introduction to Arrays: Declaration, Accessing the Elements of an Array - Storing Values in Arrays Operations on Arrays - Two dimensional arrays - String operations

UNIT IV	**FUNCTIONS AND POINTERS**	**6**

Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion. Pointers – Declaring Pointer Variables- Pointer Expressions and Pointer Arithmetic -Null Pointers -– Parameter passing: Pass by value, Pass by reference

UNIT V	**STRUCTURES AND UNION**	**6**

Structure - Nested structures – Pointer and Structures – Array of structures – Self referential structures – Dynamic memory allocation– Union
TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Develop simple applications using basic C components.

CO2: Build applications adopting array and string concepts.

CO3: Develop and implement applications in C using functions and pointers.

CO4: Build applications in C by employing structure and union concepts.

CO5: Design simple applications that make use of C construct.

TEXT BOOKS:

1. ReemaThareja, "Programming in C", Oxford University Press, 2nd Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", 2nd Edition, Pearson Education, 2015.
3. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
2. YashwantKanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4. PradipDey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.

21EM101	ENGINEERING PRACTICES LABORATORY *(Common to all B.E / B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To draw pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- To demonstrate the basic switch board wiring, fluorescent lamp wiring and stair case wiring using various electrical components.
- To choose various joints in steel plates using arc welding work and machining various simple processes like turning, drilling, tapping in parts.
- To build a tray out of metal sheet using sheet metal work.
- To develop electronic circuit and testing for soldering and desoldering using PCB board.

LIST OF EXPERIMENTS:

GROUP – A (CIVIL & ELECTRICAL)

PART – I

CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

- Sawing,
- Planning and Making joints like T-Joint, Cross lap and Dovetail joint.

PART – II
ELECTRICAL ENGINEERING PRACTICES • Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket • Staircase wiring • Fluorescent Lamp wiring with introduction to CFL and LED types. • Energy meter wiring and related calculations/ calibration • Study of Iron Box wiring and assembly • Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac) • Measurement of resistance to earth of an electrical equipment.
GROUP – B (MECHANICAL & ELECTRONICS)
PART III
MECHANICAL ENGINEERING PRACTICES **WELDING WORK:** • Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding. • Practicing gas welding. **BASIC MACHINING WORK:** • Usage of Spanners and screw drivers • Facing and Turning. • Taper Turning **ASSEMBLY WORK:** • Assembling a centrifugal pump. • Assembling a household mixer. • Assembling an air conditioner. **SHEET METAL WORK:** • Making of a square tray **FOUNDRY WORK:** • Demonstrating basic foundry operations.
PART IV
ELECTRONIC ENGINEERING PRACTICES **SOLDERING WORK:** • Soldering simple electronic circuits and checking continuity. **ELECTRONIC ASSEMBLY AND TESTING WORK:** • Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

- Study elements of smart phone.
- Assembly and dismantle of computer / laptop

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build various plumbing joints.

CO2: Develop various carpentry joints.

CO3: Construct various wiring electrical joints in common household electrical wire work.

CO4: Construct various welded joints, sheet metal and basic machining operations.

CO5: Develop the electronic circuit for soldering and testing using PCB board.

21EC103	ELECTRONIC DEVICES AND CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES :

- To gain knowledge about KVL, KCL, Thevenin, Norton and Superposition theorems.
- To study the transient analysis of RLC circuits.
- To infer the characteristics of Diode.
- To summarize the characteristics of BJT, FET and SCR.
- To demonstrate the working principle of half wave and full wave rectifiers.

LIST OF EXPERIMENTS:

1. Verification of KVL and KCL
2. Verification of Superposition theorem.
3. Verification of Thevenin and Norton theorem.
4. Verification of Maximum power transfer and reciprocity theorem.
5. Determination of Resonance frequency of series and parallel RLC Circuits.
6. Characteristics of PN Junction diode and Zener diode.

7. Common Emitter input-output Characteristics.
8. Common Base input-output Characteristics.
9. FET Characteristics.
10. SCR Characteristics.
11. Half-wave rectifier and Full-wave rectifier.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build circuits to verify Kirchoff's laws and network theorems.

CO2: Make use of RLC circuits to determine their frequency response.

CO3: Examine the characteristics of PN and Zener diodes.

CO4: Compare the characteristics of BJT, FET and SCR.

CO5: Distinguish half wave rectifier with full wave rectifier.

SEMESTER III

21MA201	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS (*Common to B.E.(CIVIL Engg.,ECE & MECH. Engg.) Programmes*)	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To use various methods of Laplace transforms for efficiently solving the problems that occur in various branches of engineering disciplines.
- To identify Fourier series which is essential to many applications in engineering.
- To explain the mathematical tools for the solutions of partial differential equations that model several physical processes.
- To explain the student with Fourier transform techniques used in wide variety of situations.
- To develop Z transform techniques to solve difference equations for discrete time systems.

UNIT I	LAPLACE TRANSFORM	12

Laplace transform- conditions for existence –Transform of elementary functions –Basic properties –First shifting theorem –Transform of derivatives on $t\ f(t), f(t)/t$ and periodic functions- Transform of unit step function and impulse functions. Inverse Laplace transform by partial function method and convolution theorem (excluding proof)-Initial and finial value theorems-Solutions of linear ODE of second order with constant coefficients using Laplace transform techniques.		
UNIT II	**FOURIER SERIES**	**12**
Dirichlet's conditions – General Fourier series odd and even functions – Half range sine series – half range cosine series – Parseval's identity – Harmonic Analysis.		
UNIT III	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**12**
Classifications of PDE – Solutions of one dimensional wave equations – one dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).		
UNIT IV	**FOURIER TRANSFORMS**	**12**
Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transform – Properties – Transforms of simple functions – convolution theorem – Parseval's identity.		
UNIT V	**Z- TRANSFORMS AND DIFFERENCE EQUATIONS**	**12**
Z- Transforms – Elementary properties – Inverse Z- Transforms (Using partial fractions and residues) – Convolution theorem – Formation of difference equations – Solution of difference equations using Z-transforms.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1**:** Calculate Laplace transform and inverse Laplace transform of different functions.

CO2: Express the Fourier series expansion to represent the given function in the given interval.

CO3: Classify the second order PDE and to know about solving initial and final value problems.

CO4: Apply Fourier transform techniques to evaluate the given integral.

CO5: Solve the given difference equations using Z-transforms.

TEXT BOOKS:

1. Kreyszig Erwin, "Advanced Engineering Mathematics ", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. Peter V.O. Neil "Advanced Engineering Mathematics", 7th Edition, Cengage, New Delhi, 2012.
3. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2016.

REFERENCES:

1. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2. Wylie C. R. and Barrett L. C "Advanced Engineering Mathematics", 6thEdition, Tata McGraw-Hill, New Delhi, 2012.
3. Datta K.B., "Mathematical Methods of Science and Engineering", 2nd Edition, Cengage Learning India Pvt Ltd, Delhi, 2013.

		L	T	P	C
21EC201	**DIGITAL PRINCIPLES AND SYSTEM DESIGN** *(Common to B.E. (ECE & CSE) /B.Tech. (IT) Programmes)*				
		3	**0**	**0**	**3**

COURSE OBJECTIVES :

- To outline the digital fundamentals, Boolean algebra and its applications in digital systems.
- To summarize the design of various combinational digital circuits using logic gates.
- To infer the design procedures for synchronous sequential circuits.
- To familiarize with the analysis and design procedures for asynchronous sequential circuits.
- To explain the various semiconductor memories.

UNIT I	**DIGITAL FUNDAMENTALS**	**9**

Number systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map minimization, NAND and NOR implementations.

UNIT II	COMBINATIONAL CIRCUIT DESIGN	9
Design of Half and Full adders, Half and Full subtractors, Binary parallel adder – Carry look ahead adder, BCD adder, Multiplexer, Demultiplexer, Magnitude comparator, Decoder, Encoder and Priority Encoder.		
UNIT III	**SYNCHRONOUS SEQUENTIAL CIRCUITS**	**9**
Flip flops – SR, JK, T, D, Master / Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - state minimization, state assignment, circuit implementation – Design of Counters- Ripple counters, Ring counters, Shift registers and Universal shift register.		
UNIT IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS**	**9**
Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Design of Hazard free circuits.		
UNIT V	**MEMORY DEVICES AND VERILOG PROGRAMMING**	**9**
Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL. Design of half adder, full adder, flip flops and counters using Verilog.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of minimization techniques to simplify Boolean algebraic equations.

CO2: Build various combinational circuits using logic gates.

CO3: Develop synchronous sequential circuits using flip flops.

CO4:Construct asynchronous sequential circuits using flip flops.

CO5: Explain various semiconductor memories and programmable logic devices.

TEXT BOOKS:

1. M. Morris R. Mano, Michael D. Ciletti, “Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog”, 6th Edition, Pearson Education, 2017.
2. S.Salivahanan and S.Arivazhagan, “Digital Electronics”, 1stEdition, Vikas Publishing House pvt Ltd, 2012.

3. Soumitra Kumar Mandal, “Digital Electronics”, McGraw Hill Education Private Limited, 2016.

REFERENCES:

1. Charles H.Roth, “Fundamentals of Logic Design”, 6thEdition, Thomson Learning, 2013.
2. Thomas L. Floyd, “Digital Fundamentals”, 10th Edition, Pearson Education Inc, 2011
3. A.Anand Kumar, “Fundamentals of Digital Circuits”, 4thEdition, PHI Learning Private Limited, 2016.

21EC202	ELECTRONIC CIRCUITS I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES :

- To infer the various biasing techniques of BJT.
- To summarize the concepts of different biasing techniques of JFET and MOSFET.
- To introduce the design procedure of single stage amplifier circuits.
- To demonstrate the multistage BJT, FET and MOSFET amplifiers.
- To infer the frequency response of small signal amplifiers.

UNIT I	BIASING OF BJT	9

BJT– Need for biasing - DC load line and Bias point – DC analysis of transistor circuits - Various biasing methods of BJT – Bias circuit design - Thermal stability - Stability factor - Bias compensation techniques using Diode, Thermistor and Sensistor.

UNIT II	BIASING OF JFET AND MOSFET	9

JFET - DC load line and Bias point - Various biasing methods of JFET - JFET bias circuit design - MOSFET biasing - Biasing FET switching circuits.

UNIT III	SINGLE STAGE BJT, JFET AND MOSFET AMPLIFIERS	9

Small signal Hybrid π equivalent circuit of BJT – Early effect - Analysis of CE, CC and CB amplifiers using Hybrid π equivalent circuits - AC load line analysis, Small signal Hybrid π equivalent circuit of FET and MOSFET - Analysis of CS, CD and CG amplifiers using Hybrid π equivalent circuits.

UNIT IV	MULTISTAGE BJT, FET AND MOSFET AMPLIFIERS	9

Multistage BJT amplifiers - Darlington - Bootstrap – Cascade and Cascode configurations - Differential amplifier - Basic BJT differential pair – Small signal analysis and CMRR, Multistage JFET - Basic FET differential pair- BiCMOS circuits, Multistage MOSFET – Cascode amplifier.

UNIT V	FREQUENCY RESPONSE OF AMPLIFIERS	9

Amplifier frequency response – Frequency response of transistor amplifiers with circuit capacitors – BJT frequency response – short circuit current gain - cut off frequency – f_α, f_β and unity gain bandwidth – Miller effect - Frequency response of FET - High frequency analysis of CE and MOSFET CS amplifier - Transistor switching times.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Analyze the biasing techniques of BJT using stability factor.

CO2: Interpret the working principle of various biasing techniques of JFET and MOSFET.

CO3: Design CE, CB and CC single stage amplifiers based on hybrid-π equivalent model.

CO4: Inspect the effect of cascading BJT amplifiers on bandwidth.

CO5: Analyze the low frequency and high frequency response of BJT, JFET and MOSFET.

TEXT BOOKS:

1. Donald .A. Neamen, "Electronic Circuit Analysis and Design", 2nd Edition, Tata Mc Graw Hill, 2009.
2. Robert L. Boylestad and Louis Nasheresky, "Electronic Devices and Circuit Theory", 11th Edition, Pearson Education, 2013.
3. Behzad Razavi, "Design of Analog CMOS Integrated Circuits" 2nd Edition, Tata Mc Graw Hill, 2007.

REFERENCES:

1. S. Salivahanan, N. Suresh Kumar and A. Vallavaraj, "Electronic Devices and Circuits", 2nd Edition, TMH, 2017.
2. Adel .S. Sedra, Kenneth C. Smith, "Micro Electronic Circuits", 6th Edition, Oxford University Press, 2010.
3. David A. Bell, "Electronic Devices and Circuits", 5th Editon, Oxford Higher Education Press, 2010.
4. Millman and Halkias. C., "Integrated Electronics", 2nd Edition, TMH, 2007.

21EC203	SIGNALS AND SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES :

- To infer the basic properties of signals and systems.
- To gain knowledge about the continuous time signals and systems in the Fourier and Laplace domain.
- To interpret the discrete time signals and systems in the Fourier and Z transform domain.
- To be familiar with the analysis of differential equation of continuous time systems.
- To introduce different methods of analysis of discrete time systems.

UNIT I	CLASSIFICATION OF SIGNALS AND SYSTEMS	9

Standard signals- Step, Ramp, Pulse, Impulse, Real and Complex exponentials and Sinusoids_ Classification of signals – Continuous Time (CT) and Discrete Time (DT) signals, Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - Classification of systems- CT systems and DT systems – Linear & Nonlinear, Time-variant & Time-invariant, Causal & Non-causal, Stable & Unstable.

UNIT II	ANALYSIS OF CONTINUOUS TIME SIGNALS	9

Fourier series for periodic signals - Fourier Transform – properties- Laplace Transforms and properties.

UNIT III	ANALYSIS OF DISCRETE TIME SIGNALS	9

Baseband signal sampling – Fourier Transform of discrete time signals (DTFT) – Properties of DTFT - Z Transform and Properties.

UNIT IV	LINEAR TIME INVARIANT - CONTINUOUS TIME SYSTEMS	9

Convolution integrals - Differential Equation- Interconnection of LTI systems, Analysis of CT systems using Fourier and Laplace transforms- Stability and Causality.

UNIT V	LINEAR TIME INVARIANT - DISCRETE TIME SYSTEMS	9

Linear and Circular Convolutions- Sectioned Convolution- Difference Equations- Interconnection of LTI systems – Analysis of DT Systems using Discrete Time Fourier and Z Transform - Stability and Causality.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret the classification of signals and systems.

CO2: Apply Fourier and Laplace transform for continuous time signals.

CO3: Apply Z transform and DTFT for discrete time signals.

CO4: Make use of Laplace transform, Fourier transform to analyze the continuous time systems.

CO5: Utilize Fourier and Z transform in discrete time system analysis.

TEXT BOOKS:

1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, "Signals and Systems", 2nd Edition, Pearson, 2013.
2. S.Haykin and B.VanVeen "Signals and Systems, 2nd Edition, Wiley, 2007.
3. Hsu.H.P and Rakesh Ranjan, "Signals and Systems", Schaums's Outlines, 2nd Edition, Tata Mc Graw Hill, 2008.

REFERENCES:

1. B. P. Lathi, "Principles of Linear Systems and Signals", 2nd Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, "Signals & Systems - Continuous and Discrete", Pearson, 2007.
3. John Alan Stuller, "An Introduction to Signals and Systems", Thomson, 2007.
4. Samir S. Soliman and Mandyam Dhati Srinath, "Continuous and Discrete Signals and Systems", 2nd Edition, Prentice-Hall International, 1998.

21CS214	OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES :

- To describe the fundamentals of object oriented programming in C++.
- To explain the basics of OOP and Object-oriented approach to design software.
- To illustrate the concept of data structures through ADT including List, Stack, Queues.

- To demonstrate the concept of Non-Linear Data Structures and their applications.
- To choose the various sorting and searching techniques.

UNIT I	**BASIC OOPS CONCEPTS**	**9**

Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables – Constructors – Destructors – Member Functions and Classes – Friend Function – Dynamic Memory Allocation – Static ClassMembers – Overloading: Function overloading and Operator Overloading.

UNIT II	**INHERITANCE & POLYMORPHISM**	**9**

Base Classes and Derived Classes – Protected Members – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors in derived Classes - Class Object To Base – Class Object Conversion – Composition Vs. Inheritance – Virtual functions – This Pointer – Virtual Destructors – Dynamic Binding.

UNIT III	**LINEAR DATA STRUCTURES**	**9**

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation –– singly linked lists –Polynomial Manipulation - Stack ADT – Queue ADT - Evaluating arithmetic expressions

UNIT IV	**NON-LINEAR DATA STRUCTURES**	**9**

Trees – Binary Trees – Binary tree representation and traversals – Application of trees: Set representation and Union-Find operations – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search - Connected components

UNIT V	**SORTING AND SEARCHING**	**9**

Sorting algorithms: Insertion sort - Quick sort - Merge sort - Searching: Linear search –Binary Search

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Develop simple applications using Basic OOPS concepts.

CO2: Build C++ programs using inheritance.

CO3: Construct the concept of stack, linked list and memory allocation.

CO4: Solve problems related to trees and Graphs.

CO5: Compare different sorting and searching algorithms.

TEXT BOOKS:

1. Herbert Schildt, "C++: The Complete Reference", 4th Edition, McGraw Hill Education, 2017.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4th Edition, Addison-Wesley, 2014.
3. Ellis Horowitz, SartajSahni and Dinesh Mehta, "Fundamentals of Data Structures in C++", Second edition, Universities Press,2008.

REFERENCES:

1. Bhushan Trivedi, "Programming with ANSI C++, A Step-By-Step approach", Oxford University Press, 2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, "Data Structures and Algorithms in C++", 2nd Edition, Wiley. 2013.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, McGraw Hill, 2010.

21EC204	LINEAR INTEGRATED CIRCUITS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES :

- To infer the basic building blocks of linear integrated circuits.
- To illustrate the linear and non-linear applications of operational amplifiers.
- To outline the concepts & applications of analog multipliers and PLL.
- To explain the working principle of ADC and DAC.
- To summarize the operation of waveform generation and some special function ICs.

UNIT I	BASICS OF OPERATIONAL AMPLIFIERS	9

Basics of IC fabrication, Current mirror and current sources, Voltage sources, Voltage references, BJT Differential amplifier with active loads, Basic information about op-amps – Ideal operational amplifier - General operational amplifier stages, Slew rate, Open and closed loop configurations, Basics of JFET operational amplifiers – LF155 and TL082.

UNIT II	APPLICATIONS OF OPERATIONAL AMPLIFIERS	9

Sign changer, Scale changer, Voltage follower, V-to-I and I-to-V converters, Adder, Subtractor, Instrumentation amplifier, Integrator, Differentiator, Logarithmic amplifier, Antilogarithmic

amplifier, Comparator, Schmitt trigger, Precision rectifier, Peak detector, Clipper and Clamper, Op-amps in home applications.		
UNIT III	**ANALOG MULTIPLIER AND PLL**	**9**
Analog multiplier using Emitter coupled transistor pair - Gilbert multiplier cell –Analog multiplier ICs and their applications, Operation of basic PLL, Voltage controlled oscillator, Monolithic PLL IC 565, Application of PLL for AM detection, FM detection, FSK modulation and demodulation, Frequency synthesizing and Clock synchronization.		
UNIT IV	**ANALOG TO DIGITAL AND DIGITAL TO ANALOG CONVERTERS**	**9**
Analog and Digital data conversions, D/A converter – Weighted resistor type, R-2R Ladder type, Voltage mode and Current Mode R-2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – Flash type - Successive approximation type - Single Slope type – Dual Slope type - A/D Converter using Voltage-to-Time Conversion – A/D & D/A specifications.		
UNIT V	**WAVEFORM GENERATORS AND SPECIAL FUNCTION ICS**	**9**
Sine-wave generators, Multivibrators and Triangular wave generator, Saw-tooth wave generator, ICL8038 function generator, Timer IC 555, IC Voltage regulators – Three terminal fixed and adjustable voltage regulators - IC 723 general purpose regulator - Monolithic switching regulator, Low drop-out (LDO) regulators - Isolation amplifier, Opto-couplers and Fibre optic IC.		
TOTAL: 45 PERIODS		
LIST OF EXPERIMENTS		
• Design & Testing of inverting, non inverting and differential amplifiers. • Design & Testing of integrator and differentiator, schmitt trigger using op-amp. • Design & Testing of PLL characteristics & its use as frequency multiplier and clock synchronization. • Design & Testing of R-2R Ladder Type D- A Converter using Op-amp. • Simulation using PSPICE- Astable and Monostable multivibrators using NE555 timer.		
TOTAL: 30 PERIODS		
COURSE OUTCOMES: At the end of the course, learners will be able to		

CO1: Outline the basic concepts of operational amplifiers.

CO2: Construct op-amp circuits for linear and non-linear applications.

CO3: Summarize about the analog multiplier and phase locked loop circuits.

CO4: Build ADC and DAC circuits using op – amps.

CO5: Explain the concepts of waveform generating circuits and special function ICs.

TEXT BOOKS:

1. D.Roy Choudhry, Shail Jain, "Linear Integrated Circuits", 6th Edition, New Age International Pvt. Ltd., 2021.
2. S.Salivahanan & V.S. Kanchana Bhaskaran, "Linear Integrated Circuits", 3rd Edition, TMH, 2018.
3. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 3rd Edition, Tata Mc Graw-Hill, 2007.

REFERENCES:

1. Ramakant A. Gayakwad, "OP-AMP and Linear ICs", 4th Edition, Prentice Hall / Pearson Education, 2015.
2. Robert F.Coughlin & Frederick F.Driscoll, "Operational Amplifiers and Linear Integrated Circuits", 6th Edition, PHI, 2001.
3. B.S.Sonde, "System design using Integrated Circuits" , 2nd Edition, New Age Pub, 2001

21EC205	ANALOG AND DIGITAL CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES :

- To obtain the frequency response of CE, CB, CC and CS amplifier.
- To determine the bandwidth of multistage amplifiers and study the transfer characteristics of differential amplifier.
- To perform SPICE simulation of BJT, JFET and MOSFET amplifiers using various biasing techniques.
- To design various combinational digital circuits using logic gates.
- To design synchronous and asynchronous sequential circuits.

LIST OF ANALOG EXPERIMENTS:

1. Frequency Response of CE and CB amplifiers
2. Frequency Response CC and CS amplifiers
3. Differential Amplifiers - Transfer characteristics, CMRR Measurement
4. Cascode and Cascade BJT amplifiers
5. Determination of bandwidth of single stage & multistage BJT amplifier
6. Analysis of BJT with Fixed bias and Voltage divider bias using PSPICE
7. Analysis of Cascode and Cascade BJT amplifiers using PSPICE

LIST OF DIGITAL EXPERIMENTS:

8. Study of logic gates and design of half adder and full adder
9. Design and implementation of code converters using logic gates
10. Design and implementation of 4 bit binary adder/ subtractor using IC 7483
11. Design and implementation of BCD adder using IC 7483
12. Design and implementation of multiplexer and de-multiplexer using logic gates
13. Design and implementation of encoder and decoder using logic gates
14. Construction and verification of 4 bit ripple counter and Mod-10/Mod-12 ripple counters
15. Design and implementation of 3-bit synchronous up/down counter
16. Design of Shift Registers using D flip-flops

TOTAL PERIODS : 60

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build CE, CB, CC, CS, Cascode / Cascade Amplifiers and obtain the frequency response.

CO2: Analyze the transfer characteristics of Differential amplifier, Power amplifiers, bandwidth of single stage and Multistage amplifiers.

CO3: Construct BJT, JFET and MOSFET amplifiers with various biasing techniques using SPICE.

CO4: Develop multiplexer, de-multiplexer, encoder and decoder using logic gates.

CO5: Experiment with synchronous and asynchronous sequential circuits.

21CS215	OBJECT ORIENTED PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES :

- To describe the fundamentals of object oriented programming, particularly in C++.
- To use object oriented programming to implement data structures.
- To illustrate linear data structures and their applications.
- To demonstrate non-linear data structures and their applications.
- To explain the concept of data structures through ADT.

LIST OF EXPERIMENTS

1. Basic Programs for C++ Concepts
2. Array implementation of List Abstract Data Type (ADT)
3. Linked list implementation of List ADT
4. Cursor implementation of List ADT
5. Stack ADT - Array and linked list implementations
6. Implement stack Applications using Stack ADT
7. Queue ADT – Array and linked list implementations
8. Implement Queue Applications using Queue ADT
9. Search Tree ADT - Binary Search Tree
10. Graphs- Breadth first and Depth first search
11. Insertion sort
12. Quick Sort
13. Develop a C++ application to solve real world problem using ADT algorithms

TOTAL: 60 PERIODS

COURSE OUTCOMES:

CO1: Develop simple applications using Basic OOPS concepts.

CO2: Execute and Implement programs using inheritance and use them in programs.

CO3: Construct the concept of stack, linked list and memory allocation.

CO4: Solve problems related to trees and Graphs. CO5: Compare different sorting and searching algorithms.
TEXT BOOKS: 1. Herbert Schildt, "C++: The Complete Reference", 4^{th} Edition, McGraw Hill Education, 2017. 2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", 4^{th} Edition, Addison-Wesley, 2014. 3. Ellis Horowitz, SartajSahni and Dinesh Mehta, "Fundamentals of Data Structures in C++", 2^{nd} Edition, Universities Press, 2008.
REFERENCES: 1. Bhushan Trivedi, "Programming with ANSI C++, A Step-By-Step approach", Oxford University Press,2010. 2. Goodrich, Michael T., Roberto Tamassia, David Mount, "Data Structures and Algorithms in C++", 2^{nd} Edition, Wiley. 2011. 3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3^{rd} Edition, McGraw Hill, 2010. 4. BjarneStroustrup, "The C++ Programming Language", 4^{th} Edition, Addison-Wesley, 2013.

SEMESTER IV

21MA206	PROBABILITY AND RANDOM PROCESSES	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To explain the basic concepts in probability and random variables.
- To discuss the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To make use of the basic concepts of two dimensional random variables.
- To use the basic concepts of random processes in engineering disciplines.
- To explain the concept of correlation and spectral densities.

UNIT I	PROBABILITY AND RANDOM VARIABLES	12

Axioms of probability, Conditional probability, Total probability, Bayes theorem, Random variables- Probability mass function- Probability density function-Properties-Moments- Moment generating functions and their properties.		
UNIT II	**STANDARD DISTRIBUTIONS**	**12**
Binomial -Poisson -Geometric – Uniform-Exponential –Gamma and Normal distributions and their properties- Functions of a random variable.		
UNIT III	**TWO DIMENSIONAL RANDOM VARIABLES**	**12**
Joint Distributions-Marginal And Conditional Distributions-Covariance-Correlation And Linear Regression- Transformations Of Random Variables-Central limit theorem(without proof)		
UNIT IV	**CLASSIFICATION OF RANDOM PROCESSES**	**12**
Definition and examples-first order-second order-strictly stationary-wide sense stationary and Ergodic processes-Markov process-Poisson and Normal processes-Sine wave process.		
UNIT V	**CORRELATION AND SPECTRAL DENSITIES**	**12**
Auto correlation functions – Cross correlation functions – Properties – Power spectral density – Cross spectral density – Properties-Wiener – Khintchine relation- Relationship between cross power spectrum and cross correlation function- Linear time invariant system – System transfer function – Linear systems with random inputs – Auto correlation and cross correlation functions of input and output.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the basic concepts of Probability and Random variables.

CO2: Experiment the performance of random variables in terms of distributions.

CO3: Calculate the correlation and regression of two dimensional random variables.

CO4: Make use of random processes concept in engineering disciplines.

CO5: Apply the concept of correlation and spectral densities and the significance of linear systems with random inputs .

TEXT BOOKS:

1. JAY.L. Devore, “Probability and Statistics for Engineering and the Science”, 8^{th} Edition,Cengage Learning India Pvt. Ltd, 2012.

2. Peebles, P.Z., "Probability, Random Variables and Random Signal Principles ", 4th Edition, Tata McGraw Hill, 2002.
3. Cooper. G.R., McGillem. C.D., "Probabilistic Methods of Signal and System Analysis", 3rd Indian Edition, Oxford University Press, New Delhi, 2012.

REFERENCES:

1. Miller. S.L. and Childers. D.G., ―Probability and Random Processes with Applications to Signal Processing and Communications ", 2ndEdition, Academic Press, 2004.
2. Sheldon M.Ross, "Introduction to Probability Models". 11th edition, Academic Press, 2014
3. Yates. R.D. and Goodman. D.J., "Probability and Stochastic Processes", 2ndEdition, Wiley India Pvt. Ltd., Bangalore, 2012.

21CH103	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES:

- To describe the structure and function of an ecosystem and biodiversity.
- To interpret the environmental impacts of natural resources.
- To demonstrate causes, effects and control measures of different types of pollution.
- To manipulate the importance of disaster management, environmental ethics and values.
- To dramatize the important social issues and sustainable practices.

UNIT-I	**ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY**	**6**

Multidisciplinary nature of environmental studies - ecosystem- general structure and function of an ecosystem- ecological succession-biodiversity-types-values of biodiversity- endangered and endemic species-red data book- hot spots of biodiversity-criteria- hot spots in India-threats to biodiversity(man-animal conflicts, habitat loss, poaching)-case studies-conservation of biodiversity- in-situ and ex-situ conservation.

UNIT-II	**NATURAL RESOURCES AND ITS ENVIRONMENTAL IMPACTS**	**6**

Natural resources-forest resource-ecological functions – causes, effects and control measures of deforestation-water resource-sources-conflict over water-dams benefits and problems-food resource-overgrazing- impacts of over grazing- impacts of modern agriculture-energy resource-environmental impacts of wind mills and solar panels- role of an individual in conservation of natural resources.

UNIT III	ENVIRONMENTAL POLLUTION AND CONTROL	6
Air pollution-causes, effects and control methods - water pollution- causes, effects-waste water treatment-soil pollution-causes, effects-solid waste management–e-waste- causes, effects and management-Pollution control acts-air(prevention and control of pollution) act,1981-water(prevention and control of pollution) act,1974- wildlife (protection) act,1972 - e-waste management rules,2016-case studies - role of an individual in control of pollution.		
UNIT IV	**DISASTER MANAGEMENT AND ENVIRONMENTAL ETHICS**	**6**
Disaster management-causes, effects and management of- flood, landslide, earthquake and tsunami-case studies- environmental ethics- value education-traditional value systems in India-water conservation-rain water harvesting-watershed management.		
UNIT V	**SOCIAL ISSUES AND SUSTAINABLE PRACTICES**	**6**
Unsustainable development- social issues-climate change-causes, effects and control measures-global warming-causes, effects and control measures-Acid rain-causes, effects and control measures-ozone layer depletion-causes, effects and control measures-nuclear accident and holocausts-EIA-Sustainable development-goals-target- green buildings- ISO 14000 series.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO 1 : Explain the concept, structure and function of an ecosystem and biodiversity.

CO2 : Demonstrate the environmental impacts of natural resources.

CO 3 : Illustrate the suitable management method for pollution control.

CO 4 : Relate the proper way of managing disaster with environmental ethics.

CO5 : Apply social issues and adopt suitable sustainable practices.

TEXT BOOKS:

1. Kaushik, A & Kaushik. C.P, "Environmental Science and Engineering", 6th Edition, New Age International, 2018.
2. Garg S.K &Garg, Ecological and Environmental studies, Khanna Publishers, 2015.
3. Wright &Nebel, Environmental science towards a sustainable future, 12thEditon, Prentice Hall of India Ltd, 2015.

REFERENCES:

1. ErachBharucha, "Text book of Environmental studies for Undergraduate courses", 3rd

Edition, UGC, 2021. 2. Ravi P. Agrahari, Environmental ecology, Biodiversity, climatic change & Disaster management, 1st Edition, McGraw Hill, 2020. 3. Benney Joseph, "Environmental Science and Engineering", 1st Edition, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017.

21EC206	**ELECTRONIC CIRCUITS II**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES : • To infer the principles of feedback amplifiers. • To explain the operation of RC & LC oscillators. • To demonstrate the concept of tuned amplifiers. • To explain various wave shaping and multivibrator circuits. • To demonstrate the working principle of power amplifiers and DC convertors.					
UNIT I	**FEEDBACK AMPLIFIERS**				**9**
Feedback concept – Block diagram – Loop gain – Transfer gain with feedback – General characteristics of negative feedback amplifiers – Input resistance – Output resistance – Method of identifying feedback topology – Analysis of voltage-series, current-series, current-shunt and voltage shunt feedback amplifiers.					
UNIT II	**OSCILLATORS**				**9**
Oscillators – Barkhausen criterion – Mechanism for start of oscillation and stabilization of amplitude, Analysis of RC oscillators – Phase shift – Wien bridge, Analysis of LC oscillators – Hartley ,Colpitt's & Clapp oscillators, Crystal oscillators –Miller and Pierce Crystal oscillators.					
UNIT III	**TUNED AMPLIFIERS**				**9**
Small signal tuned amplifiers – Analysis of capacitor coupled single tuned amplifier – Double tuned amplifier – Effect of cascading single tuned and double tuned amplifiers on bandwidth – Neutralization - Hazeltine neutralization method.					
UNIT IV	**WAVE SHAPING AND MULTIVIBRATOR CIRCUITS**				**9**
RC integrator and differentiator circuits, Diode clippers and clampers, Multivibrators –					

Triggering methods, Collector coupled Astable multivibrator, Monostable multivibrator, Bistable multivibrator - Fixed bias and Self Bias, Schmitt Trigger.

UNIT V	POWER AMPLIFIERS AND DC CONVERTERS	9

Power amplifiers- Class A- Class B- Class AB- Class C, Power MOSFET-Temperature effect- Class AB Power amplifier using MOSFET –DC/DC convertors – Analysis of Buck, Boost and Buck-Boost amplifiers.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the topologies of feedback amplifiers.

CO2: Compare the various types of RC and LC oscillators.

CO3: Experiment with different types of tuned amplifiers.

CO4: Illustrate wave shaping and multi vibrator circuits.

CO5: Describe the concept of Power amplifiers and DC converters.

TEXT BOOKS:

1. Millman and Halkias. C., “Integrated Electronics”, TMH, 2007.
2. Millman J. and Taub H., “Pulse Digital and Switching Waveforms”, TMH, 2000.
3. S. Salivahanan, N. Suresh Kumar, “Electronic Devices and Circuits”, 3rd Edition, TMH, 2012.

REFERENCES:

1. Sedra and Smith, “Micro Electronic Circuits”, 6th Edition, Oxford University Press, 2011.
2. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition, Pearson Education / PHI, 2008..
3. David A. Bell, “Electronic Devices and Circuits”, 5th Edition, Oxford University Press, 2008.
4. Jacob Millman, ‘Microelectronics‘, 2nd Edition, McGraw Hill, Reprinted, 2009.

21EC207	ELECTROMAGNETIC FIELDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES :

- To infer the rudiments of electromagnetic theory in free space and in materials.
- To explain the electro static fields and parameters through Coloumb's law and Gauss's law.
- To familiarize with magneto static theorems & laws and infer the behavior of Magnetic materials.
- To derive the Maxwell's equations.
- To summarize the wave propagation mechanism in lossless and in lossy media.

UNIT I	INTRODUCTION	9

Electromagnetic model, Units and Constants, Nature of Scalars and Vectors, Review of vector algebra, Rectangular, Cylindrical and Spherical coordinate systems, Line, Surface and Volume integrals, Gradient of a scalar field, Divergence of a vector field, Divergence theorem, Curl of a vector field, Stoke's theorem, Null identities, Helmholtz's theorem.

UNIT II	ELECTROSTATICS	9

Introduction to Electro static fields, Coulomb's law, Electric field intensity, Field due to continuous charge distribution- Field due to line charge- Field due to a sheet of charge - Gauss's law and applications, Electric potential, Electric flux density and Dielectric constant, Boundary conditions, Capacitance, Parallel, Cylindrical and Spherical capacitors, Electrostatic energy, Poisson's and Laplace's equations, Uniqueness of electrostatic solutions, Current density and Ohm's law, Continuity equation, Energy stored in electric fields and Energy density.

UNIT III	MAGNETOSTATICS	9

Lorentz force equation, Law of non magnetic monopoles, Ampere's law, Vector magnetic potential, Biot-Savart law and applications, Magnetic field intensity, Ampere's circuital law and applications, Magnetic circuits, Behaviour of magnetic materials, Boundary conditions, Inductance and Inductors, Magnetic energy, Magnetic forces and torques.

UNIT IV	TIME-VARYING FIELDS AND MAXWELL'S EQUATIONS	9

Time Varying Fields, EMF and MMF, Faraday's law, Displacement current and current density, Modified form of Ampere's circuital law, Maxwell's equations in integral form and differential form – Poynting vector and power flow, Power flow in a co–axial cable – Instantaneous, Average and Complex poynting vector and Electromagnetic boundary conditions.

UNIT V	PLANE ELECTROMAGNETIC WAVES	9

Wave equations and solutions - Plane waves in lossless media, Plane waves in lossy media (Low-loss dielectrics and good conductors), Waves in ionized medium, Group velocity, Skin depth, Polarization – Linear, Circular and Elliptical polarization; Reflection by a perfect conductor -Normal and Oblique incidence - Reflection by a dielectric- Normal and Oblique incidence.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Relate various coordinate systems and vector algebra.

CO2: Apply the basic laws to evaluate electric fields and potentials due to static charges.

CO3: Solve magnetic fields with the help of Biot Savart's law and Ampere circuital law.

CO4: Outline the principles of time varying fields and Maxwell's equations.

CO5: Explain the plane electromagnetic waves in lossless and lossy media.

TEXT BOOKS:

1. D.K. Cheng, "Field and Wave Electromagnetics", 2nd Edition, Pearson (India), 2014
2. W.H. Hayt and J.A. Buck, "Engineering Electrmagnetics", 8th Edition, McGraw-Hill (India), 2012.
3. Joseph A.Edminister and Mahmood Nahvi, Schaum's Outline of Electromagnetics, 5th Edition, McGraw Hill, 2019.

REFERENCES:

1. John D Kraus and Daniel Fleisch, "Electromagnetics", 5th Edition, McGraw Hill, 2017.
2. D.J. Griffiths, "Introduction to Electrodynamics", 4th Edition, Pearson (India), 2013.
3. B.M. Notaros, "Electromagnetics", 1st Edition, Pearson: New Jersey, 2011.
4. M.N.O. Sadiku and S.V. Kulkarni, "Principles of Electromagnetics", 6th Edition, Oxford (Asian Edition), 2015.

<table>
<tr><td>21EC208</td><td>MICROPROCESSORS AND MICROCONTROLLERS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td></td><td></td><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES :
• To gain knowledge about the architecture of 8086 Microprocessor and assembly language programming fundamentals.
• To develop skills in interfacing of peripheral devices with 8086 Microprocessor, 8051 Microcontroller and MSP430 Microcontroller.
• To explain about 8086 Microprocessor and 8051 Microcontrollers.
• To demonstrate the architecture of MSP430 Microcontroller.
• To develop microcontroller based systems.</td></tr>
<tr><td>UNIT I</td><td colspan="4">ARCHITECTURE OF 8086 AND ASSEMBLY LANGUAGE PROGRAMMING</td><td>12</td></tr>
<tr><td colspan="6">Microprocessor families – 8086 – Architecture – Instruction set – Addressing modes – Bus cycles – Assembly language programming of 8086 – Assembler directives – Interrupts and applications.</td></tr>
<tr><td>UNIT II</td><td colspan="4">PERIPHERAL INTERFACING</td><td>12</td></tr>
<tr><td colspan="6">External memory interface – Programmable peripheral interface (8255) – Serial communication interface (8251) – Keyboard and Display interface (8279) – Programmable timer controller (8253/8254) – Programmable interrupt controller (8259).</td></tr>
<tr><td>UNIT III</td><td colspan="4">8051 MICROCONTROLLER</td><td>12</td></tr>
<tr><td colspan="6">8051 Microcontroller – Instruction set – Assembly Language Programming – I/ O interfacing – 8051 Timers –USART – Interrupts – 8051 programming in C</td></tr>
<tr><td>UNIT IV</td><td colspan="4">MSP430 MICROCONTROLLER</td><td>12</td></tr>
<tr><td colspan="6">Architecture introduction - Embedded C Programming in MSP430 - GPIO pins & configuration - Timers, Capture & PWM – DAC – ADC Ports - I2C</td></tr>
<tr><td>UNIT V</td><td colspan="4">SYSTEM DESIGN USING MICROCONTROLLERS</td><td>12</td></tr>
<tr><td colspan="6">ADC & DAC interfacing – Sensor interfacing – RTC interfacing (DS1307) using I2C Standard – Relay, Motor control – DC & Stepper motor – System design: Traffic Light Controller & Digital weighing machine</td></tr>
</table>

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to:

CO1: Explain the architecture of Microprocessors and Microcontrollers.

CO2: Analyze various types of Interfacing techniques.

CO3: Write assembly language program for 8086 Microprocessor, 8051 and MSP430 Microcontrollers.

CO4: Demonstrate the architecture of MSP430 Microcontroller.

CO5: Develop ALP for microcontroller based system design.

TEXT BOOKS:

1. Douglas V Hall, "Microprocessors and Interfacing", 3rd Edition, McGraw Hill Education, 2012.
2. Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded Systems using Assembly and C", 2nd Edition, Pearson India, 2007.
3. John H. Davies, "MSP430 Microcontroller Basics", 2nd Edition, Newnes, 2008.

REFERENCES:

1. A.K. Ray and K.M. Burchandi, "Intel Microprocessors Architecture Programming and Interfacing", McGraw Hill, 2000.
2. Sunil Mathur, "Microprocessor 8086: Architecture, Programming and Interfacing", PHI Learning Pvt.Ltd., 2011.
3. Kenneth Ayala, "The 8051 Microcontroller", 3rd Edition, Delmar Cengage Learning, 2004.

21EC209	ANALOG COMMUNICATION	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES :

- To explain the concept of various Amplitude modulation techniques.
- To gain knowledge about the Angle Modulation Techniques.
- To analyze the performance of Continuous Wave Modulation Systems.
- To be familiarize with various noises.

• To demonstrate the Information Theory and Source Coding.		
UNIT I	**AMPLITUDE MODULATION SYSTEMS**	**9**
Review of Spectral Characteristics of Periodic and Non – periodic signals – Need for modulation, Generation and Demodulation of AM, DSBSC, SSB and VSB Signals –Spectrum, Power relations, Comparison of various Amplitude Modulation Systems –Frequency Translation –FDM.		
UNIT II	**ANGLE MODULATION SYSTEMS**	**9**
Phase and Frequency Modulation, PM - FM Conversion, FM - PM Conversion, Single tone, Narrow Band and Wideband FM - Transmission Bandwidth - Generation and Demodulation of FM Signal.		
UNIT III	**NOISE THEORY**	**9**
Types of Noise – Shot noise, Thermal noise and white noise; Noise Equivalent Bandwidth-Narrow band noise -Envelope of Sine wave and Narrow band noise- Noise temperature; Noise Figure.		
UNIT IV	**PERFORMANCE OF AM AND FM MODULATION SYSTEMS**	**9**
AM receiver – SNR - Noise in DSBSC systems using coherent detection - coherent detection with SSB Modulation Noise in AM system using envelope detection, FM receiver- Noise in FM Reception - FM threshold effect – Pre-emphasis and De-emphasis in FM.		
UNIT V	**INFORMATION THEORY & SOURCE CODING TECHNIQUES**	**9**
Discrete Messages and Information Content - Entropy - Information rate - Mutual information and channel capacity Bandwidth- S/N trade-off - Source coding - Shannon-Fano coding - Huffman coding - Lempel-Ziv (LZ) coding		
TOTAL: 45 PERIODS		
LIST OF EXPERIMENTS:		
1. Amplitude Modulation and Demodulation 2. Frequency Modulation and Demodulation 3. Study the performance of AM and FM for noisy (random, thermal, and impulse) signal by measuring SNR of demodulated signal 4. Design and Testing of Pre-Emphasis / De-emphasis Circuits. 5. Pulse Code Modulation		

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1: Design, Test and Compare various amplitude modulators and demodulators with practical design parameters.

CO2: Design, Test and Compare various angle modulators and demodulators with practical design parameters.

CO3: Analyze the various noises in Analog systems.

CO4: Compare the performance of AM and FM modulation systems.

CO5: Apply various source coding techniques for the message Signals.

TEXT BOOKS:

1. Simon Haykin, "Communication Systems", 4th Edition, Wiley, 2014.
2. J.G.Proakis, M.Salehi, "Fundamentals of Communication Systems", Pearson Education 2014.
3. R.P Singh and S.D.Sapre, "Communication Systems – Analog and Digital", Tata McGraw Hill, 2nd Edition, 2007.

REFERENCES:

1. A. Bruce Carlson & Paul B Crilly, "Communication Systems", McGraw Hill, 4th Edition, 2009.
2. Dennis Roddy & John Coolen –"Electronic Communication" Prentice Hall of India, 4th Edition, 1995.
3. Lathi B. P. And Ding Zhi, "Modern Digital and Analog Communication Systems", Oxford Press, 4th Edition, 2011.

21EC210	CIRCUIT DESIGN AND SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES :

- To design feedback Amplifier circuits and to measure gain, Input and output resistances and compare their performance with and without feedback.
- To design Oscillators and verify its outputs.

- To gain hands-on experience on wave shaping and tuned amplifier circuits.
- To acquire knowledge to construct Astable and Monostable Multivibrator circuits.
- To model electronic circuits using circuit simulation tool.

LIST OF EXPERIMENTS:

DESIGN AND ANALYSIS OF THE FOLLOWING CIRCUITS

1. Voltage Series and Current Shunt feedback amplifiers
2. Hartley Oscillator and Colpitts Oscillator
3. Clippers and Clampers circuits
4. Astable and Monostable multivibrators
5. Class C amplifier

SIMULATION USING PSPICE:

6. Single tuned and double tuned amplifiers
7. Phase shift oscillator
8. Wein Bridge Oscillator
9. Multivibrators

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Analyze the various types of negative feedback amplifiers
CO2: Construct RC and LC oscillators
CO3: Experiment with Single tuned amplifiers and Wave Shaping circuits
CO4: Build Astable and Monostable multivibrator circuits
CO5: Make use of PSPICE tool to simulate Oscillators, Multivibrator Circuits and Power Amplifiers

21EC211	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES :

- To study ALP concepts, features and Coding methods.
- To learn ALP for arithmetic and logical operations in 8086 and 8051.
- To differentiate Serial and Parallel Interface.
- To interface different I/Os with Microprocessors.
- To be familiar with MASM.

LIST OF EXPERIMENTS:

8086 PROGRAMS USING KITS AND MASM

1. Basic arithmetic and Logical operations
2. Move a data block without overlap
3. Code conversion, decimal arithmetic and Matrix operations.
4. Floating point operations, string manipulations, sorting and searching
5. Password checking, Print RAM size and system date
6. Counters and Time Delay

PERIPHERALS AND INTERFACING EXPERIMENTS

7. Traffic light control
8. Stepper motor control
9. Digital clock
10. Key board and Display
11. Printer status
12. Serial interface and Parallel interface
13. A/D and D/A interface and Waveform Generation

8051 EXPERIMENTS USING KITS AND MASM

14. Basic arithmetic and Logical operations
15. Square and Cube program, Find 2's complement of a number
16. Unpacked BCD to ASCII
17. UART operations in 8051 using C.
18. MSP430 GPIO Programming
19. MSP430 DAC & PWM Programming
20. MSP430 Low Power Mode Programming
21. Mini Project.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Write ALP Programmes for fixed and Floating Point and Arithmetic operations.
CO2: Interface different I/Os with processor.
CO3: Generate waveforms using Microprocessors.
CO4: Execute Programs in 8051.
CO5: Explain the difference between simulator and Emulator.

SEMESTER V

21EC301	DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the parameters of information theory.
- To interpret the various waveform coding and line coding techniques.
- To summarize the baseband transmission and reception schemes.
- To illustrate various bandpass signaling schemes.
- To outline the fundamentals of channel coding.

UNIT I	INFORMATION THEORY	9

Discrete memoryless source, Information, Entropy, Mutual Information - Discrete Memoryless Channels, Binary Symmetric Channel, Channel Capacity - Hartley - Shannon law - Source coding theorem - Shannon & Huffman codes.

UNIT II	WAVEFORM CODING AND REPRESENTATION	9

Prediction filtering and DPCM - Delta Modulation - ADPCM & ADM principles - Linear Predictive Coding- Properties of Line codes- Power Spectral Density of Unipolar / Polar RZ & NRZ, Bipolar NRZ – Manchester

UNIT III	BASEBAND TRANSMISSION AND RECEPTION	9

ISI, Nyquist criterion for distortion less transmission, Pulse shaping, Correlative coding - Eye pattern, Receiving Filters- Matched Filter, Correlation receiver, Adaptive Equalization

UNIT IV	DIGITAL MODULATION SCHEME	9

Geometric Representation of signals - Generation, detection, PSD & BER of Coherent BPSK, BFSK & QPSK - QAM - Carrier Synchronization - Structure of Non-coherent Receivers - Principle of DPSK.

UNIT V	ERROR CONTROL CODING	9

Channel coding theorem - Linear Block codes - Hamming codes - Cyclic codes - Convolutional codes - Viterbi Decoder, ARQ & FEC.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Outline the parameters of information theory.

CO2: Compare different waveform coding and line coding techniques.

CO3: Illustrate the different baseband transmission and reception schemes.

CO4: Explain bandpass signaling schemes and its spectral characteristics.

CO5: Apply error control coding schemes for error correction.

TEXT BOOKS:

1. Simon Haykin, “Digital Communication”, 1st Edition, John Wiley, Reprint 2009.
2. B.Sklar, F. J. Harris, “Digital Communication Fundamentals and Applications”, 3rd Edition, Pearson Education, 2020.
3. K. Sam Shanmugam, “Digital and Analog Communication Systems”, Wiley, 2019

REFERENCES:

1. H P Hsu, “Schaum Outline Series -Analog and Digital Communications”, 3rd Edition, TMH, 2017.
2. J.G Proakis, M. Salehi, “Digital Communication”, 5th Edition, TMH, 2014.
3. B.P.Lathi, “Modern Digital and Analog Communication Systems”, 4th Edition, Oxford University Press, 2017.

21EC302	TRANSMISSION LINES AND RF SYSTEMS	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To explore various types of transmission lines and its characteristics.
- To know about high frequency lines, power and impedance measurements.
- To apply the knowledge in impedance matching concepts using Smith Chart.
- To summarize the wave propagation in waveguides.
- To design RF transceivers.

UNIT I	TRANSMISSION LINE THEORY	9
General theory of Transmission lines - general solution - The infinite line - Wavelength, velocity of propagation - Waveform distortion - the distortion-less line - Loading and different methods of loading - Line not terminated by Z_0 - Reflection coefficient - calculation of current, voltage, power delivered and efficiency of transmission - Input and transfer impedance - Open and short circuited lines - reflection factor and reflection loss.		
UNIT II	**HIGH FREQUENCY TRANSMISSION LINES**	**9**
Transmission line equations at radio frequencies - Line of zero dissipation - Voltage and current on the dissipation-less line, Standing Waves, Nodes, Standing Wave Ratio - Input impedance of the dissipation-less line - Open and short circuited lines - Power and impedance measurement on lines - Reflection losses - Measurement of VSWR and wavelength.		
UNIT III	**IMPEDANCE MATCHING IN HIGH FREQUENCY LINES**	**9**
Impedance matching: Quarter wave transformer - Impedance matching by stubs –Single stub and double stub matching - Smith chart - Solutions of problems using Smith chart -Single and double stub matching using Smith chart.		
UNIT IV	**WAVEGUIDES**	**9**
General Wave behaviors along uniform guiding structures, Transverse Electromagnetic waves, Transverse Magnetic waves, Transverse Electric waves, TM and TE waves between parallel plates, TE and TM waves in Rectangular wave guides, Bessel function, TE and TM waves in Circular wave guides.		
UNIT V	**RF SYSTEM DESIGN CONCEPTS**	**9**
Active RF components: Semiconductor basics in RF, bipolar junction transistors, RF field effect transistors, High electron mobility transistors, Basic concepts of RF circuit design, Mixers, Low noise amplifiers, voltage control oscillators, power amplifiers, transducer power gain and stability considerations.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the basic concepts of Transmission Line theory

CO2: Outline the signal propagation in Transmission Lines at High frequencies.

CO3: Develop impedance matching networks using Smith Chart.

CO4: Choose guided systems for electromagnetic wave propagation.

CO5: Design RF Transceivers.

TEXT BOOKS:

1. John D Ryder, "Networks, Lines and Fields", 2^{nd} Edition, Prentice Hall India, 2015.
2. Mathew M. Radmanesh, "Radio Frequency & Microwave Electronics Illustrated", 2^{nd} Edition, Pearson Education Asia, 2015.
3. E.C.Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems", 2^{nd} Edition, Prentice Hall of India, 2015.

REFERENCES:

1. Reinhold Ludwig and Powel Bretchko, "RF Circuit Design – Theory and Applications", 1^{st} Edition, Pearson Education Asia, 2001.
2. D. K. Misra, "Radio Frequency and Microwave Communication Circuits- Analysis and Design", 2^{nd} Edition, John Wiley & Sons, 2004.
3. G.S.N Raju, "Electromagnetic Field Theory and Transmission Lines", 1^{st} Edition, Pearson Education, 2006.

21EC303	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To explain the concepts of DFT and FFT.
- To design IIR filters and to filter undesirable signals in various frequency bands.
- To compare the performance of various windowing techniques used to realize linear phase FIR filters.
- To illustrate the effects of finite precision representation on digital filters.
- To identify the concepts behind multivariate signal processing techniques.

UNIT I	DISCRETE FOURIER TRANSFORM	9

Review of signals and systems, Discrete Fourier transform (DFT), deriving DFT from DTFT, properties of DFT - periodicity, symmetry, circular convolution. Linear filtering using DFT. Fast computation of DFT - Radix-2 Decimation-in-time (DIT) Fast Fourier transform (FFT),

Decimation-in-frequency (DIF) Fast Fourier transform (FFT). Linear filtering using FFT.		
UNIT II	**INFINITE IMPULSE RESPONSE DIGITAL FILTERS**	**9**
Review of design of analog Butterworth and Chebyshev Filters, Frequency Transformation in analog domain, Design of IIR digital filters using Impulse Invariance technique, Design of digital filters using bilinear transform, pre-warping, Realization of IIR digital filters: direct form I, direct form II, cascade and parallel forms.		
UNIT III	**FINITE IMPULSE RESPONSE DIGITAL FILTERS**	**9**
Symmetric and Anti-symmetric FIR filters, Linear phase FIR filters, Design of linear phase FIR filters using Rectangular, Hamming, Hanning and Blackmann Windows, Frequency sampling method, Realization of FIR filters, Transversal, Linear phase realization structures.		
UNIT IV	**FINITE WORD LENGTH EFFECTS**	**9**
Fixed point and floating point number representation, Truncation and Rounding errors, Quantization noise, Derivation for quantization noise power, Coefficient quantization error, Product quantization error, Overflow error, Round off noise power, limit cycle oscillations due to product round off and overflow errors, signal scaling.		
UNIT V	**MULTIVARIATE SIGNAL PROCESSING**	**9**
Multivariate Time Series: Time Domain Approach, Concept of Stochastic Processes, Stationarity and Ergodicity, Time series models: AR Models & ARMA Models, Estimating time series models from data, Assessing the relations among time series, Information theoretic measures: Mutual information and complexity.		
TOTAL : 45 PERIODS		
LIST OF EXPERIMENTS		
1. Generation of elementary Discrete-Time sequences. 2. Convolution and Correlation. 3. Frequency Analysis using DFT. 4. Sampling and Effect of Aliasing. 5. Design of FIR filters. 6. Design of IIR Filters.		
TOTAL : 30 PERIODS		
COURSE OUTCOMES:		

At the end of this course, learners will be able to CO1: Apply the concepts of FFT for linear filtering. CO2: Construct IIR filters using various transformation techniques. CO3: Realize FIR Filters using Windowing and Frequency Sampling techniques. CO4: Analyze the effects of finite word length in signal processing. CO5: Outline multivariate signal processing techniques.
TEXT BOOKS: 1. John G. Proakis and Dimitris G.Manolakis, "Digital Signal Processing - Principles, Algorithms & Applications", 4th Edition, Pearson Education, 2007. 2. B.Venkatramani and M.Bhaskar, "Digital Signal Processors: Architecture, Programming and Applications", 2nd Edition, Tata McGraw Hill, 2017. 3. V. Oppenheim, R. W. Shafer and J.R.Buck, "Discrete-Time Signal Processing", 4th Edition, Pearson Education, 2011.
REFERENCES: 1. Ifeachor E.C. and Jervis B.W., "Digital Signal Processing: A Practical Approach", 2nd Edition, Pearson Education, 2002. 2. Sanjit. K. Mitra "Digital Signal Processing - A computer based approach", 4th Edition, Tata McGraw Hill, 2011. 3. Andreas Antoniou, "Digital Signal Processing: Signals, Systems and Filters", Tata McGraw Hill, 2006. 4. Monson H Hayes, "Schaum's Outlines of - Digital Signal Processing", 2nd Edition, Tata McGraw Hill, 2012.

21EN301	**PROFESSIONAL COMMUNICATION LABORATORY** *(Common to all B.E./B.Tech. Programmes)*	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVES:

- To demonstrate communication skills that can lead to improved interpersonal relationships.
- To plan to set and achieve goals with focus.
- To organize themselves in work life to face the professional set up with confidence.
- To interpret ideas and participate in group discussion with positive attitude.

• To develop their confidence and help learners to attend interviews successfully.		
UNIT I	**COMMUNICATION AND PROFESSIONAL ETIQUETTES**	**6**
•Importance and Types of Communication Verbal communication -Presentation skills- Non-Verbal communication - Personal Appearance, Posture, Gestures, Facial Expressions, Eye Contact and Space Distancing - Professional Etiquette		
UNIT II	**GOAL SETTING AND MOTIVATION**	**6**
Short term and Long term Goals- Strategies to set and achieve goals- Motivation		
UNIT III	**TIME AND STRESS MANAGEMENT**	**6**
Importance of Time - Time Management Skills - Sources of Stress - Managing Stress - Analysis of the Case Studies on time and stress management		
UNIT IV	**GROUP DISCUSSIONS AND POSITIVE ATTITUDE**	**6**
Group Discussions - Leadership Qualities - Decision Making - Problem Solving - Negotiation Skills - Positive Attitude		
UNIT V	**RESUME MAKING AND INTERVIEW SKILLS**	**6**
Preparing Resume - E - Resume - Covering Letter – Job Application through email - Career Portfolio - Types of Interviews - Mock Interviews		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Demonstrate effective communication skills through presentations.

CO2: Utilize their knowledge of motivation in setting and achieving goals.

CO3: Examine time and stress management.

CO4: Formulate their ideas into an effective communication in formal contexts.

CO5: Develop a well-composed resume and face interviews confidently.

TEXT BOOKS:

1. Dhanavel S P, “English and Soft Skills”, 1st Edition , Orient Black Swan Ltd, Hyderabad 2012.
2. Dr. Tobin Porterfield & Bob Graham ,“The 55 Soft Skills That Guide Employee and

Organizational Success," Mason – West Publishing House ,January 4-2018 3. Prashant Sharma, "Soft Skills Personality Development for Life Success, "BPB Publications, New Delhi, January 2018.
REFERENCES: 1. M. Ashraf Rizvi, "Effective Technical Communication," Tata McGraw Hill Education Pvt. Ltd. New Delhi, 2016. 2. Mohan Krishna & Meera Banerji, "Developing Communication Skills," 1st Edition, Trinity Press, 2017. 3. N. Krishnaswami & T. Sriraman, "Creative English for Communication," 3rd Edition, Laxmi Publications Private Limited, 2017.

SEMESTER VI

21EC304	ANTENNAS AND WAVE PROPAGATION	L	T	P	C
		2	2	0	3
COURSE OBJECTIVES: • To illustrate the basic principles of antennas. • To explore the radiation mechanism of antennas. • To gain knowledge about the characteristics and design of antenna arrays. • To design Microstrip Patch Antennas. • To inspect different Propagation Phenomena related to Radiation.					
UNIT I	**ELECTROMAGNETIC RADIATION AND ANTENNA FUNDAMENTALS**				**12**
Vector potential – Solution to wave equation – Retarded vector and scalar potential – Hertzian dipole – Antenna characteristics – Radiation pattern, Beam solid angle, Directivity, Gain, Input impedance, Polarization, Beam width, Bandwidth, Reciprocity, Equivalence of Radiation patterns, Effective aperture, Effective length, Antenna temperature.					
UNIT II	**WIRE ANTENNAS AND ANTENNA ARRAYS**				**12**
Short dipole – Radiation resistance and Directivity – Half wave Dipole – Monopole – Small loop antennas – Antenna Arrays – Linear Array and Pattern Multiplication, Two–element Array, Uniform Array – Array with non– uniform Excitation – Binomial Array and Dolph					

Tchebychef Array.		
UNIT III	**APERTURE ANTENNAS**	**12**
Magnetic Current and its fields – Uniqueness theorem – Field equivalence principle – Duality principle – Method of Images – Pattern properties – Slot antenna – Horn Antenna – Pyramidal Horn Antenna – Reflector Antennas – Parabolic Reflectors-Flat Reflector – Corner Reflector-Lens Antenna.		
UNIT IV	**SPECIAL ANTENNAS AND ANTENNA MEASUREMENTS**	**12**
Yagi Uda Antenna – Helical Antenna – Axial mode helix, Normal mode helix- Biconical Antenna, Log Periodic Dipole Array – Spiral Antenna – Microstrip Patch Antennas – Metamaterial Antennas- Fractal Antennas, Reconfigurable Antennas, Optical Antennas, Antenna Measurements- Radiation Pattern, Gain and Directivity, Impedance. Anechoic Chamber.		
UNIT V	**RADIO WAVE PROPAGATION**	**12**
Free Space Propagation -FRISS Transmission Formula – Ground Wave Propagation, Ground Reflection, Surface Waves, Space Waves – Diffraction – Wave Propagation in Complex Environments – Tropospheric Propagation – Tropospheric Scatter – Ionospheric Propagation – Structure of Ionosphere, Sky Waves, Skip Distance, Virtual Height, Critical Frequency, MUF, Electrical Properties of Ionosphere – Effects of Earth's Magnetic Fields.		
TOTAL: 60 PERIODS		

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the fundamentals of antennas.

CO2: Construct wire antennas and antenna arrays.

CO3: Analyze the characteristics aperture antennas.

CO4: Explain the characteristics of special antennas and procedure to measure antenna parameters.

CO5: Analyze the Atmospheric Effects on Radio Wave Propagation.

TEXT BOOKS:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas and Wave Propagation", 5th Edition, Tata McGraw-Hill, 2017.
2. Constantine A.Balanis, "Antenna Theory Analysis and Design", 4th Edition, John Wiley

India Pvt Ltd., 2016.

3. R.E.Collin, "Antennas and Radiowave Propagation", 2nd Edition, Tata McGraw-Hill, 2007.

REFERENCES:

1. A.R.Harish, M.Sachidanada, “Antennas and Wave Propagation”, 2nd Edition, Oxford University Press, 2007.
2. K.D.Prasad, “Antenna Wave Propagation” 4th Edition, Sathya Prakashan Publication, 2019.
3. W.L Stutzman and G.A. Thiele, “Antenna Analysis and Design”, 3rd Edition, John Wiley, 2016.

21EC305	VLSI AND CHIP DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the fundamentals of CMOS circuits and its characteristics.
- To design combinational and sequential circuits using verilog HDL.
- To analyze the combinational & sequential digital circuits.
- To construct the arithmetic blocks and memory subsystems.
- To illustrate the methods of testing CMOS circuits.

UNIT I	INTRODUCTION TO MOS TRANSISTOR	9

VLSI Design Flow, MOS Transistor, CMOS logic, Pass Transistor, Transmission gate, Layout Design Rules, Stick Diagrams, I-V Characteristics, C-V Characteristics, Non ideal I-V Effects, DC Transfer characteristics

UNIT II	CIRCUIT DELAY AND VERILOG HDL	9

Delay estimation – Logical effort and Transistor sizing – Power dissipation – Interconnect – Design Margin-Reliability – Scaling

Basic concepts – identifiers – gate primitives – gate delays – operators – timing controls – procedural assignments –conditional statements – Design of combinational and sequential circuits using four types of modeling –Test benches

UNIT III	COMBINATIONAL AND SEQUENTIAL CIRCUIT DESIGN	9
Combinational Circuits - Static CMOS, Ratioed Circuits, Cascode Voltage Switch Logic, Dynamic Circuits, Pass Transistor Logic, Transmission Gates, Domino, Introduction to Low power VLSI Design, Sequential Circuits - Static latches and Registers, Dynamic latches and Registers.		
UNIT IV	**DESIGN OF ARITHMETIC BUILDING BLOCKS AND MEMORY SUBSYSTEMS**	**9**
Arithmetic Building Blocks: Data Paths, Adders, Multipliers, Shifters, ALUs, power and speed tradeoffs, SRAM–Memory cell read/write operation, Decoders, Bit-line conditioning and Column circuitry– DRAM –Sub array architectures and Column circuitry.		
UNIT V	**CMOS TESTING**	**9**
Need for testing – Testers, Text fixtures and test programs – Logic verification – Silicon debug principles – Manufacturing test – Design for testability – Boundary scan test.		
	TOTAL : 45 PERIODS	

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Outline the concepts of digital building blocks using MOS transistor.

CO2: Make use of Verilog HDL to synthesize combinational and sequential circuits.

CO3: Examine combinational MOS circuits and sequential circuits.

CO4: Develop arithmetic building blocks and memory subsystems using CMOS.

CO5: Summarize the methods of CMOS testing.

TEXT BOOKS:

1. Neil H.E. Weste, David Money Harris, “CMOS VLSI Design: A Circuits and Systems Perspective”, 4th Edition, Pearson Education, 2011.
2. Jan M. Rabaey, Anantha P.Chandrakasan and Borivoje Nikolic, “Digital Integrated Circuits: A Design perspective”, 2nd Edition , Pearson Education, 2003.
3. J.Bhasker, “A Verilog HDL Primer”, 3rd Edition, Star Galaxy Publishing, 2018.

REFERENCES:

1. Uyemura J.P, “Introduction to VLSI circuits and systems”, 1st Edition, Wiley 2009.
2. M.J. Smith, “Application Specific Integrated Circuits”, 1st Edition, Addison Wesley,

2009.

3. D.A Pucknell and K.Eshraghian, “Basic VLSI Design”, 3rd Edition, PHI, 2007.
4. Wayne Wolf, “Modern VLSI Design: System on Chip”, 1st Edition, Pearson Education, 2009.
5. Samir Palnitkar “Verilog HDL a guide to Digital design and Synthesis”, 2nd Edition, Prentice Hall, 2003.

21EC306	COMMUNICATION NETWORKS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To outline the division of network functionalities.
- To explain the data link layer functionalities.
- To apply the knowledge in routing and subnet process.
- To summarize the flow control and congestion control algorithms.
- To classify the different application layer protocols.

UNIT I	INTRODUCTION TO LAYER ARCHITECTURE & PHYSICAL LAYER	9

Overview of Data Communications: Networks, Building Network and its types: Overview of Internet: Protocol Layering, OSI Mode: Physical Layer, Switching.

UNIT II	DATALINK LAYER	9

Introduction to Data Link Layer: Link layer Addressing, Error Detection and Correction: Overview of Data link Control and Media access control: Flow and Error Control: Protocols, HDLC.

UNIT III	NETWORK LAYER	9

Network layer services: Packet Switching:IPV4 Address: Routing, Unicast Routing, Algorithms, Protocols: Multicast Routing and its basics: Overview of Intra domain and interdomain protocols: Overview of IPv6 Addressing, Transition from IPv4 to IPv6.

UNIT IV	TRANSPORT LAYER	9

Introduction to Transport layer: Protocols- User Datagram Protocols (UDP) and Transmission Control Protocols (TCP): Services, Features, TCP Connection, State Transition Diagram, Flow and Error control, Mobile TCP, Snooping TCP, Indirect TCP, Congestion Control, Congestion avoidance.		
UNIT V	**APPLICATION LAYER**	**9**
Application Layer Paradigms: Client Server Programming, World Wide Web and HTTP, DNS, Electronic Mail (SMTP, POP3, IMAP, MIME): Need for Cryptography and Network Security, Firewalls.		
TOTAL: 45 PERIODS		

LIST OF EXPERIMENTS:

1. Implementation and Analysis of star and bus topologies.
2. Implementation of Stop and wait, Goback N and Selective repeat protocol
3. Configuration of IP address and implementation of basic networking commands.
4. Implementation of Distance vector routing algorithm.
5. Implementation of Link state routing algorithm.
6. Configuration and analysis of a network using Packet tracer software.
7. Implementation of an encryption and decryption algorithm using any programming language.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Outline the layered architecture and functionalities of a network.

CO2: Make use of Media Access Control protocols for error detection and flow control.

CO3: Develop routing table to efficiently route data using routing protocols.

CO4: Explain end to end data delivery protocols to improve congestion control and QoS.

CO5: Summarize the functionalities of application layer protocols.

TEXT BOOKS:

1. Behrouz A. Forouzan, “Data communication and Networking”, 5th Edition, Tata McGraw Hill, 2017.
2. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, 6th

Edition, Morgan Kaufmann Publishers, 2021.

3. William Stallings, "Data and Computer Communications", 9th Edition, Pearson Education, 2013.

REFERENCES:

1. James F. Kurose, Keith W. Ross, "Computer Networking - A Top-Down Approach Featuring the Internet", 7th Edition, Pearson Education, 2017.
2. Nader. F. Mir,"Computer and Communication Networks", 2nd Edition, Pearson Prentice Hall Publishers, 2014.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, "Computer Networks: An Open Source Approach", 3rd Edition,Tata McGraw Hill,2012.

21EC307	**VLSI DESIGN LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSE OBJECTIVES:

- To gain knowledge about the basic programming concepts in verilog HDL.
- To develop verilog code for combinational and sequential circuits.
- To implement the programs in FPGA.
- To simulate and synthesize the combinational and sequential circuits.
- To develop CMOS inverter and inverting amplifiers.

LIST OF EXPERIMENTS:

1. Design and Implementation of Logic Gates and Adders.
2. Design and Implementation of multipliers.
3. Design and Implementation of decoders, multiplexers, and comparators.
4. Design and Implementation of Flip-Flops.
5. Design and Implementation of Shift Registers.
6. Design and Implementation of ALU.
7. Design and simulate 4-bit synchronous counter using Flip-Flops.
8. Design and simulate Mealy and Moore state machines.

9. Generate synthesis, timing and power analysis.
10. Design and Simulate a CMOS Differential Amplifiers.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Develop programs for basic combinational circuits.

CO2: Utilize verilog HDL and simulate the sequential digital circuits.

CO3: Demonstrate the logic modules using FPGA boards.

CO4: Analyze the synthesis report and infer the utilization.

CO5: Develop the analog CMOS circuits using SPICE.

SEMESTER VII

21EC401	MICROWAVE AND OPTICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the characteristics of microwave passive components.
- To illustrate microwave semiconductor devices.
- To gain knowledge about the basic principles of microwave tubes and microwave measurements.
- To analyze optical fiber transmission characteristics.
- To understand the mechanism of optical sources and detectors.

UNIT I	MICROWAVE PASSIVE COMPONENTS	9

Microwave frequency range – significance of microwave frequency range – important properties & applications of microwaves – Microwave junctions – Tee junctions – Magic Tee – Rat race – Corners – bends and twists – Directional couplers – two hole directional couplers – Ferrites – Termination – Gyrator – Isolator – Circulator – Attenuator – Phase changer – S Matrix for microwave components – Cylindrical cavity resonators.

UNIT II	MICROWAVE SEMICONDUCTOR DEVICES	9

Microwave semiconductor devices – operation, characteristics and application of BJTs and FETs – power frequency limitations - Principles of tunnel diodes – Varactor and Step recovery diodes – Transferred Electron Devices – Gunn diode – Avalanche Transit time devices – Reed diode, IMPATT and TRAPATT devices. Filter design by insertion loss method – Butterworth and Chebyshev MIC Filters.		
UNIT III	**MICROWAVE TUBES AND MEASUREMENT**	**9**
Microwave tubes – High frequency limitations – Principle of operation of Multi cavity Klystron, Reflex Klystron, Traveling Wave Tube and Magnetron. Microwave measurements – power, wavelength, impedance, SWR, attenuation, Q and Phase shift measurements.		
UNIT IV	**FUNDAMENTALS OF OPTICAL FIBERS**	**9**
Ray theory of light transmission through a fiber – Total internal reflection – Acceptance angle – Numerical aperture – Skew rays – Electromagnetic mode theory of optical propagation – Step Index and Graded Index, Single Mode and Multi-Mode fibers – Attenuation in a fiber – Fiber bending Loss.		
UNIT V	**OPTICAL SOURCES AND DETECTORS**	**9**
Optical sources: Light Emitting Diodes – LED structures – surface and edge emitters, mono and hetero structures – internal quantum efficiency – injection laser diode structures – comparison of LED and ILD - Optical Power Launching and Coupling. Optical Detectors: PIN Photo detectors, Avalanche photo diodes, construction, characteristics and properties – Comparison of performance – Photo detector noise – Noise sources, Signal to Noise ratio – Detector response time.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Design passive microwave components.

CO2: Demonstrate the working principles of semiconductor microwave devices

CO3: Illustrate the principle of operation of microwave tubes and procedure to measure microwave power, wavelength, impedance, SWR, attenuation, Q and Phase shift.

CO4: Analyze optical fiber transmission characteristics

CO5: Analyze the various optical source materials and LED structures and photo detectors.

TEXT BOOKS:

1. Samuel Y Liao, "Microwave Devices & Circuits", 3rd edition, Prentice Hall of India,

2006.

2. Gerd Keiser, "Optical Fiber Communication", 5th Edition, McGraw Hill, 2014.
3. David M.Pozar, "Microwave Engineering", 4th Edition, Wiley India, 2013.

REFERENCES:

1. Annapurna Das and Sisir K Das, "Microwave Engineering", 3rd Edition, Tata McGraw Hill Inc., 2017.
2. J.Gower, "Optical Communication System", 3rd Edition, Prentice Hall of India, 2001.
3. John M. Senior, "Optical Fiber Communication", 3rd Edition, Pearson Education, 2009.

21EC402	**MOBILE COMMUNICATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To summarize the basic concepts of mobile computing and various types of multiple access techniques.
- To explain the basics of mobile telecommunication system.
- To explore the characteristics of Wireless LAN, Bluetooth and Wi-Fi Technologies.
- To interpret the network protocol stack.
- To learn about transport and application layer.

UNIT I	**INTRODUCTION TO MOBILE COMMUNICATION**	**9**

Introduction to Mobile Computing, Applications of Mobile Computing, Generations of Mobile Communication Technologies, MAC Protocols, SDMA, TDMA, FDMA, CDMA. Comparison between the Multiple Access Techniques.

UNIT II	**MOBILE TELECOMMUNICATION SYSTEM**	**9**

GSM: Architecture, Protocols, Connection Establishment, Frequency Allocation, Routing, Mobility Management, Security, GPRS, UMTS, Architecture.

UNIT III	**WIRELESS NETWORKS**	**9**

Wireless LANs and PANs, IEEE 802.11 Standard, Architecture, Services, Bluetooth, Wi-Fi, WiMAX.

UNIT IV	MOBILE NETWORK LAYER	9

Mobile IP, DHCP, AdHoc, Proactive and Reactive Routing Protocols, Multicast Routing, Vehicular Ad Hoc networks (VANET), MANET Vs VANET, Security Issues.

UNIT V	MOBILE TRANSPORT AND APPLICATION LAYER	9

Mobile TCP- Types of TCP, WAP, Architectures - WDP, WTLS, WTP, WSP, WAE, WTA Architecture, WML.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the basics of mobile telecommunication system.

CO2: Summarize the generations of telecommunication systems in wireless network.

CO3: Illustrate the architecture of wireless LAN technologies.

CO4: Interpret the functionality of network layer and Identify a routing protocol for a given Adhoc networks.

CO5: Summarize the functionalities of Transport and Application layer.

TEXT BOOKS:

1. Jochen Schiller, “Mobile Communications”, 2nd Edition, PHI, 2009.
2. Prasant Kumar Pattnaik, Rajib Mall, “Fundamentals of Mobile Computing”, 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2016.
3. William.C.Y.Lee, “Mobile Cellular Telecommunications-Analog and Digital Systems”, 2nd Edition, Tata McGraw Hill Edition, 2017.

REFERENCES:

1. Dharma Prakash Agarwal and Qing-An Zeng, “Introduction to Wireless and Mobile systems”, 4th Edition, Cengage Learning, 2016.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, “Principles of Mobile Computing”, 2nd Edition, Springer, 2006.
3. Gordon L. Stüber, “Principles of Mobile Communication” , Springer US, 2013.

21EC403	MICROWAVE AND OPTICAL LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To analyse the characteristics of microwave generators.
- To summarize the performance measurement of microwave passive components.
- To gain knowledge on ADS simulation tool.
- To outline the characteristics of LED and Photo diode.
- To analyze various losses of digital and analog optical link.

LIST OF EXPERIMENTS:

MICROWAVE EXPERIMENTS:

1. Mode characteristics of Reflex Klystron.
2. Characteristics of Gunn Diode.
3. VSWR, Frequency and Wavelength Measurement of microwave signal within waveguide.
4. Measurement of Directivity and Coupling Coefficient of Directional Coupler.
5. S - Parameter measurement of Isolator and Circulator.
6. S - Matrix Characterization of E-Plane Tee, H-Plane Tee and Magic Tee Junctions.
7. Gain Measurement of Horn Antenna.
8. Microstrip Patch Antenna Design using ADS.
9. Study of SDR kit.

OPTICAL EXPERIMENTS:

1. DC characteristics of LED and PIN Photodiode.
2. Measurement of Connector and Bending Losses.
3. Study of Fiber optic Analog and Digital Link.
4. Determination of Numerical Aperture in optical Fibers
5. Attenuation Measurement in Fibers

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Compare the performance of different microwave generators

CO2: Analyze the performance of passive microwave components.

CO3: Interpret the characteristics of antennas using ADS package.

CO4: Analyze the characteristics of optical sources and detectors. CO5: Examine various optical fiber links and their transmission losses.

21EC404	PROJECT WORK I	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To identify the problems in industries and social relevant applications.
- To make use of innovative methods for problem identification.
- To develop the prototype for the project.
- To apply the real time for successful working.
- To identify the platforms for the project explorations.

METHOD OF EVALUATION:

- The students in a group of 2 to 4 works on a topic approved by the head of the department and prepare a comprehensive project-I report after completing the work.
- The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester.
- The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Outline the problem identified in industries.
CO2: Experiment with the innovative techniques.
CO3: Make use of advanced tools for the solution.
CO4: Select a suitable method for implementation.
CO5: Analyze the developed prototype for future scope.

21EC405	PROJECT WORK II	L	T	P	C
		0	0	20	10

COURSE OBJECTIVES:

- To organize the works related to project.
- To solve a specific problem right from its identification and literature review till the successful solution of the same.
- To develop the students in preparing project reports.

• To build the students to face reviews and viva voce examination. • To plan project contest and journal publication.
METHOD OF EVALUATION:
• The students in a group of 2 to 4 works on a topic approved by the review committee under the guidance of the HoD and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor. • The progress of the project is evaluated based on minimum of three reviews. • A project report is required at the end of the semester. • The project work is evaluated based on oral presentation, hardware/software results and the project report jointly by external and internal examiners.
TOTAL: 300 PERIODS
COURSE OUTCOMES: At the end of the course, learners will be able to CO1: Solve engineering problem with social relevance. CO2: Plan for writing report and viva voce examination. CO3: Make use of the project reports for publications. CO4: Choose a suitable methodology for a problem solving. CO5**:** Organize the works related to project implementation.

PROFESSIONAL ELECTIVE COURSES

VERTICAL – I

RF CIRCUITS AND ANTENNA DESIGN

21PEC01	**RF TRANSCEIVERS**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

COURSE OBJECTIVES:

- To outline the design considerations and architectures of a RF transceiver.
- To analyze the performance of various RF amplifiers.
- To explain the functionalities of RF power amplifiers.
- To design RF mixers and oscillators.
- To understand the design and packaging mechanism of RFIC.

UNIT I	SPECIFICATIONS AND ARCHITECTURES	12
Two port Noise theory, Noise Figure, THD, IP2, IP3, Sensitivity, SFDR, Phase noise - Specification distribution over a communication link Transceiver Architectures: Receiver: Homodyne, Heterodyne, Image reject, Low IF Architectures - Transmitter: Direct upconversion, Two step upconversion.		
UNIT II	**IMPEDANCE MATCHING AND AMPLIFIERS**	**12**
S-parameters with Smith chart - Passive IC components - Impedance matching networks Amplifiers: Common Gate, Common Source Amplifiers - OC Time constants in bandwidth estimation and enhancement. Power match, Noise match-Single ended, and Differential LNA.		
UNIT III	**FEEDBACK SYSTEMS AND POWER AMPLIFIERS**	**12**
Feedback Systems: Stability of feedback systems: Gain and phase margin, Root Locus techniques - Time and Frequency domain considerations – Compensation. Power Amplifiers: General model - Class A, AB, B, C, D, E and F amplifiers.		
UNIT IV	**MIXERS AND OSCILLATORS**	**12**
Mixer: characteristics - Non-linear based mixers: Quadratic mixers - Multiplier based mixers Single balanced and double balanced mixers - subsampling mixers. Oscillators: Colpitts oscillators - Resonators - Tuned Oscillators - Negative resistance oscillators - Phase noise.		
UNIT V	**RFIC & PACKAGING**	**12**
Transceiver architectures-Role of RFICs in Transceiver, Lower frequency design and RFIC design issues of RFICs in transceivers-Active/Passive device technologies for RFIC implementations-Modern RFIC chip sets for current wireless standards, Packaging techniques, High frequency measurement.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Apply the knowledge of RF electronics for characterizing RF Systems.

CO2: Design different types of RF amplifiers.

CO3: Illustrate the requirements and design procedure of RF power amplifiers.

CO4: Analyze the performance of practical RF circuits.

CO5: Design RFIC and understand the packaging techniques.

TEXT BOOKS: 1. B.Razavi, "RF Microelectronics", 2^{nd} Edition, Pearson Education, 2011. 2. T.Lee, "Design of CMOS RF Integrated Circuits", 2^{nd} Edition, Cambridge, 2004. 3. Hooman Darabi, "Radio Frequency integrated circuits and design", 2^{nd} Edition, Cambridge university press, 2020.
REFERENCES: 1. David M Pozar, "Microwave Engineering", 4^{th} Edition, John Wiley and Sons, 2011. 2. Jan Crols, Michiel Steyaert, "CMOS Wireless Transceiver Design", Reprint of 1^{st} Edition, Springer-Verlag New York Inc., 2010. 3. John M. W. Rogers, John W. M. Rogers, Calvin Plett, "Radio Frequency Integrated Circuit Design", 2^{nd} Edition, Arctech House, 2010.

21PEC02	**RF MEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES: • To explain the concept of MEMS technology. • To interpret the working principles of MEMS components. • To design the phase shifters and transmission lines using MEMS. • To demonstrate the characteristics of micro machined antennas. • To design RF MEMS using computer aided tools.					
UNIT I	**INTRODUCTION TO RF MEMS**				**9**
Introduction to RF MEMS: Application in wireless communications, space and defense applications, Benefits of Miniaturization and Scaling, RF MEMS in industry and academia, Actuation Mechanisms in MEMS: Piezoelectric, Electrostatic, Thermal, Magnetic					
UNIT II	**MEMS COMPONENTS**				**9**

MEMS Switch: Example of RF MEMS switches and applications, Mechanical design, Electromagnetic modeling (Capacitance, Loss, Isolation), Current research Tunable Capacitors and Inductors: Example of tunable capacitors and inductors and their applications in circuits, Effect of inductor layout, reduction of stray capacitance of planar inductor, Approaches for improving quality factor, Polymer based inductors, MEMS gap tuning, area tuning and dielectrictuning capacitors.		
UNIT III	**PHASE SHIFTERS AND TRANSMISSION LINES**	**9**
Types of phase shifters and their limitations, MEMS phase shifters: Switched delay line phase shifters, Distributed phase shifters, Polymer based phase shifters, Losses in transmission lines, Micro shield and membrane supported transmission lines – Radar applications.		
UNIT IV	**MICROMACHINED ANTENNAS**	**9**
Overview of microstrip antennas, Micromachining techniques to improve antenna performance, micro machined reconfigurable antennas, Micro fabrication Techniques: Materials Properties, Bulk and surface micromachining, Wet and dry etching Thin-film depositions (LPCVD, Sputtering, Evaporation), other techniques (LIGA, Electroplating)		
UNIT V	**PACKAGING & CAD DESIGN**	**9**
Packaging of RF MEMS: Role of MEMS packaging, Types of MEMS Packages, Reliability issues of MEMS packaging. Computer aided design of MEMS: Introduction to Commercial packages, Introduction and usage of Intellisuite and Coventorware, RF MEMS Switch simulation using Intellisuite, RF MEMS Phase shifter simulation.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Illustrate the concepts of RF MEMS mechanism.

CO2: Design RF MEMS switches and passive components.

CO3: Design RF phase shifters and transmission lines.

CO4: Design an intelligent control based micromachining for antenna design.

CO5: Analyze properties of RF MEMS using CAD tools for application specific designs.

TEXT BOOKS:

1. Tai- Ran Hsu, "MEMS and Microsystems Design and Manufacture", 1st Edition, Tata McGraw Hill, 2017.
2. Shiban Kishen Koul, Sukomal Dey, "Radio Frequency Micro machined Switches, Switching Networks, and Phase Shifters", CRC Press, 2019.
3. Vijay K.Varadan and K.J. Vinoy, K.A. Jose., "RF MEMS and their Applications", John Wiley and Sons, 2011

REFERENCES:

1. Nitaigour Mahalik, "MEMS", 1st Edition, Tata McGraw Hill, 2014.
2. Rai Chaoudhry, "MEMS and MOEMS Technology and Applications", 2nd Edition, PHI Learning, 2012.
3. G.K.Anantha Suresh, K.J.Vinoy, K.N.Bhatt and V.K.Aatre, "Micro and Smart Systems",1st Edition, John Wiley & Sons, 2010.

21PEC03	RF TEST AND MEASUREMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To gain knowledge about the basic principles of RF measurement.
- To learn about equipments used for measurements.
- To explain testing procedures for different RF devices.
- To analyze the performance of antenna.
- To study the basic principles EMI/EMC and Testing.

UNIT I	**INTRODUCTION**	**9**

RF Systems and components – Need for Characterization, evaluation and Certification. RF measurement, Measurement Parameters- S parameters and power.

UNIT II	**EQUIPMENT FOR MEASUREMENT**	**9**

Spectrum Analyzer- Principle, Measurement procedure, Network Analyzer- Principle, Measurement procedure, Calibration.

UNIT III	**RF DEVICE MEASUREMENT**	**9**

S parameters for Devices - transmission lines, coupler, filters, circulators, resonator, antenna etc. Measurement with Network Analyzer, Amplifier testing, gain, phase noise and Noise margin measurement, Power measurement.

UNIT IV	ANTENNA MEASUREMENT	9

Reflection coefficient, Return loss of different antennas, Measurement with Spectrum and Network Analyzer, Gain Measurement, Radiation pattern measurement in both Indoor and Anechoic chamber, Test ranges.

UNIT V	EMI/EMC MEASUREMENT	9

Open field test, TEM cell for immunity test , Shielded anechoic chamber , EMI test receivers - EMI test wave simulators - EMI coupling networks - Line impedance stabilization networks - Feed through capacitors- Some International Precautionary Exposure Guidelines, EMF Measurement System, RF Exposure Measurements & Testing, Mobile phone SAR Measurements

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the basics of RF measurement and related parameters.
CO2: Explain the measurement techniques and procedure.
CO3: Demonstrate the testing of RF components/systems and measurement of electromagnetic emission.
CO4: Analyze the performance of RF components and systems
CO5: Demonstrate the issues with EMI/EMC through RF testing.

TEXT BOOKS:

1. John D Krauss, Ronald J Marhefka and Ahmad S. Khan, "Antennas for all Applications", 2nd Edition, Tata McGraw-Hill, 2008.
2. David M.Pozar, " Microwave Engineering", 4th Edition, Wiley India, 2013.
3. Scott A. Wartenberg, "RF measurements of die and packages", Artech House, 2002.

REFERENCES:

1. V Prasad Kodali, "Engineering Electromagnetic Compatibility", 2nd Edition, IEEE Press, New York, 2001.
2. Clayton Paul, "Introduction to Electromagnetic Compatibility", 2nd Edition, Wiley Interscience, 2010.

3. Agilent's AppNote, "Fundamentals of RF and Microwave Power Measurement".

21PEC04	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of EMI and EMC.
- To outline the basic principles of coupling.
- To illustrate various EMI mitigation techniques.
- To summarize the comprehensive insight about the current EMC standards.
- To explain EMI test methods and equipments.

UNIT I	BASIC THEORY	9

Introduction to EMI and EMC- Intra and inter system EMI-Elements of Interference-Sources and Victims of EMI- Conducted and Radiated EMI emission and susceptibility- Radiation hazards to humans- Various issues of EMC- EMC Testing categories - EMC Engineering Application.

UNIT II	COUPLING MECHANISM	9

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radioactive coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT III	EMI MITIGATION TECHNIQUES	9

Shielding - Principle of Grounding, Isolated grounds, Grounding strategies for Large systems, Grounding for mixed signal systems – Filtering – EMI Suppression Cables – EMC connectors- EMC Gaskets – Isolation Transformers – Opto-Isolators - Transient and Surge Suppression devices.

UNIT IV	STANDARDS AND REGULATIONS	9

Need for Standards - Generic/General Standards for Residential and Industrial environment - Basic Standards - Product Standards - National and International EMI Standardizing Organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC - Electro Magnetic Emission and susceptibility standards and specifications, MIL461E Standards.

UNIT V	EMI TEST METHODS AND INSTRUMENTATION	9

Fundamental considerations - EMI Shielding effectiveness tests - Open field test, TEM cell for immunity test - Shielded anechoic chamber - EMI test receivers - EMI test wave simulators - EMI coupling networks - Line impedance stabilization networks -Feed through capacitors - Antennas- Current probes - MIL -STD test methods, Civilian STD test methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Infer the basic concepts of Electromagnetic Interference and Compatibility.

CO2: Utilize various EMI coupling principles to achieve compatibility.

CO3: Outline EMI mitigation techniques.

CO4: Summarize the EMC standards and regulations in measurement techniques.

CO5: Select EMI methods and equipments based on specific requirements.

TEXT BOOKS

1. V Prasad Kodali, "Engineering Electromagnetic Compatibility", 2nd Edition, IEEE Press, New York, 2001.
2. Henry W. Ott, "Electromagnetic Compatibility Engineering", 2nd Edition, John Wiley & Sons Inc, Newyork, 2009.
3. Xingcun Colin Tong, "Advanced Materials and Design for Electromagnetic Interference Shielding", CRC Press, 2008

REFERENCES:

1. Clayton Paul, "Introduction to Electromagnetic Compatibility", 2nd Edition, Wiley Interscience, 2010.
2. W Scott Bennett, "Control and Measurement of Unintentional Electromagnetic Radiation", 1st Edition, John Wiley & Sons Inc., (Wiley Interscience Series), 1997.
3. Dr Kenneth L Kaiser, "The Electromagnetic Compatibility Handbook", 1st Edition, CRC Press, 2005.

21PEC05	ELECTROMAGNETIC METAMATERIALS	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To explain the concepts of left handed materials.
- To design metamaterial transmission lines.
- To learn about the structure of metamaterials.
- To design metamaterial antennas.
- To interpret the applications of metamaterials.

UNIT I	LEFT HANDED MATERIALS AND THEIR PROPERTIES	12

Left-Handedness from Maxwell's equations, Entropy conditions in dispersive media, Boundary conditions, Reversal of Doppler effect, Reversal of Snell's law: Negative refraction, Reversal of Goos-Haenchen effect, Reversal of convergence and divergence in Convex and Concave lenses, Sub-wavelength diffraction, Fresnel coefficients.

UNIT II	METAMATERIAL TRANSMISSION LINES	12

Ideal homogeneous CRLH TLs- equivalent MTM constitutive parameters, Balanced and Unbalanced resonances, LC network implementation: Transmission matrix analysis, Input impedance, Cutoff frequencies, Analytical dispersion relation, Bloch impedance. Experimental transmission characteristics, Conversion from transmission line to constitutive parameters.

UNIT III	METAMATERIAL STRUCTURES AND ANALYSIS	12

Real distributed 1D CRLH structures: General design guidelines, Microstrip implementation, and parameters extraction, Two-dimensional MTMs: Eigen value problem, Negative Refractive Index (NRI) effects: Negative phase velocity, Negative refraction, Negative focusing, RH-LH interface surface plasmons. Distributed 2D structures.

UNIT IV	METAMATERIAL ANTENNAS	12

Fundamental aspects of Leaky-Wave structures, Principle of leakage radiation, Uniform and periodic Leaky-Wave structures, Uniform LW structures, Periodic LW structures, Metamaterial Leaky-Wave structures. Backfire-to End fire (BE) Leaky-Wave (LW) antenna, Electronically scanned BE LW antenna: Electronic scanning principle, Electronic beamwidth control principle, Two-Dimensional structures: Two Dimensional LW radiation, Conical-Beam antenna, Full-Space scanning antenna, Dual-Band CRLH-TL resonating ring antenna.

UNIT V	APPLICATION AND ADVANCES IN METAMATERIALS	12
Three-dimensional Isotropic LH MTMs, Optical MTMs, ‘Magnetless’ magnetic MTMs, Terahertz magnetic MTMs, Surface plasmonic MTMs, Antenna radomes and Frequency selective surfaces, Nonlinear MTMs, Active MTMs.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the properties of metamaterials.

CO2: Construct metamaterial transmission lines.

CO3: Design the metamaterial structures.

CO4: Demonstrate the metamaterial inspired antennas.

CO5: Select the metamaterials for advanced applications.

TEXT BOOKS:

1. Christophe Caloz and Tatsuo Itoh, “Electromagnetic Metamaterials: Transmission Line Theory and Microwave Applications”, 1st Edition, A John Wiley & Sons, Inc., Publication, 2006.
2. Tie Jun Cui, David Smith and Ruopeng Liu, “Metamaterials: Theory, Design, and Applications”, 1st Edition, Springer, 2009.
3. Kazuaki Sakoda, “Electromagnetic Metamaterials Modern Insights Into Macroscopic Electromagnetic Fields”, Springer, Singapore, 2019.

REFERENCES:

1. Douglas H. Werner and Do-Hoon K, “Transformation Electromagnetics and Metamaterials”, 1stEdition, Springer-Verlag London, 2014.
2. Fajun Xiao, Ivan Rukhlenko, Weiren Zhu, Xingzhan Wei, “Theory and Applications of Electromagnetic Metamaterials”, Frontiers Media SA, 2021.
3. Nader Engheta, Richard W. Ziolkowski, “Metamaterials: Physics and Engineering Explorations” Wiley, 2006.

21PEC06	MODERN ANTENNA DESIGN	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To gain knowledge on various types of printed antennas.
- To explain about wearable antennas.
- To gain the knowledge about active integrated antennas.
- To explain the reconfigurability function in antenna design.
- To explore the theory of metamaterials and metasurfaces.

UNIT I	PRINTED ANTENNAS	12

Concepts of Printed antennas, Broadband microstrip patch antennas, Circularly polarized planar antennas, Enhanced gain patch antennas, Wideband compact patch antennas, Microstrip slot antennas, Microstrip planar monopole antenna, Patch antennas for multiband applications.

UNIT II	WEARABLE ANTENNAS	12

Overview of wearable systems and its characteristics, Antennas for wearable devices, Design requirements, Modeling and Characterization of wearable antennas, WBAN radio channel characterization and Effect of wearable antennas, Domains of operation, Sources on the human body, Compact wearable antenna for healthcare sensors.

UNIT III	ACTIVE INTEGRATED ANTENNAS	12

Active wearable antenna modules-Features, Electromagnetic characterization of fabrics and Flexible foam materials, Matrix-Pencil two-line method, Small-Band inverse planar antenna Resonator method. Substrate integrated waveguide technology.

UNIT IV	RECONFIGURABLE ANTENNAS	12

Reconfigurable methodologies: Frequency and Pattern Reconfigurabilities, Design considerations for reconfigurable systems, Reconfigurable planar/printed antenna configurations, Active reconfigurable systems.

UNIT V	METAMATERIALS AND METASURFACES	12

Double negative properties, Structures, Design of metamaterial antennas, Multi-surface - Metasurface antennas, Metahorns, Metalenses, Analysis of metasurfaces.

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to CO1: Evaluate the performance of different printed antennas. CO2: Analyze the properties of wearable antennas. CO3: Apply EM characterization to active integrated antennas. CO4: Design reconfigurable antennas. CO5: Develop metamaterials and metasurfaces.
TEXT BOOKS: 1. Debatosh Guha and Yahia M.M. Antar, "Microstrip and Printed Antennas", 1st Edition, John Wiley & Sons, 2011. 2. Taming the Borg, "Moving Wearables into the Mainstream", 1st Edition, Springer, 2008. 3. Hubregt.J.Visser "Antenna Theory and Applications" 1st Edition, John Wiley & Sons Ltd,Newyork, 2012.
REFERENCES: 1. Eng Hock Lim and Kwok Wa Leung, "Compact Multifunctional Antennas for Wireless Systems", 2nd Edition, John Wiley & Sons, 2012. 2. Zhi Ning Chen, "Antennas for Portable Devices", 3rd Edition, John Wiley & Sons, 2007. 3. Warren L Stutzman and Gary A.Thiele, "Antenna Theory and Design", 3rd Edition, John Wiley & Sons, 2013.

21PEC07	**SIGNAL INTEGRITY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To acquire knowledge on fundamentals of electromagnetic for signal integrity, its importance for high speed applications.
- To know the factors that affect signal integrity.
- To explain the characteristics of dielectric materials.
- To learn about differential signaling and modeling of transmission lines for high speed devices.
- To illustrate physical transmission line model.

UNIT I	FUNDAMENTALS OF SIGNAL INTEGRITY	9
The importance of signal integrity - new realm of bus design - Electromagnetic fundamentals for signal integrity - Maxwell equations common vector operators - wave propagations - Electrostatics – magnetostatics - Power flow and the poynting vector - Reflections of electromagnetic waves.		
UNIT II	**CROSS TALK**	**9**
Introduction - mutual inductance and capacitance-coupled wave equation - coupled line analysis – modal analysis - cross talk minimization signal propagation in unbounded conductive media - classic conductor model for transmission model.		
UNIT III	**DI-ELECTRIC MATERIALS**	**9**
Polarization of Dielectric - Classification of Dielectric material - frequency dependent dielectric material - Classification of Dielectric material fiber - Weave effect - Environmental variation in dielectric behavior - Transmission line parameters for loose dielectric and realistic conductors.		
UNIT IV	**DIFFERENTIAL SIGNALING**	**9**
Removal of common mode noise - Differential Cross talk - Virtual reference plane-Propagation of model voltages common terminology - drawbacks of differential signaling.		
UNIT V	**PHYSICAL TRANSMISSION LINE MODEL**	**9**
Introduction - non ideal return paths - Vias - IO design consideration - Push-pull transmitter – CMOS receivers - ESSD protection circuits - On chip Termination.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Outline the concept of signal integrity using electromagnetic theory, vector functions

CO2: Illustrate crosstalk that affects the integration.

CO3: Explain the properties of dielectric materials

CO4: Analyze differential signaling

CO5: Demonstrate a physical model for transmission lines

TEXT BOOKS: 1. Stephen H. Hall, Howard L. Heck, "Advanced Signal Integrity for High-Speed Digital Designs", Wiley IEEE Press, 2009. 2. James Edgar Buchanan, "Signal and power integrity in digital systems: TTL, CMOS, and BiCMOS ", Mc Graw Hill,1996. 3. Stephen C. Thierauf, "Understanding Signal Integrity", Pages displayed by permission Artech Publishing House, 2011.
REFERENCES: 1. Greg Edlund, "Timing Analysis and Simulation for Signal Integrity Engineers", Prentice Hall of India, 2008. 2. Eric Bogatin, "Signal and Power Integrity - Simplified", 2nd Edition, Prentice Hall of India, 2010. 3. Mike Peng Li, "Jitter, Noise and Signal Integrity at High-Speed", Prentice Hall of India, 2008.

VERTICAL II

SIGNAL AND IMAGE PROCESSING

21PEC08	**STOCHASTIC SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

COURSE OBJECTIVES:

- To explain the concepts of discrete random signal processing.
- To illustrate the various parametric and non-parametric spectrum estimation methods.
- To summarize the concepts behind linear estimation and prediction techniques.
- To gain knowledge about FIR adaptive filtering techniques.
- To summarize the multirate digital signal processing techniques.

UNIT I	**DISCRETE RANDOM SIGNAL PROCESSING**	**12**

Discrete Random Processes- Ensemble Averages, Stationary processes, Bias and Estimation, Autocovariance, Autocorrelation, Parseval’s theorem, Wiener-Khintchine relation, White

noise, Power Spectral Density, Spectral factorization, Filtering Random Processes, Special types of Random Processes – ARMA, AR, MA – Yule-Walker equations.		
UNIT II	**SPECTRAL ESTIMATION**	**12**
Estimation of spectra from finite duration signals, Nonparametric methods -Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods – ARMA, AR and MA model based spectral estimation, Solution using Levinson-Durbin algorithm.		
UNIT III	**LINEAR ESTIMATION AND PREDICTION**	**12**
Linear prediction – Forward and Backward prediction, Solution of Prony's normal equations, Least mean-squared error criterion, Wiener filter for filtering and prediction, FIR and IIR Wiener filters, Discrete Kalman filter		
UNIT IV	**ADAPTIVE FILTERS**	**12**
FIR adaptive filters – adaptive filter based on steepest descent method- Widrow-Hopf LMS algorithm, Normalized LMS algorithm, Adaptive channel equalization, Adaptive echo cancellation, Adaptive noise cancellation, RLS adaptive algorithm.		
UNIT V	**MULTIRATE DIGITAL SIGNAL PROCESSING**	**12**
Mathematical description of change of sampling rate – Interpolation and Decimation, Decimation by an integer factor, Interpolation by an integer factor, Sampling rate conversion by a rational factor, Polyphase filter structures, Multistage implementation of multirate system, Application to subband coding – Wavelet transform.		
TOTAL : 60 PERIODS		

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Explain the fundamental concepts of discrete random signal processing.

CO2: Apply various parametric and non parametric techniques to estimate the spectrum.

CO3: Develop algorithms for linear estimation and prediction techniques for processing signals.

CO4: Outline the various adaptive filtering techniques.

CO5: Summarize the working principles of multirate digital signal processing.

TEXT BOOKS:

1. Monson H. Hayes, "Statistical Digital Signal Processing and Modeling", 2nd Edition,

John Wiley and Sons, Inc, Singapore, 2002

2. John J. Proakis, Dimitris G. Manolakis, "Digital Signal Processing", 4th Edition, Pearson Education, 2002
3. Mitra, Sanjit Kumar, and Yonghong Kuo. Digital signal processing: A Computer-based Approach, Vol. 2, McGraw-Hill Higher Education, 2006

REFERENCES:

1. D.E. Dudgeon and RM. Mersereau, "Multidimensional Digital Signal Processing", 2nd Edition, Prentice Hall Professional Technical Reference, 2008.
2. C.Sidney Burrus, Ramesh Gopinath and Haito Guo, "Introduction to Wavelets and Wavelet Transform", 16th Edition, Prentice Hall, 2018.
3. Lawrence R.Rabiner and Bernard Gold, "Theory and Application of Digital Signal Processing" 1st Edition, Prentice-Hal, 2007

21PEC09	DIGITAL IMAGE PROCESSING	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To illustrate digital image fundamentals.
- To explore various image enhancement techniques in spatial and frequency domains.
- To summarize the concepts of degradation function, restoration techniques and segmentation algorithms.
- To explain different image compression techniques.
- To outline image representation and recognition methods.

UNIT I	FUNDAMENTALS OF DIGITAL IMAGE	12

Fundamentals of Image processing: Elements of digital image processing systems, Elements of visual perception, Image sampling and quantization, Basic Relationships between pixels, Color image fundamentals - RGB, HSI models. Image Transforms: DFT, DCT.

UNIT II	IMAGE ENHANCEMENT	12

Spatial domain: Histogram processing, Equalization, Basics of spatial filtering, smoothing spatial filters, Sharpening spatial filters.

Frequency Domain: Image smoothing and sharpening using frequency domain filters.		
UNIT III	**IMAGE RESTORATION AND SEGMENTATION**	**12**
Image Restoration: Degradation model. Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters– Inverse Filtering – Wiener filtering. Image Segmentation: Detection of discontinuities-Edge linking and boundary detection-Thresholding – Optimal thresholding-Region based segmentation-Region growing-Region splitting and merging.		
UNIT IV	**IMAGE COMPRESSION**	**12**
Image Compression Model, Huffman coding, Arithmetic coding, LZW coding, Run Length coding, Lossless and Lossy predictive coding, transform coding, JPEG and MPEG compression standards.		
UNIT V	**IMAGE REPRESENTATION AND RECOGNITION**	**12**
Boundary representation – Chain Code – Polygonal approximation, signature, boundary segments –Boundary description – Shape number – Fourier Descriptor, moments- Regional Descriptors –Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.		
TOTAL : 60 PERIODS		

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Relate the fundamental concepts of digital image processing.

CO2: Illustrate the image enhancement techniques in spatial and frequency domains.

CO3: Apply the concepts of restoration and segmentation algorithms on images.

CO4: Select appropriate image compression techniques for various applications.

CO5: Summarize different image representation techniques and recognition methods.

TEXT BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, “Digital Image Processing”, 4th Edition, Pearson Ed., 2018.
2. Anil Jain K. “Fundamentals of Digital Image Processing”, 3rd Edition, PHI Learning, 2011.
3. William K. Pratt, “Digital Image Processing”, 2nd Edition, John Wiley, New York, 2002.

REFERENCES:

1. Kenneth R. Castleman, “Digital Image Processing”, Pearson, 2006.
2. Rafael C. Gonzalez and Richard E. Woods, Steven Eddins, “Digital Image Processing using MATLAB”, 6th Edition, Pearson Education, Inc., 2011.
3. Milan Sonka et al “Image processing, analysis and machine vision”, 2nd Edition, Brookes Cole, Vikas Publishing House, 1999.

21PEC10	SPEECH PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the speech production mechanism and the various speech analysis techniques and speech models.
- To interpret the speech compression techniques.
- To comprehend the speech recognition techniques.
- To know the speaker recognition techniques.
- To understand the text to speech synthesis techniques.

UNIT I	SPEECH SIGNAL CHARACTERISTICS & ANALYSIS	9

Speech production process - speech sounds and features- Phonetic Representation of Speech – representing, speech in time and frequency domains - Short-Time Analysis of Speech – Short Time Energy and Zero-Crossing Rate - Short-Time Autocorrelation Function - Short-Time Fourier Transform (STFT) - Speech Spectrum - Cepstrum - Mel-Frequency Cepstrum Coefficients - Hearing and Auditory Perception - Perception of Loudness - Critical Bands - Pitch Perception

UNIT II	SPEECH COMPRESSION	9

Sampling and Quantization of Speech (PCM) - Adaptive differential PCM - Delta Modulation - Vector Quantization- Linear predictive coding (LPC) - Code excited Linear predictive Coding (CELP)

UNIT III	SPEECH RECOGNITION	9

LPC for speech recognition- Hidden Markov Model (HMM)- training procedure for HMM-subword unit model based on HMM- language models for large vocabulary speech recognition - Overall recognition system based on subword units - Context dependent subword units-Semantic post processor for speech recognition

UNIT IV	**SPEAKER RECOGNITION**	**9**

Acoustic parameters for speaker verification- Feature space for speaker recognition-similarity measures- Text dependent speaker verification-Text independent speaker verification techniques

UNIT V	**TEXT TO SPEECH SYNTHESIS**	**9**

Text to speech synthesis(TTS)-Concatenative and waveform synthesis methods, sub-word units for TTS, intelligibility and naturalness-role of prosody

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Interpret Speech Characteristics and Speech Analysis Techniques.

CO2: Demonstrate Speech Compression techniques.

CO3: Analyze speech recognition techniques.

CO4: Outline the speaker recognition systems.

CO5: Explain the text to speech synthesis systems.

TEXT BOOKS:

1. L. R. Rabiner and R. W. Schafer, "Introduction to Digital Signal Processing, Foundations and Trends in Signal Processing", Vol.1, Nos. 1-2 (2007) 1- 194.
2. Ben Gold and Nelson Morgan "Speech and Audio signal processing- processing and perception of speech and music", 2nd Edition, John Wiley and Sons, 2011.
3. Sadaoki Furui, Digital Speech Processing, Synthesis And Recognition, 2nd Edition, CRC Press, 2018

REFERENCES:

1. Dan, Jurafsky, James H . Martin, "Speech And Language Processing- An Introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", 2nd Edition, Pearson Prentice Hall, 2009.
2. Joseph Mariani, "Language and Speech Processing", 1st Edition, Wiley, 2009.
3. Donglos O Shanhnessy "Speech Communication: Human and Machine", 2nd Edition, University Press 2001.

21PEC11	SOFTWARE DEFINED RADIO	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline radio frequency standards.
- To implement different types of RF systems.
- To demonstrate multi rate signal processing and digital generation of signals.
- To gain knowledge about data converters and smart antennas.
- To infer digital hardware and software choices.

UNIT I	INTRODUCTION TO SDR	9

Introduction to software Radio concepts: Need for software Radios, Definition of software Radio, Characteristics and Benefits. Design Principles. Case studies: SPEAK easy, JTRS, SDR-3000.

UNIT II	IMPLEMENTATION OF RADIO FREQUENCY SYSTEMS	9

The purpose of the RF Front End, Dynamic Range, RF receivers front end Topologies, Importance of the components to Overall performance, Transmitter Architecture, Noise and Distortion in the RF Chain, ADC and DAC Distortion, Flexible RF systems using MEMS.

UNIT III	MULTIRATE SIGNAL PROCESSING AND DIGITAL GENERATION OF SIGNALS	9

Sample rate conversion principles. Digital filter Banks. Timing recovery in Digital Receivers using Multi rate Digital filters. Approaches to Direct Digital Synthesis. Analysis of spurious signal Band pass signal generation, Generation of Random sequences.

UNIT IV	DATA CONVERTERS AND SMART ANTENNAS	9
Parameters of Ideal and practical Data Converters, Techniques to Improve Data Converter performance, Common ADC and DAC Architectures. Smart Antennas- Hardware implementation of Smart Antennas.		
UNIT V	**DIGITAL HARDWARE AND SOFTWARE CHOICES**	**9**
DSP Processors, FPGA, ASIC. Tradeoffs, Object oriented programming, Object Brokers, GNU Radio-USRP.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Interpret Software radio concepts and case studies.

CO2: Illustrate the implementation of RF systems.

CO3: Infer the multirate signal processing concept.

CO4: Explain the data converters and smart antennas.

CO5: Summarize the choices of digital hardware and software.

TEXT BOOKS:

1. Jeffrey H.Reed, "Software Radio: A Modern Approach to Radio Engineering", 1st Edition, Prentice Hall, 2002.
2. Joseph Mitola III, "Software Radio Architecture: Object oriented Approaches to Wireless System Engineering", 1st Edition, Wiley-Inter Science, 2004.
3. Walter H.W. Tuttlebee, Software Defined Radio - Enabling Technologies, 1st Edition, Wiley, 2002

REFERENCES:

1. Walter H.W.Tuttlebee, "Software Defined Radio-Enabling Technologies, 1st Edition, Wiley, 2002.
2. S.Shanmugavel, M.A.Bhagyaveni and R.Kalidoss, "Cognitive Radio-An Enabler for Internet of things", 1st Edition, River Publishers, 2017.
3. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, Software Defined Radio: Architectures, Systems and Functions, 1st Edition, Wiley, 2002.

21PEC12	DSP ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the basics of programmable DSPs.
- To illustrate the concepts of TMS320C5X.
- To know the basics of TMS320C6X digital signal processors.
- To provide in depth knowledge in ADSP processors.
- To understand the concepts of advanced processors.

UNIT I	FUNDAMENTALS OF PROGRAMMABLE DSPs	9

Multiplier and Multiplier accumulator – Modified Bus Structures and Memory access in PDSPs – Multiple access memory – Multi-port memory – VLIW architecture- Pipelining – Special Addressing modes in P-DSPs – On chip Peripherals, Speed Issues, Features for External interfacing.

UNIT II	TMS320C5X PROCESSOR	9

Architecture – Assembly language syntax - Addressing modes – Assembly language Instructions - Pipeline structure, Operation – Block Diagram of DSP starter kit – Application Programs for processing real time signals.

UNIT III	TMS320C6X PROCESSOR	9

Architecture of the C6x Processor - Instruction Set - DSP Development System: Introduction – DSP Starter Kit Support Tools- Code Composer Studio - Support Files - Programming Examples to Test the DSK Tools – Application Programs for processing real time signals.

UNIT IV	ADSP PROCESSORS	9

Architecture of ADSP-21XX and ADSP-210XX series of DSP processors- Addressing modes and assembly language instructions – Application programs –Filter design, FFT calculation.

UNIT V	ADVANCED PROCESSORS	9

Architecture of TMS320C54X: Pipe line operation, Code Composer studio – Architecture of TMS320C6X - Architecture of Motorola DSP563XX – Comparison of the features of DSP family processors.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Illustrate the basic architecture and programming concepts of DSP processor.

CO2: Develop assembly language coding in TMS 320C5X.

CO3: Develop ALP in TMS 320C6X processors.

CO4: Apply DSP algorithms using ADSP processors.

CO5: Analyze the features of various advanced processors.

TEXT BOOKS:

1. B.Venkataramani and M.Bhaskar, "Digital Signal Processors – Architecture, Programming and Applications", 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.
2. Avtar Singh and S. Srinivasan, "Digital Signal Processing – Implementations using DSP Microprocessors with Examples from TMS320C54xx", 1st Edition, Cengage Learning India Private Limited, Delhi 2012.
3. Lapsley et al., "DSP Processor Fundamentals, Architectures & Features", 1st Edition, S. Chand & Co, 2000.

REFERENCES:

1. Rulph Chassaing, "Digital Signal Processing and Applications with the C6713 and C6416 DSK", 1st Edition, A John Wiley & Sons, Inc., Publication, 2005.
2. J.G. Proakis & D.G.Manolokis, "Digital Signal Processing – Principles, Algorithms Applications", 3rd Edition, PHI, 2005.
3. User guides Texas Instruments, Analog Devices and NXP.

21PEC13	WAVELETS AND MULTI RESOLUTION TRANSFORMS	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To outline the fundamental concepts of wavelet transforms.

- To explain multi resolution concepts.
- To demonstrate the wavelet system design.
- To be familiar with the different wavelet families and applications.
- To interpret the applications of various wavelets.

UNIT I	INTRODUCTION TO WAVELETS	12

Introduction to multi-rate signal processing- Decimation and Interpolation, Quadrature mirror filters, Sub-band coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous wavelet transform, Time frequency representation, Wavelet system and its characteristics, Orthogonal & Orthonormal functions and function space.

UNIT II	MULTI RESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM	12

Multi resolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks-Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

UNIT III	WAVELET SYSTEM DESIGN	12

Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

UNIT IV	WAVELET FAMILIES	12

Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets- Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.

UNIT V	APPLICATIONS OF WAVELETS	12

Denoising of Signals and Images, Image enhancement, Edge detection, Image fusion, Image compression, Wavelet based feature extraction.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the relation between vector and signal concepts.

CO2: Outline multi resolution processes.

CO3: Analyze the wavelet systems.

CO4: Examine various continuous and discrete wavelet transforms.

CO5: Select the wavelets for specific applications.

TEXT BOOKS:

1. Raguveer M Rao and Ajith S. Bopardikar, "Wavelet transforms – Introduction to theory and applications", 6th Edition, Addison Wesley, 2012
2. K.P.Soman and KL Ramachandran, "Insight into wavelets from theory to practice", 20th Edition, PHI, 2008
3. C.Sidney Burrus, Ramesh Gopinath and Haito Guo, "Introduction to Wavelets and Wavelet Transform", 16th Edition, Prentice Hall, 2018

REFERENCES:

1. G.Strang and T.Nguyen, "Wavelet and filter banks" 1st Edition, Wesley and Cambridge Press, 2008.
2. P.P.Vaidyanathan, "Multi-rate systems and filter banks", 8th Edition, Prentice Hall 1993
3. S.Mallet, "A Wavelet tour of Signal Processing", 1st Edition, Academic Press 1998

21PEC14	MULTIMEDIA COMPRESSION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the basic ideas of compression algorithms related to multimedia components such as text, speech, audio, image and video.
- To know about the principles and standards in text compression.
- To infer the use of image compression in multimedia processing applications.
- To explain the concept of audio compression.
- To explore the video compression and its applications.

UNIT I	FUNDAMENTALS OF COMPRESSION	9

Introduction to multimedia – Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression – Taxonomy of compression algorithms - Elements of information theory –

Error free compression – Lossy compression.		
UNIT II	**TEXT COMPRESSION**	**9**
Huffman coding – Adaptive Huffman coding - Arithmetic coding – Shannon-Fano coding Dictionary techniques – LZW family algorithms.		
UNIT III	**IMAGE COMPRESSION**	**9**
Image compression: Fundamentals – Compression standards – JPEG standard – Sub-band coding – Wavelet based compression – Implementation using Filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG and JBIG2 standards.		
UNIT IV	**AUDIO COMPRESSION**	**9**
Audio compression techniques – μ law, A-Law companding – Frequency domain and filtering – Basic sub-band coding – Applications to speech coding – G.722 – MPEG audio – Progressive encoding – Silence compression, Speech compression – Formant and CELP vocoders.		
UNIT V	**VIDEO COMPRESSION**	**9**
Video compression techniques and standards – MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-3 and MPEG-4 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – DVI real time compression – Current trends in compression standards.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the requirement of compression in different real time applications.

CO2: Select relevant techniques for text compression.

CO3: Experiment with various image compression algorithms.

CO4: Compare the performance of audio compression techniques.

CO5: Illustrate the different standards applicable for video compression.

TEXT BOOKS:

1. David Solomon, "Data Compression – The Complete Reference", 4^{th}Edition, Springer Verlog, New York, 2006.
2. Darrel Hankerson, Greg A Harris and Peter D Johnson, "Introduction to Information

Theory and Data Compression", 2nd Edition, Chapman and Hall, CRC Press, 2003. 3. Khalid Sayood, "Introduction to Data Compression", Morgan Kauffman Harcourt India, 3rd Edition, 2010.
REFERENCES: 1. Mark S. Drew and Ze-Nian Li, "Fundamentals of Multimedia", 1st Edition, PHI, 2009. 2. Peter Symes, "Digital Video Compression", 1st Edition, McGraw Hill Publishers, 2004. 3. Yun Q.Shi and Huifang Sun, "Image and Video Compression for Multimedia Engineering, Algorithms and Fundamentals", CRC Press, 2003.

VERTICAL III

BIO MEDICAL TECHNOLOGIES

21PEC15	**WEARABLE DEVICES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES: • To outline the real time applications and scope of wearable technology. • To explain the usage of fabrics in wearable devices. • To interpret the communication in wearable systems. • To design remote and rehabilitation systems. • To demonstrate the applications of smart textiles.					
UNIT I	**INTRODUCTION TO WEARABLE DEVICES**				**9**
Role of Wearables, Attributes of Wearables, The Meta Wearables – Textiles and clothing, Social Aspects: Interpretation of Aesthetics, Adoption of Innovation, On-Body Interaction; Case Study: Google Glass, health monitoring, Wearables: Challenges and Opportunities, Future and Research Roadmap.					
UNIT II	**SMART FABRICS**				**9**

Introduction, Sensing fabrics, Actuating fabrics, smart fabric applications – Health care, motion capture and kinaesthetic interfaces, Conductive textiles, Performance of electrically conductive fabrics, smart textiles – Manufacturing and applications.		
UNIT III	**WEARABLE COMPUTING SYSTEMS**	**9**
Electronic textiles- Significance, Electrical characterization of textile networks, Smart clothing concept, model, Data transfer in smart clothing, Implementations for communication, dematerialization of information, Technology enablers.		
UNIT IV	**KNITTED ELECTRONIC TEXTILES**	**9**
Fibers to Textile Sensors, Interlaced Network, Physiological State Monitoring, Biomechanical Sensing, Platforms for Remote Monitoring, System for Remote Rehabilitation, Emotional State Assessment, Woven Electronic Textiles – applications.		
UNIT V	**SMART TEXTILE SUIT**	**9**
Principle of capture system – optical motion, Inertial motion, Textile Goniometer, Modality of measurement, applications – Rehabilitation: Stroke patient monitoring, Multisensorial Platform for Ambient and Assistance Living, Future prospects.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Illustrate the need and design requirements for wearable systems.

CO2: Interpret the significance of smart fabric technology.

CO3: Demonstrate wearable computing systems.

CO4: Summarize the existing technology through demonstrations.

CO5: Design the smart fabric wearable systems for real time applications.

TEXT BOOKS:

1. Subhas C. Mukhopadhyay, "Wearable Electronics Sensors-For Safe and Healthy Living", 1st Edition, Springer International Publishing, 2015.
2. Edward Sazonov, Michael R Neuman, "Wearable Sensors: Fundamentals, Implementation and Applications", 1st Edition, Elsevier, 2014.
3. Mehmet R. Yuce, Jamil Y. Khan, "Wireless Body Area Networks Technology, Implementation and Applications", Pan Stanford Publishing Pvt. Ltd, Singapore, 2012.

REFERENCES:

1. Xiaoming Tao, “Wearable electronics and photonics”, Woodhead Publishing Ltd and CRC Press LLC, 2016.
2. “Seamless Healthcare Monitoring Advancements in Wearable, Attachable, and Invisible Devices”, Springer, 2018.
3. Andreas Lymberis, Danilo de Rossi , “Wearable eHealth systems for Personalized Health Management - State of the art and future challenges” IOS press, The Netherlands, 2004.

21PEC16	HUMAN ASSIST DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the various mechanical techniques that will help in assisting the heart functions.
- To explain the working principles and parameters of the dialysis unit.
- To outline the different types of hearing aids.
- To infer various orthotic devices and prosthetic devices to overcome orthopedic problems.
- To discuss the sensory impairments and its substitutions.

UNIT I	CARDIAC ASSIST DEVICES	9

Principle of External counter pulsation techniques, intra-aortic balloon pump, Cardiac catheterization, cardio pulmonary resuscitation, prosthetic heart valves

UNIT II	HEMODIALYSERS	9

Artificial kidney, Dialysis action, hemodialysis unit, membrane dialysis, portable dialyzer monitoring and functional parameters

UNIT III	HEARING AIDS	9

Common tests – audiograms, air conduction, bone conduction, masking techniques, SISI, Hearing aids – principles, drawbacks in the conventional unit, DSP based hearing aids.

UNIT IV	PROSTHETIC AND ORTHOTIC DEVICES	9

Hand and arm replacement – different types of models, externally powered limb prosthesis, feedback in orthotic system, functional electrical stimulation, sensory assist devices

UNIT V	SENSORY AUGUMENTATION AND SUBSTITUTIONS	9

Classification of visual impairments, Prevention and cure of visual impairments, Visual augmentation, Tactile vision Substitution, Auditory substitution and augmentation, Assistive device for visual impaired.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Interpret various mechanical techniques that will help in assisting the heart functions.

CO2: Demonstrate the working principles and parameters of the dialysis unit.

CO3: Illustrate the characteristics of hearing aids.

CO4: Infer the various orthotic devices and prosthetic devices to overcome orthopedic problems.

CO5: Summarize the sensory impairments and its substitutions.

TEXT BOOKS:

1. John G.Webster " Encyclopedia of medical devices and instrumentation" Vol.II, III, IV,V, 3rd Edition, Wiley Interscience, 2006.
2. D.S. Sunder, "Rehabilitation Medicine", 3rd Edition, Jaypee Medical Publication, 2010.
3. R Chinnathurai ,"Short Textbook of Prosthetics and Orthotics", Jaypee Brothers Medical Publishers (P) Ltd, 2010.

REFERENCES:

1. Paul A. Iaizzo "Hand book of cardiac Anatomy, Physiology and Devices" 2nd Edition, Springer, 2012.
2. Jeffrey H. Shuhaiber, "Ventricular assist devices", 1st Edition, Intech publications, 2014.
3. R.S. Khandpur, "Handbook of Biomedical Instrumentation", 2nd Edition ,Tata McGraw Hill, 2003.

21PEC17	THERAPEUTIC EQUIPMENTS	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To outline the devices for measurement of cardiology.
- To illustrate the recording and measurement of EEG.
- To demonstrate EMG recording unit and Biomechanical measurement.
- To explain laser-based bio-medical diagnostic equipments.
- To explore the concepts of sensory measurements.

UNIT I	CARDIAC EQUIPMENTS	9

Electrocardiograph, Normal and Abnormal Waves, Heart rate monitor, Holter Monitor, Phonocardiography, ECG machine maintenance and troubleshooting, Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter.

UNIT II	NEUROLOGICAL EQUIPMENTS	9

Clinical significance of EEG, Multi-channel EEG recording system, Epilepsy, Evoked Potential– Visual, Auditory and Somato sensory, MEG (Magneto Encephalo Graph). EEG Bio Feedback Instrumentation. EEG system maintenance and troubleshooting.

UNIT III	MUSCULAR AND BIOMECHANICAL MEASUREMENTS	9

Recording and analysis of EMG waveforms, fatigue characteristics, Muscle stimulators, nerve stimulators, Nerve conduction velocity measurement, EMG Bio Feedback Instrumentation. Static Measurement – Load Cell, Pedobarograph. Dynamic Measurement – Velocity, Acceleration, GAIT, Limb position

UNIT IV	LASER BASED BIO-MEDICAL EQUIPMENTS	9

Lasers in Medicine – Types, Tissue reactions. Lasers in ophthalmology, Flow Cytometry, Endoscopy, Minimally Invasive Laparoscopy, Laser Micro irradiation, Laser Doppler Velocimetry, Neurosurgical Laser Techniques. IR and UV lamp – application

UNIT V	SENSORY MEASUREMENT	9

Psycho physiological Measurements – polygraph, Basal Skin Resistance (BSR), Galvanic Skin Resistance (GSR), Sensory responses - Audiometer-Pure tone, Speech, Eye Tonometer, Applanation Tonometer, slit lamp, auto refractometer.

	TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Outline the working and recording setup of basic cardiac equipment.

CO2: Infer the working and recording of basic neurological equipment.

CO3: Illustrate the recording of diagnostic and therapeutic equipment's related to EMG.

CO4: Explain laser based diagnostic equipment in medical.

CO5: Demonstrate the measurement techniques of sensory responses.

TEXT BOOKS:

1. Leslie Cromwell, Fred J.Weibell and Erich A.Pfeiffer, "Biomedical Instrumentation and Measurements", 2nd Edition, Pearson Education India, 2015.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", 3rd Edition, Tata McGraw Hill, New Delhi, 2014.
3. John G.Webster, "Medical Instrumentation Application and Design", 4th Edition, John Wiley and Sons, New York, 2009.

REFERENCES:

1. Myer Kutz, "Biomedical Engineering & Design Handbook: Volume 2", 2nd Edition, McGraw- Hill Publisher, 2009.
2. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd Edition, John Wiley and Sons, Reprint 2008.
3. Antony Y.K.Chan, "Biomedical Device technology, Principles and design", Charles Thomas Publisher Ltd, Illinois, USA, 2008.
4. Joseph J. Carr and John M. Brown, "Introduction to Biomedical equipment technology", 4th Edition, Pearson Education, 2014.

21PEC18	MEDICAL IMAGING SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the principles of radiographic equipments.
- To demonstrate the types of CT imaging techniques.

- To summarize the different types of Radio Isotopic Imaging techniques.
- To know the principles of Ultra Sound Imaging systems.
- To gain knowledge about MRI systems.

UNIT I	**PRINCIPLES OF RADIO GRAPHIC EQUIPMENT**	**9**
X-Ray tubes, cooling systems, removal of scatters, Fluoroscopy construction of image Intensifier tubes, angiographic setup, mammography, digital radiography, DSA.		
UNIT II	**COMPUTED TOMOGRAPHY**	**9**
Need for sectional images, Principles of sectional scanning, Generation in CT, CT detectors, Methods of Reconstruction-Iterative, Back projection, convolution and Back-Projection and central slice theorem, Artifacts, Principle of 3D imaging		
UNIT III	**RADIO ISOTOPIC IMAGING**	**9**
Alpha, Beta and Gamma radiation, Radiation detectors, Radio isotopic imaging equipment, Radio nuclides for imaging, Gamma camera, scanners, Positron Emission tomography, SPECT, PET/CT.		
UNIT IV	**ULTRA SOUND IMAGING SYSTEMS**	**9**
Wave propagation and interaction in Biological tissues, Acoustic radiation fields, continuous and pulse dexcitation, Transducers and imaging systems, Scanning methods, Imaging Modes, Principle and theory of image generation, Applications. Doppler Ultrasound, Ultrasound Image Quality and Artifacts.		
UNIT V	**MAGNETIC RESONANCE IMAGING**	**9**
NMR, Principle of MRI, Relaxation processes and their measurements, Pulse sequencing and MR image acquisition, MRI Instrumentation, MR Artifacts, Magnetic Resonance Spectroscopy and Functional MRI Case Study.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Discuss the principle and working of various radiographic equipments.

CO2: Explain the tomography concept and image reconstruction techniques.

CO3: Illustrate the concept of radio isotopic imaging techniques.

CO4: Describe the basic principle involved in Ultrasound Imaging technique.

CO5: Outline the basic principle and working of Magnetic resonance imaging technique.

TEXT BOOKS:

1. Jerrold T.Bushberg, J.Anthony Seibert, Edwin M.Leidholdt, John M.Boone, The Essential Physics of Medical Imaging, Lippincott Williams and Wilkins; Fourth Edition,2020.
2. D.N.Chesneyand M.O.Chesney, Radiographic imaging, CBS Publications, 4th Edition, 2021.
3. Andreas Maier, Joachim Hornegger, Stefan Steid, Vincent Christlein, "Medical Imaging Systems-An Introductory Guide", Springer International Publishing, 2018.

REFERENCES:

1. Donald W.McRobbice, Elizabeth A.Moore, Martin J.Graveand Martin R.Prince, MRI from picture to proton, 3rd Edition, Cambridge University press, NewYork, 2017.
2. Steve Webb, The Physics of Medical Imaging, Taylor& Francis, NewYork, 2nd edition 2008.
3. Jerry L.Prince and Jonathan M.Links, Medical Imaging Signals and Systems-Pearson Education Inc, 2014.

21PEC19	**HUMAN COMPUTER INTERFACE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES :

- To learn the basic concepts of HCI.
- To explain the basics of screen design.
- To gain knowledge about the components of window.
- To explore the evaluation techniques of the software.

• To know the various models of HCI.		
UNIT I	**INTRODUCTION TO HCI**	**9**
Introduction: Importance of user Interface – definition, importance of good design. Benefits of gooddesign. A brief history of Screen design.The graphical user interface – popularity of graphics, the concept of direct manipulation, graphicalsystem, Characteristics, Web user – Interface popularity, characteristics- Principles of user interface.		
UNIT II	**SCREEN DESIGNING**	**9**
Design process – Human interaction with computers, importance of human characteristics humanconsideration, Human interaction speeds- business junctions.Screen Designing: Design goals – Screen planning and purpose, organizing screen elements, orderingof screen data and content – screen navigation and flow – Visually pleasing composition – amount ofinformation – focus and emphasis – presentation information simply and meaningfully – informationretrieval on web – statistical graphics – Technological consideration in interface design.		
UNIT III	**COMPONENTS**	**9**
Windows – New and Navigation schemes selection of window, selection of devices based and screen-based controls. Components – text and messages, Icons and increases – Multimedia, colors, uses problems, choosing colors.		
UNIT IV	**EVALUATION TECHNIQUES**	**9**
HCI in the software process, The software life cycle -Usability engineering Iterative design and prototyping -Design Focus: Prototyping in practice Design rationale Design rules Principles to support usability Standards Golden rules and heuristics HCI patterns Evaluation techniques, Goals of evaluation, Evaluation through expert analysis, Evaluation through user participation, Choosing an evaluation method. Universal design, Universal design principles Multi-modal interaction		
UNIT V	**MODELS OF HCI**	**9**
Cognitive models Goal and task hierarchies Design Focus-GOMS saves money Linguistic models -Challenge of display-based systems Physical and device models Cognitive architectures Ubiquitous computing and augmented realities Ubiquitous computing applications research Design Focus-Ambient Wood – augmenting the physical Virtual and augmented reality Design Focus: Shared experience Design Focus-Applications of augmented reality Information and data visualization- Design Focus- Getting the size right.		

TOTAL: 45 PERIODS

COURSE OUTCOMES:

On successful completion of this course, the student will be able to

- Outline the basic concepts of HCI.
- Illustrate the screen design theory of human interaction.
- Summarize the various components of HCI.
- Interpret the available evaluation techniques.
- Explain the models of HCI.

TEXT BOOKS:

1. Wilbert O Galitz, "The essential guide to user interface design", John Wiley & Sons, 2007.
2. Alan Dix, Janet Fincay, GreGoryd, Abowd, Russell Bealg, "Human – Computer Interaction", Pearson Education, 2009
3. Varun Bajaj, G R Sinha, "Artificial Intelligence – Based Brain Computer Interface", Elsevier Science, 2022.

REFERENCES:

1. Ben Shneidermann, "Designing the user interface", 5th Edition, Pearson Education, 2010.
2. Prece, Rogers, Sharps, "Interaction Design", 5th Edition,Wiley Dream tech, 2019.
3. Soren Lauesen, "User Interface Design", Pearson Education, 2003.

21PEC20	**WIRELESS BODY AREA NETWORKS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the fundamental concepts of wireless sensor networks.
- To explore the design concepts of BAN and WBAN.
- To be familiar with sensor networking protocols and technologies.
- To introduce the topologies and protocols of WBAN.
- To develop methodologies for health care applications.

UNIT I	OVERVIEW OF WIRELESS SENSOR NETWORKS	9
Challenges for Wireless Sensor Networks-Characteristics requirements-required mechanisms, Difference between mobile ad-hoc and sensor networks, Enabling Technologies for Wireless Sensor Networks – Operating Systems – Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node-level Simulators, State-centric programming.		
UNIT II	**DESIGN REQUIREMENT OF BAN AND WBAN**	**9**
BAN Positioning- Architecture of BAN- Requirements of BAN- BAN Standardization - Media Access Control (MAC) - Frame Processing- Physical Layer (PHY) - Application of BAN - Design Requirement of WBAN - WBAN Reference architecture - Software frameworks for programming WBAN- Hardware Development and systems for WBAN.		
UNIT III	**NETWORKING OF SENSORS**	**9**
Physical (PHY) layer technologies – Narrow band and UWB – Medium access control (MAC) technologies for WBAN – Unified MAC design independent of underlying PHY technologies; Standardization with IEEE802.15.6, IEEE 11073, and ETSI eHealth Project.		
UNIT IV	**WBAN TECHNOLOGIES**	**9**
WBAN Network topologies and configurations-Basics Medium Access Control protocols – Scheduled protocols-Random Access protocols-Hybrid MAC protocols		
UNIT V	**WIRELESS SENSOR NETWORKS FOR HEALTHCARE APPLICATIONS**	**9**
General approach to WSN in Healthcare – Key Principles, Methodology – Architecting WSN solutions for Healthcare – Hardware, Firmware and Software Choices.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

- CO1: Illustrate the characteristics of wireless sensor networks.
- CO2: Outline the fundamentals of BAN and WBAN.
- CO3: Summarize the salient features of Wireless Body Area Networks.
- CO4: Relate the topologies and protocols of WBAN.
- CO5: Interpret the approaches of wireless sensor networks for healthcare applications.

TEXTBOOKS:
1. Kazem sohraby, Daniel Minoli and Taiebznati , "Sensor Networks: Technology, Protocols, and Applications", 1st Edition, Wiley Interscience, 2010. 2. Mehmet R. Yuce and Jamil Khan, "Wireless Body Area Networks: Technology, Implementation, and Applications", 1st Edition, CRC press, 2012. 3. Kaveh Pahlavan and Prasanth Krishnamoorthy, "Principles of Wireless Networks", 1st Edition, Pearson Education, 2013.
REFERENCES:
1. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003. 2. Huan-Bang Li, Kamya YekehYazdandoost, and Bin Zhen, "Wireless Body Area Network", River Publishers, Series in Information Science and Technology, 2010. 3. R. Maheswar, G. R. Kanaga Chidambaresan, R. Jayaparvathy and Sabu M. Thampi, "Body Area Network Challenges and Solutions", Springer 2019. 4. Mohammed llyas and Imad Mahgaob, "Handbook of Sensor Networks: Compact Wireless and Wired Sensing Systems", CRC Press, 2004.

21PEC21	**BIO MEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES: • To know about the fabrication process of Microsystems. • To explore the operation of mechanical and thermal sensors. • To outline the working of electrostatic and piezoelectric sensors. • To gain knowledge about the equations governing the Microsystems. • To study about application of Bio MEMS.					
UNIT I	**MEMS AND MICROSYSTEMS**				**9**
Typical MEMs and Microsystems, materials for MEMS - active substrate materials- Silicon and its compounds, Silicon piezo resistors, Gallium Arsenide, quartz, polymers. Micromachining- photolithography, thin film deposition, doping, etching, bulk machining, wafer bonding, LIGA					
UNIT II	**MECHANICAL AND THERMAL SENSORS AND ACTUATORS**				**9**

Mechanics for MEMs design- static bending of thin plates, mechanical vibration, thermo mechanics, fracture and thin film mechanics. Mechanical sensors and actuators – beam and cantilever – microplates, strain, pressure and flow measurements, Thermal sensors and actuators- actuator based on thermal expansion, thermal couples, thermal resistor, Shape memory alloys- Inertia sensor, flow sensor		
UNIT III	**ELECTROSTATIC AND PIEZOELECTRIC SENSORS AND ACTUATORS**	**9**
Parallel plate capacitor, pull in effect, Electrostatic sensors and actuators- Inertia sensor, Pressure sensor, flow sensor, tactile sensor, comb drive. Properties of piezoelectric materials, Piezoelectric sensor and actuator – inchworm motor, inertia sensor, flow sensor.		
UNIT IV	**MICROFLUIDIC SYSTEMS**	**9**
Fluid dynamics, continuity equation, momentum equation, equation of motion, laminar flow in circular conduits, fluid flow in micro conduits, in sub micrometer and nanoscale. Microscale fluid, expression for liquid flow in a channel, fluid actuation methods, dielectro phoresis, micro fluid dispenser, micro needle, micro pumps-continuous flow system, micro mixers		
UNIT V	**APPLICATION OF BIO MEMS**	**9**
CAD for MEMS, Drug delivery, micro total analysis systems (MicroTAS) detection and measurement methods, microsystem approaches to polymerase chain reaction (PCR), DNA hybridization, Electronic nose, Bio chip.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the design process of microsystems.

CO2: Demonstrate the mechanics involved in the design of sensors.

CO3: Explain about the electrostatic sensors and actuators.

CO4: Infer the concepts of microfluidic systems.

CO5:Apply the knowledge of CAD tools for MEMS design.

TEXT BOOKS:

1. Chang Liu, " Foundations of MEMS", Pearson Education International, New Jersey, USA, 2006.
2. Ellis Meng , "Biomedical Microsystems", CRC Press, Boca Raton, FL, 2011.

3. Marc J. Madou," Fundamentals of Microfabrication: the science of miniaturization", CRC Press, 2002.
REFERENCES: 1. Nitaigour Premchand Mahalik, "MEMS", Tata McGraw Hill Publishing Company, New Delhi, 2007. 2. Nadim Maluf, Kirt Williams. "An introduction to Micro electro mechancial Systems Engineering", Second Edition, Artech House Inc, MA, 2004. 3. Tai Ran Hsu, "MEMS and Microsystems design and manufacture", Tata McGraw Hill Publishing Company, New Delhi, 2002. 4. Wanjun Wang, Steven A.Soper , "BioMEMS- Technologies and applications", CRC Press, BocaRaton, 2007. 5. Yang, Victor C., Ngo, That T," Biosensors and Their Applications", Springer, 2000.

VERTICAL IV

EMBEDDED SYSTEMS AND IOT

21PEC22	**WIRELESS SENSOR NETWORKS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES: • To know the fundamentals of wireless sensor networks. • To explain various MAC protocols. • To illustrate different data centric and energy aware routing protocols. • To explore about various operating systems used in sensor network architecture. • To summarize important applications of WSN.					
UNIT I	**CHARACTERISTICS OF WSN**				**9**
Characteristic requirements for WSN ,Challenges for WSNs , WSN vs Adhoc Networks , Sensor node architecture , Commercially available sensor nodes , Imote , IRIS, Physical layer and transceiver design considerations in WSNs, Energy usage profile, Choice of modulation scheme, Dynamic modulation scaling, Antenna considerations					

UNIT II	MEDIUM ACCESS CONTROL PROTOCOLS	9
Fundamentals of MAC protocols, Low duty cycle protocols and wakeup concepts,Contention based protocols , Schedule-based protocols , SMAC ,BMAC , Traffic-adaptive medium access protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.		
UNIT III	**ROUTING AND DATA GATHERING PROTOCOLS**	**9**
Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR, Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GPSR – Real Time routing Protocols – TEEN, RAP - Data aggregation - data aggregation operations - Aggregate Queries in Sensor Networks - Aggregation Techniques		
UNIT IV	**NETWORK OPERATING SYSTEMS DESIGN**	**9**
Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS –MANTIS. Introduction to TinyOS – NesC – Interfaces and Modules- Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.		
UNIT V	**APPLICATIONS OF WSN**	**9**
WSN Applications - Home Control – Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Infer the basics of Wireless Sensor Networks.

CO2: Interpret the concepts of MAC Protocol.

CO3: Illustrate various routing protocols.

CO4: Summarize various operating systems for wireless sensor networks.

CO5: Outline various applications of wireless sensor networks.

TEXT BOOKS:

1. C. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education, 2008.
2. Anna Hac, “Wireless Sensor Network Designs”, John Wiley, 2003.
3. WaltenegusDargie , Christian Poellabauer, “Fundamentals of Wireless Sensor Networks - Theoryand Practice”, John Wiley & Sons Publications, 2011.

REFERENCES:

1. Feng Zhao and LeonidesGuibas, "Wireless sensor networks ", Elsevier publication, 2004.
2. Jochen Schiller, "Mobile Communications", Pearson Education, 2nd Edition, 2003.
3. William Stallings, "Wireless Communications and Networks ", Pearson Education, 2004.
4. Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks", JohnWiley, 2005.
5. Feng Zhao & Leonidas J.Guibas, “Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.
6. Kazem Sohraby, Daniel Minoli, & TaiebZnati, “Wireless Sensor Networks-Technology, Protocols, and Applications”, John Wiley, 2007.

21PEC23	**MEMS DESIGN**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

COURSE OBJECTIVES:

- To relate the concept of MEMS technology and the materials used.
- To infer fabrication methods used in MEMS technology.
- To analyze the design of passive components using MEMS.
- To gain knowledge on the design of new MEMS devices based on various principles.
- To demonstrate the concept of nano electronics.

UNIT I	**OVERVIEW OF MICROSYSTEMS**	**12**

MEMS and microsystems – typical products – Micro systems & miniaturization – principle of micro sensors- Bio medical and Bio sensors, chemical sensors, optical sensors – principle of micro actuation-thermal effects, shape memory alloy, piezo electric crystals, electro static force - MEMS with micro actuators – micro grippers.		
UNIT II	**MATERIALS AND FABRICATION**	**12**
Materials for MEMS and Micro system-Substrate and wafers - active substrate materials - silicon as substrate material-silicon compound - silicon piezo-resistors - Gallium arsenide – Quartz - Piezo electric crystals –Polymers Fabrication processes – photolithography - ion implantation – oxidation – Chemical vapour deposition– Physical vapour deposition – Etching - LIGA process.		
UNIT III	**SENSORS AND SWITCHES**	**12**
Case studies – capacitive accelerometer - Piezo electric pressure sensor - thermal sensor - radiation sensors - mechanical sensors - bio-chemical sensors - RF MEMS switch – Mechanical switch - Electronic Switch - Optical MEMS - Digital Micro Mirror device.		
UNIT IV	**CASE STUDIES**	**12**
Acceleration sensors - gyroscopes-piezo-resistive sensors-magnetic actuation-micro fluids applications-medical applications- optical MEMS.		
UNIT V	**NANO ELECTRONICS**	**12**
Nano electronics with tunneling devices – Nano electronics with super conducting devices - Molecular nano technology – Applications of MNT - Direct self-assembly- Electrostatic self-assembly-nano tubes – Nano wire and carbon-60 – Dielectrophoreticnano assembly.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO 1: Summarize about various MEMS devices.

CO 2: Apply their knowledge for fabrication of MEMS materials.

CO 3: Explicate the design of new MEMS devices based on various principles.

CO4: Illustrate the case studies of application specific MEMS.

CO5: Illustrate the principles of nano electronics with its applications.

TEXTBOOKS:
1. Tai- Ran Hsu, "MEMS and Microsytems Design and Manufacture", 1^{st} Edition, Tata McGraw Hill, 2017. 2. Nitaigour Mahalik, "MEMS", 3^{rd} Edition, Tata McGraw Hill, 2014. 3. Paolo Di Barba, Slawomir Wiak, "MEMS: Field Models and Optimal Design", Springer, 2019.
REFERENCES:
1. Siva Yellampalli, "MEMS Sensors - Design and Application", IntechOpen, 2018. 2. Rai Chaoudhary, "MEMS and MOEMS Technology and Applications", 2^{nd} Edition, PHI Learning, 2012. 3. Marc Madou, "Fundamentals of Microfabrication", CRC Press, 2011.Sergey Edward Lyshevski,"MEMS and NEMS: Systems, Devices, and Structures", CRC Press, 2002.

21PEC24	EMBEDDED AND REAL TIME SYSTEMS	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES: • To learn the architecture and programming of ARM processor. • To summarize the embedded computing platform design and analysis. • To expose the concepts and overview of real time operating system. • To explain the system design techniques and networks for embedded systems to industrial applications. • To demonstrate the applications of embedded systems in various domains.					
UNIT I	**INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS**				**9**
Introduction to embedded computing: Characteristics of embedded computing applications, Challenges in embedded system design, Embedded system Design process. ARM 7(LPC2148) Processor Instruction set-Programming – GPIO configuration, UART, Interfacing of ADC and DAC.					
UNIT II	**EMBEDDED COMPUTING PLATFORM DESIGN**				**9**

The CPU Bus–Memory devices and I/O devices–Models of programs– Assembly, linking and loading – compilation techniques– Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size– Program validation and testing.		
UNIT III	**PROCESSES AND OPERATING SYSTEMS**	**9**
Introduction – Kernel, Threads –Multiple tasks and multiple processes – Multirate systems– Preemptive real–time operating systems– Priority based scheduling– Inter-process communication mechanisms. Introduction to OS- GPOS versus RTOS- Classification of RTOS- Example Real time operating systems– POSIX/Windows CE. Evaluating operating system performance.		
UNIT IV	**SYSTEM DESIGN TECHNIQUES AND NETWORKS**	**9**
Design methodologies– Design flows – Requirement Analysis – Specifications – Quality Assurance techniques– Distributed embedded systems – Networks for embedded systems: I2C, Ethernet, Field bus– Overview on Internet of Things.		
UNIT V	**APPLICATIONS OF EMBEDDED SYSTEMS**	**9**
GPS Navigation system – Engine control unit – Audio Player– Video Accelerator – Digital Camera –Smart Home Security System – Challenges and trends in embedded systems in industrial applications.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Describe the architecture and programming of ARM processor.

CO2: Outline the concepts of embedded systems.

CO3: Illustrate the Multi rate task in real time operating system.

CO4: Demonstrate the system design techniques for embedded systems.

CO5: Model real-time consumer/industrial applications using embedded-system concepts.

TEXT BOOKS:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", 4th Edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2016.
2. Jane W.S.Liu , "Real Time Systems", 3rd Edition, Pearson Education, 2003.

3. Sriram V Iyer and Pankaj Gupta, "Embedded Real Time Systems Programming", 1st Edition, Tata McGraw Hill, 2017.

REFERENCES:

1. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", 3rd Edition Cengage Learning, 2012.
2. David. E. Simon, "An Embedded Software Primer", 1st Edition, Impression Addison Wesley Professional, 2007.
3. C.M. Krishna, Kang G. Shin, "Real-Time Systems", 1st Edition, Tata McGraw-Hill Education, 2010.
4. K.V.K.K. Prasad, "Embedded Real-Time Systems: Concepts, Design & Programming",1st Edition, Dream Tech Press, 2005.
5. Sriram V Iyer and Pankaj Gupta, "Embedded Real Time Systems Programming", 1st Edition, Tata McGraw Hill, 2017.
6. Dr.Mark fisher ,"ARM Cortex M4 Cookbook", 1st Edition, PACKT publications, 2016.

21PEC25	IOT BASED SYSTEM DESIGN	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To develop the programming skills for low power sensing applications using MSP430 Microcontroller.
- To explain the advanced ARM Cortex microcontrollers.
- To impart the knowledge of various peripherals related to sensing and communication.
- To build IoT systems and sensor interfacing.
- To design embedded systems for industrial applications.

UNIT I	MSP430 MICROCONTROLLERS	12

Architecture of the MSP430, Memory, Addressing modes, Reflections on the CPU instruction set. Clock system, Exceptions: Interrupts and resets. Functions and subroutines, Mixing C and assembly language, Interrupts, Interrupt service routines, Issues associated with interrupts, Low power modes of operation.

UNIT II	ARM CORTEX MX MICROCONTROLLER	12

ARM Cortex M4: Assembly language basics, Thumb-2 Technology, ARM Instruction set, Cortex M4 architecture, advantages, peripherals, instruction set, floating point operations, Advanced Cortex MX Microcontroller, core, architecture, on-chip Wi-Fi.		
UNIT III	**DISPLAY AND COMMUNICATION MODULES AND SENSORS INTERFACING**	**12**
GPIO, LCD display, graphical display, relays, Peripheral programming SPI, I2C, UART, Zigbee controller. Sensors interfacing techniques- Port Programming, ADC, SPI thermometer, I2C thermometer, PWM generation and demodulation, DTH11, single wire thermometer, Frequency counters.		
UNIT IV	**MICROCONTROLLERS PLATFORM FOR IOT**	**12**
ESP8266, NodeMCU, TI-CC3200,Access point and station point mode, HTTP, MQTT, transmission and receiving, Intel-Gallileo boards.		
UNIT V	**SINGLE BOARD COMPUTERS AND CLOUD INTERFACING**	**12**
Raspberry pi board, porting Raspbian, sensor interface examples, Python programming for cloud access, sensor systems using Arduino boards, Interfacing and data logging with cloud: Thing speak, Things board, Blync platform.		
		TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Design embedded programs for sensor applications.

CO2: Develop ARM basic and advanced programs.

CO3: Interface and deploy analog and digital sensors.

CO4: Develop communication system with sensor units.

CO5: Design IoT systems using Wi-Fi CC3200 and program the single board computers.

TEXT BOOKS:

1. John H. Davies, "MSP430 Microcontroller Basics", 2nd Edition, Newnes publishing, New York, 2011.
2. Jacob Fraden, "Hand Book of Modern Sensors: physics, Designs and Applications", 4th Edition, Springer, New York, 2014.
3. Pethuru Raj and Anupama C. Raman, "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, USA, 2017.

REFERENCES:

1. Sergey Y. Yurish,"Digital Sensors and Sensor Systems: Practical Design", 1st Edition, IFSA publishing, New York, 2011.
2. Jonathan W Valvano, "Introduction to ARM Cortex – M3 Microcontrollers", 5th Edition., Create Space publishing, New York, 2012.
3. Muhammad Ali Mazidi, Shujen Chen, Sarmad Naimi and Sepehr Naimi, "TI ARM Peripherals Programming and Interfacing: Using C Language", 2nd Edition, Mazidi and Naimi publishing, New York, 2015.

21PEC26	CONTROL SYSTEMS FOR IOT APPLICATIONS	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To impart the knowledge of the components and their representation of control systems.
- To outline the methods for analyzing the time response and stability of the systems.
- To gain knowledge about various methods for analyzing the frequency response and stability of the systems.
- To explain the working of sensors and actuators.
- To analyze the control theory as used in embedded systems and IoT platforms.

UNIT I	SYSTEMS COMPONENTS AND THEIR REPRESENTATION	12

Control System: Terminology and Basic Structure-Feed forward and Feedback control theory, Electrical and Mechanical Transfer Function Models-Block diagram Models-Signal flow graphs models-DC and AC servo Systems-Synchronous -Multivariable control system

UNIT II	TIME RESPONSE ANALYSIS	12

Transient response-steady state response-Measures of performance of the standard first order and second order system-effect on an additional zero and an additional pole-steady error constant and system- type number-PID control-Analytical design for PD, PI,PID control systems

UNIT III	FREQUENCY RESPONSE AND SYSTEM ANALYSIS	12

Closed loop frequency response-Performance specification in frequency domain-Frequency response of standard second order system- Bode Plot – Polar Plot- Nyquist plots-Design of compensators using Bode plots-Cascade lead compensation-Cascade lag compensation-Cascade lag-lead compensation.

UNIT IV	SENSORS AND ACTUATORS	12

Linear and angular displacement sensors: resistance sensor, induction displacement sensor, digital optical displacement sensor, pneumatic sensors. Speed and flow rate sensors, Force sensors.

Electrical actuating systems: Solid-state switches, Solenoids, Electric Motors- Principle of operation and its application: D.C motors - AC motors - Single phase & 3 Phase Induction Motor; Synchronous Motor; Stepper motors - Piezoelectric Actuator.

UNIT V	CASE STUDIES/INDUSTRIAL APPLICATIONS	12

Cisco IoT system, IBM Watson IoT platform, Manufacturing, Converged Plant wide Ethernet Model (CPwE), Power Utility Industry, Grid Blocks Reference Model, Smart and Connected Cities: Layered architecture, Smart Lighting, Smart Parking Architecture and Smart Traffic Control.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate the various control system components and their representations.

CO2: Analyze the various time domain parameters.

CO3: Analyze the various frequency response plots and its system.

CO4: Outline the Sensors and Actuators used in control systems.

CO5: Summarize applications of IoT in real time scenario.

TEXT BOOKS:

1. M.Gopal, “Control System – Principles and Design‖”, 4th Edition, Tata McGraw Hill, 2012.
2. TimWiscott, “Applied control for embedded systems”, 1st Edition, Elsevier Publications, 2006.
3. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, “IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things”, 1st Edition, Cisco Press, 2017.

REFERENCES:

1. J.Nagrath and M.Gopal, “Control System Engineering”, 5th Edition, New Age

International Publishers, 2007.
2. K. Ogata, “Modern Control Engineering”, 5th edition, PHI, 2012.
3. S.K.Bhattacharya, Control System Engineering, Pearson, 3rd Edition, 2013.

21PEC27	**INDUSTRIAL IOT AND INDUSTRY 4.0**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explore the Industrial Internet of Things.
- To illustrate the cyber system and Big Data Analytics.
- To outline various IIoT Architectures and domains.
- To explain Communication Protocols used in IIoT.
- To summarize the business issues in Industry 4.0.

UNIT I	**INTRODUCTION TO INDUSTRIAL INTERNET**	**9**

Innovation and IIoT, Intelligent Devices, Industrial Internet, Health care, Oil and Gas Industry, Smart Office, Logistics, IoT Innovations in Retail.

UNIT II	**INDUSTRY 4.0**	**9**

Miniaturization – Cyber Physical Systems – Wireless technology – IP Mobility – Network Functionality Virtualization – Cloud and Fog - Big Data and Analytics – M2M Learning and Artificial Intelligence.

UNIT III	**IIOT REFERENCE ARCHITECTURE**	**9**

Industrial Internet Architecture Framework – Functional Viewpoint – Operational Domain, Information Domain, Application Domain, Business Domain – Implementation View point – Architectural Topology – Three Tier Topology – Data Management.

UNIT IV	**INDUSTRIAL INTERNET SYSTEMS**	**9**

Introduction-Proximity Network Protocols – WSN Edge Node – Legacy Industrial Protocols – RS232 Serial Communications, 40-20ma Current Loop, Field Bus Technologies – Modern Communication Protocols – Industrial Ethernet – Industrial Gateways.

UNIT V	**BUSINESS ISSUES IN INDUSTRY 4.0**	**9**

Opportunities and Challenges, Future of Works and Skills for Workers in the Industry 4.0 Era, Strategies for competing in an Industry 4.0 world.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Classify the Industrial Internet of Things.

CO2: Illustrate the cyber system and Big Data Analytics.

CO3: Outline various IIoT Architecture and domains.

CO4: Interpret Communication Protocols used in IIoT.

CO5: Summarize the Business Issues in Industry 4.0.

TEXT BOOKS:

1. S. Misra, A. Mukherjee and A. Roy, “Introduction to IoT”, 1st Edition, Cambridge University Press, 2020.
2. S. Misra, C. Roy and A. Mukherjee, “Introduction to Industrial Internet of Things and Industry 4.0.”, 1st Edition, CRC Press. 2020.
3. Dr. Guillaume Girardin, Antoine Bonnabel and Eric Mounier, 'Technologies Sensors for the Internet of Things Businesses & Market Trends 2014 -2024”,Yole Development Copyrights, 2014.

REFERENCES:

1. Jean-Claude André “Industry 4.0”, Wiley- ISTE, 2019.
2. Miller M, “The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world”, 1st Edition, Pearson Education, 2015.
3. Diego Galar Pascual, Pasquale Daponte and Uday Kumar, “Handbook of Industry 4.0 and SMART Systems”, 1st Edition, Taylor and Francis, 2020

21PEC28	**IOT FOR SMART SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain Internet of Things technologies and its role in real time applications.
- To infer the infrastructure required for IoT.

- To gain knowledge about the accessories and communication techniques for IoT.
- To provide insight about the embedded processor and sensors required for IoT.
- To learn about the different platforms and Attributes for IoT.

UNIT I	INTRODUCTION TO INTERNET OF THINGS	9

Overview, Hardware and software requirements for IOT, Sensor and actuators, Technology drivers, Business drivers, Typical IoT applications, Trends and implications.

UNIT II	IOT ARCHITECTURE	9

IoT reference model and architecture -Node Structure - Sensing, Processing, Communication, Powering, Networking - Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons.

UNIT III	PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT	9

NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe GSM, CDMA, LTE, GPRS, small cell. Wireless technologies for IoT: WiFi (IEEE 802.11), Bluetooth/Bluetooth Smart, ZigBee/ZigBee, Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems-Recent trends.

UNIT IV	IOT PROCESSORS	9

Services/Attributes: Big-Data Analytics for IOT, Dependability, Interoperability, Security, Maintainability. Embedded processors for IOT :Introduction to Python programming -Building IOT with RASPERRY PI and Arduino.

UNIT V	CASE STUDIES	9

Industrial IoT, Home Automation, smart cities, Smart Grid, connected vehicles, electric vehicle charging, Environment, Agriculture, Productivity Applications, IOT Defense.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Analyze the concepts of IoT and its present developments.

CO2: Compare different platforms and infrastructures available for IoT.

CO3: Explain different protocols and communication technologies used in IoT.

CO4: Analyze the big data analytic and programming of IoT.

CO5: Implement IoT solutions for smart applications.
TEXT BOOKS: 1. Arshdeep Bahga and Vijai Madisetti : A Hands-on Approach “Internet of Things”, Universities, Press 2015. 2. Oliver Hersent, David Boswarthick and Omar Elloumi, “The Internet of Things”, Wiley,2016. 3. Samuel Greengard, “The Internet of Things”, The MIT press, 2015.
REFERENCES: 1. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things “, Wiley, 2014. 2. Jean- Philippe Vasseur, Adam Dunkels, “Interconnecting Smart Objects with IP: The Next Internet” Morgan Kuffmann Publishers, 2010. 3. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley and sons, 2014.

VERTICAL V

SPACE TECHNOLOGIES

21PEC29	SATELLITE COMMUNICATION	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES: • To explain the basics of satellite orbits and launching procedures. • To illustrate the satellite segment and earth segment. • To understand various parameters involved in designing satellite link. • To analyze the various methods of satellite access. • To interpret the applications of satellite systems.					
UNIT I	**SATELLITE ORBITS**				**9**
Frequency allocations for satellite services, Kepler’s Laws, Newton’s law, orbital parameters, orbital perturbations, Station keeping, Geo stationary and non Geo-stationary orbits – Look					

Angle Determination- Limits of visibility – eclipse -Sub satellite point –Sun transit outage- Launching Procedures - launch vehicles and propulsion.		
UNIT II	**SPACE SEGMENT AND EARTH SEGMENT**	**9**
Spacecraft Technology- Structure, Primary power, Attitude and Orbit control, Thermal control and Propulsion, Communication Payload and supporting subsystems, Telemetry, Tracking and command-Transponders - Antenna subsystem. Earth Segment - TVRO, MATV, CATV, Transmit and Receive earth station.		
UNIT III	**SATELLITE LINK DESIGN**	**9**
EIRP, Transmission losses, Link budget equation, Performance impairments - System noise, Rain induced attenuation, Ionospheric characteristics, Inter modulation and interference, C/N ratio - Uplink and downlink analysis and design, Rain fade margin, Combined Uplink and Downlink C/N Ratio.		
UNIT IV	**SATELLITE ACCESS AND CODING METHODS**	**9**
Modulation and Multiplexing - Voice, Data, Video, Analog and digital transmission system, Digital video Broadcast, Satellite access - Preassigned and demand assigned FDMA, TDMA - CDMA, Compression – Encryption, Coding Schemes.		
UNIT V	**SATELLITE APPLICATIONS**	**9**
INTELSAT Series, INSAT, VSAT, Mobile satellite services - GSM, GPS, INMARSAT, LEO, MEO, Satellite Navigational System. GPS Position Location Principles, Differential GPS, Direct Broadcast Satellites (DBS/DTH).		
TOTAL : 45 PERIODS		

COURSE OUTCOMES:

At the end of the course, learners should be able to

CO1: Summarize the basics of satellite orbits and launching procedures.

CO2: Illustrate the components of Space Segment and Earth Segment.

CO3: Outline the uplink and downlink analysis of satellite.

CO4: Compare multiple access schemes in satellite systems.

CO5: Summarize the applications of satellite systems.

TEXT BOOKS:

1. Dennis Roddy, “Satellite Communication”, 4th Edition, Mc Graw Hill International,

2017. 2. Timothy Pratt, Charles, Bostain, Jeremy E.Allnutt,"Satellite Communication”, 3rd Edition, Wiley Publications, 2019. 3. Bruce R. Elbert, “The Satellite Communication Applications Hand Book”, 2nd Edition, Artech House Boston London, 2004.
REFERENCES: 1. Wilbur L.Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, “Satellite Communication Systems Engineering”, 2nd Edition, Prentice Hall/Pearson, 2007. 2. N.Agarwal, “Design of Geosynchronous Space Craft”, 1st Edition, Prentice Hall, 1986. 3. Tri T. Ha, “Digital Satellite Communication”, 2nd Edition, TMH, 1990.

21PEC30	**AVIONICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES: • To illustrate the basics of avionics and its need for civil and military aircrafts. • To summarize the various architectures of avionics. • To explain the various control and display technologies. • To outline the various avionics navigation subsystems. • To construct an autopilot system for aircrafts using MATLAB.					
UNIT I	**INTRODUCTION TO AVIONICS**				**9**
Need for avionics in civil and military aircraft and space systems – Integrated avionics and weapon systems – Typical avionics subsystems, design, technologies – Introduction to digital computer and memories.					
UNIT II	**ARCHITECTURE OF DIGITAL AVIONICS**				**9**
Avionics system architecture – Data buses – MIL-STD-1553B – ARINC – 420 – ARINC – 629.					
UNIT III	**FLIGHT DECKS AND COCKPITS**				**9**

Control and display technologies: CRT, LED, LCD, EL and plasma panel, Touch screen, Direct voice input (DVI), Virtual Cockpit - Civil and Military Cockpits. MFDS, HUD, MFK, HOTAS.

UNIT IV	INTRODUCTION TO NAVIGATION SYSTEMS	9

Radio navigation – ADF, DME, VOR, LORAN, DECCA, OMEGA, ILS, MLS, Inertial Navigation Systems (INS): Inertial sensors, 3D gyro - INS block diagram – Satellite navigation systems – GPS – Unmanned aerial vehicle system – Design methodology.

UNIT V	AIR DATA SYSTEMS AND AUTO PILOT	9

Air data quantities – Altitude, Air speed, Vertical speed, Mach Number, Total air temperature, Mach warning, Altitude warning – Auto pilot – Basic principles, Longitudinal and lateral auto pilot.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Summarize the technologies of avionics systems and its sub systems.

CO2: Compare the various architecture and functionalities of digital avionics.

CO3: Outline the various display and control technologies of decks and cockpit.

CO4: Interpret the design of navigation systems.

CO5: Develop an autopilot systems for small aircrafts using MATLAB.

TEXTBOOKS:

1. Albert Helfrick. D., "Principles of Avionics", 9th Edition, Avionics Communications Inc., 2015.
2. Collinson. R.P.G. "Introduction to Avionics", 3rd Edition, Chapman and Hall, 2014.
3. Scott Kenney, “Avionics-Fundamentals of Aircraft Electronics”, Avotek Information Resources, 2013

REFERENCES:

1. Middleton, D.H., Ed., "Avionics systems, Longman Scientific and Technical", 1st Edition, Longman Group UK Ltd., England, 2007.
2. Spitzer, C.R. "Digital Avionics Systems", 2nd Edition, Prentice-Hall, Englewood Cliffs, 2001.
3. Spitzer. C.R. "The Avionics Hand Book", 3rd Edition, CRC Press, 2017.

21PEC31	POSITIONING AND NAVIGATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know about the elements of satellite orbits.
- To infer various electronic observation techniques.
- To impart knowledge about the operation of GPS receivers.
- To explain various GPS data processing techniques.
- To gain knowledge on various applications of satellite geodesy.

UNIT I	BASICS OF ORBITAL MECHANICS	9

Definition – Fundamental goals of Geodesy – Definitions – basic concepts – Historical perspective – development applications in Satellite Geodesy – Geoid and Ellipsoid satellite orbital motion – Keplerian motion – Kepler‟s Law – Perturbing forces – Geodetic satellite.

UNIT II	EARTH OBSERVATION TECHNIQUES	9

Determination of direction by photography – SECOR – Electronic observation techniques – Doppler effect – Positioning concept – Development of TRANSIT satellites.

UNIT III	SATELLITE SYSTEM	9

GPS – Different segments – space control and user segments – satellite configuration – GPS signal structure – Orbit determination and Orbit representation Anti Spoofing and Selective Availability – Task of control segment – GPS receivers – main receiver components – Example of GPS receivers.

UNIT IV	GPS DATA PROCESSING	9

GPS observables – code and carrier phase observation – linear combination and derived observables – concept of parameter estimation – data processing – software modules – solutions of cycle slips ambiguities RINEX format. Concepts of rapid static methods with GPS semi kinematic and pure kinematic methods – basic constellation of satellite geometry & accuracy measures.

UNIT V	APPLICATIONS OF SATELLITE GEODESY	9

Geodetic control surveys, Cadastral surveying, Photogrammetry & Remote Sensing, Engineering applications, and Monitoring – GIS. GLONASS, GALILEO, COMPASS and

IRNSS satellite configuration comparison – Satellite Laser Ranging & Applications – Concepts of satellite altimetry.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Outline the elements of satellite orbits.

CO2: Explain the techniques of development of satellites.

CO3: Infer the working of GPS receivers.

CO4: Demonstrate the error detection and correction methods of GPS data.

CO5: Illustrate the applications of Satellite Geodesy.

TEXT BOOKS:

1. Gunter Seeber, Walter De Gruyter, "Satellite Geodesy", 1st Edition, Prentice Hall, 2003.
2. W. B, Lichtenegger. H, Collins. J, "Global Positioning System – Theory and Practice – Hofmann", 1st Edition, Springer Verlag Wein, New York, 2008.
3. Alfred Leick, "GPS Satellite Surveying", 3rd Edition, John Wiley and Sons, 2004.

REFERENCES:

1. G. S. Rao, "Global Navigation Satellite Systems", 1st Edition, Tata McGraw Hill Education Pvt. Ltd, 2002.
2. Guocheng Xu, "GPS Theory, Algorithms and Applications", 1st Edition Springer-Verlag, 2003.
3. Parkinson, B. W., J. Spilker, et al. Global Positioning System: Theory and Applications. Vol. 1. American Institute of Aeronautics & Ast, 2001

21PEC32	**RADAR TECHNOLOGIES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To outline the fundamentals concepts of radar systems.
- To summarize the basics of signal models.

- To illustrate the concepts of sampling and quantization of pulsed radar signals.
- To provide in-depth knowledge in radar waveforms.
- To gain knowledge on Doppler processing techniques.

UNIT I	**INTRODUCTION TO RADAR SYSTEMS**	**9**
Basic radar function, elements of pulsed radar, review of signal processing concepts and operations, A preview of basic radar signal processing, radar system components, advanced radar signal processing.		
UNIT II	**SIGNAL MODELS**	**9**
Components of a radar signal, amplitude models, types of clutters, noise model and signal-to-noise ratio, jamming, frequency models: the Doppler shift, spatial models, spectral model.		
UNIT III	**SAMPLING AND QUANTIZATION OF PULSED RADAR SIGNALS**	**9**
Domains and criteria for sampling radar signals, Sampling in the fast time dimension, Sampling in slow time: selecting the pulse repetition interval, sampling the Doppler spectrum, Sampling in the spatial and angle dimension, Quantization, I/Q Imbalance and Digital I/Q.		
UNIT IV	**RADAR WAVEFORMS**	**9**
Introduction, The waveform matched filter, Matched filtering of moving targets, The ambiguity function, The pulse burst waveform, frequency-modulated pulse compression waveforms, Range side lobe control for FM waveforms, the stepped frequency waveform, Phase-modulated pulse compression waveforms, COSTAS Frequency codes.		
UNIT V	**DOPPLER PROCESSING**	**9**
Alternate forms of the Doppler spectrum, Moving target indication (MTI), Pulse Doppler processing, dwell-to-dwell stagger, Pulse pair processing, additional Doppler processing issues, clutter mapping and the moving target detector, MTI for moving platforms: adaptive displaced phase center antenna processing		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Infer the fundamental concepts behind radar systems.

CO2: Outline various signal models involved in radar systems.

CO3: Demonstrate the sampling and quantization techniques of pulsed radar signals

CO4: Illustrate different types of radar waveforms.

CO5: Summarize the Doppler processing issues.

TEXT BOOKS:

1. Mark A. Richards, "Fundamentals of Radar Signal Processing", 1st Edition, McGraw-Hill, New York, 2005
2. Francois Le Chevalier, "Principles of Radar and Sonar Signal Processing", 1st Edition Artech House, 2002.
3. Michael O Kolawole, "Radar systems, Peak Detection and Tracking", 1st Edition, Elsevier, 2010.

REFERENCES:

1. Skolnik, "Introduction to Radar Systems" 3rd Edition, McGraw Hill, 2003.
2. Peyton Z. Peebles, "Radar Principles", 1st Edition, Wiley India, 2009
3. Fred E. Nathanson, "Radar Design Principles-Signal Processing and the Environment", PHI, 1999.

21PEC33	REMOTE SENSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the basic principles of remote sensing.
- To acquire knowledge about the motion of satellites in the space.
- To expose the various types of sensors used for remote sensing.
- To gain knowledge about the generation of satellite data products.
- To explain various stages of satellite image analysis.

UNIT I	PHYSICS OF REMOTE SENSING	9

Remote Sensing - Definition - Components - Electro Magnetic Spectrum – Basic wave theory – Particle theory – Stefan Boltzman law - Wiens-Displacement Law - Radiometric quantities - Effects of Atmosphere- Scattering – Different types –Absorption-Atmospheric window-Energy interaction with surface features – Spectral reflectance of vegetation, soil and water – atmospheric influence on spectral response patterns- multi concept in Remote sensing.

UNIT II	PLATFORMS	9
Orbit elements – Types of orbits – Motions of planets and satellites – Launch of space vehicle – Orbit perturbations and maneuvers – escape velocity - Types and characteristics of different remote sensing platforms – sun synchronous and geo synchronous satellites.		
UNIT III	**SENSORS**	**9**
Classification of remote sensors – selection of sensor parameters - resolution concept - Spectral, Radiometric and temporal resolution – Quality of images – imaging mode – photographic camera – opto-mechanical scanners – pushbroom and whiskbroom cameras – Panchromatic, multi spectral ,thermal, hyperspectral scanners and microwave sensors – geometric characteristics of scanner imagery – Operational Earth resource satellites - Landsat, SPOT, IRS, WorldView, hyperion and hysis, ERS, ENVISAT, Sentinel.		
UNIT IV	**DATA RECEPTION AND DATA PRODUCTS**	**9**
Ground segment organization – Data product generation – sources of errors in received data – referencing scheme – data product output medium – Digital products – Super structure, Fast, GeoTIFF, Hierarchical and HDF formats – Indian and International Satellite Data Products – ordering of data		
UNIT V	**DATA ANALYSIS**	**9**
Data products and their characteristics – Elements of visual interpretation – interpretation keys – Digital image processing – Preprocessing – Image rectification – Image enhancement techniques– Image classification – Supervised and unsupervised classification algorithms for multispectral and hyperspectral images – Accuracy assessment.- hybrid classification techniques – Knowledge based classification, Neural Network Classification, Fuzzy Classification.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

- CO1: Summarize the concepts and laws related to remote sensing.
- CO2: Illustrate various remote sensing platforms.
- CO3: Explain the characteristics of different types of remote sensors.
- CO4: Outline the concepts of data reception, product generation, storage and ordering of satellite data.
- CO5: Illustrate different image processing techniques and interpretation of satellite data.

TEXT BOOKS:

1. Lillesand T.M. and Kiefer. "R.W. Remote Sensing and Image Interpretation", 4^{th} Edition, John Wiley and Sons, 2015.
2. John R. Jensen, "Introductory Digital Image Processing: A Remote Sensing Perspective", 4^{th} Edition, Pearson Education, 2015.
3. Campbell, J.B, " Introduction to Remote Sensing", Taylor Publications,2002.

REFERENCES:

1. John A.Richards, "Remote Sensing Digital Image Analysis", 5^{th} Edition, Springer – Verlag, 2013.
2. George Joseph, "Fundamentals of Remote Sensing", 3^{rd} Edition, Universities Press Pvt. Ltd, Hyderabad, 2018.
3. Joseph George," Fundamentals of Remote Sensing", Universities Press, 2003.

21PEC34	**UNMANNED AERIAL VEHICLES AND DRONES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To outline the basics of UAV and its applications.
- To design an UAV system with aerodynamic concepts.
- To explain the suitable avionics hardware for UAV system.
- To summarize the payloads and control devices.
- To develop and simulate the UAV system with ground control station.

UNIT I	**INTRODUCTION TO UAV**	**9**

History of UAV: classification, Introduction to Unmanned Aircraft Systems: models and prototypes, System Composition, applications.

UNIT II	**DESIGN OF UAV SYSTEMS**	**9**

Introduction to Design and Selection of the System: Aerodynamics and Airframe Configurations, Vehicle drag, Characteristics of Aircraft Types, Design Standards and Regulatory Aspects: UK,USA and Europe, Design for Stealth: Control surfaces,

Specifications.		
UNIT III	**AVIONICS HARDWARES**	**9**
Autopilot: AGL, Pressure sensors, Servos, Accelerometer, Gyros, Actuators, Air frame controller, Power supply, Processor, Integration, Installation, Configuration and Testing.		
UNIT IV	**COMMUNICATION PAYLOADS AND CONTROLS**	**9**
Payloads: Telemetry, Tracking, Aerial photography, Controls: PID feedback, Radio control frequency range, Modems, Memory system, Simulation: Ground test, Analysis, Trouble shooting.		
UNIT V	**THE DEVELOPMENT OF UAV SYSTEMS**	**9**
Waypoints navigation: Ground control software: System Ground Testing, System In-flight Testing, Future Prospects and Challenges: Case Studies, Mini and Micro UAVs, Ornithopter.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Explain the basics of unmanned systems and its applications.

CO2: Apply the aerodynamics and airframe configurations for UAV design.

CO3: Make use of suitable avionics hardware for autopilot system.

CO4: Outline the various payloads and control devices of UAV.

CO5: Build an UAV system with ground control and waypoint navigation

TEXT BOOKS:

1. Paul G Fahlstrom, Thomas J Gleason, Introduction to UAV Systems, 5th Edition, Wiley publications, 2022.
2. Reg Austin, Unmanned Aircraft Systems: UAVs design, development and deployment, 1st Edition, Wiley, 2011.
3. Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016.

REFERENCES:

1. Dr. Armand J. Chaput, Design of Unmanned Air Vehicle Systems, 1st Edition, Lockheed Martin Aeronautics Company, 2001.
2. Kimon P. Valavanis, Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Springer, 2008.
3. Robert C. Nelson, Flight Stability and Automatic Control, 4th Edition, McGraw-Hill, Inc, 2000.

21PEC35	**ROCKETRY AND SPACE MECHANICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To infer the advanced concepts in Rocketry and Space Mechanics
- To apply the necessary mathematical knowledge in understanding the physical process
- To explain the concepts of Orbital Mechanics and Rocket Propulsion
- To develop the rocketry systems using and Aerodynamics and Rocket Stagin
- To understand the concepts of understanding of Rockets and like spacecraft systems.

UNIT I	**ORBITAL MECHANICS**	**9**

Description of solar system – Kepler's Laws of planetary motion – Newton's Law of Universal gravitation – Two body and Three-body problems – Jacobi's Integral, lunar and deep space missions, Librations points - Estimation of orbital and escape velocities.

UNIT II	**SATELLITE DYNAMICS**	**9**

Geosynchronous and geostationary satellites- factors determining life time of satellites – satellite perturbations – methods to calculate perturbations- Hohmann orbits – calculation of orbit parameters – Determination of satellite rectangular coordinates from orbital elements.

UNIT III	**ROCKET MOTION**	**9**

Principle of operation of rocket motor - thrust equation – one dimensional and two dimensional rocket motions in free space and homogeneous gravitational fields – Description of vertical, inclined and gravity turn trajectories determinations of range and altitude – simple approximations to burnout velocity- dispersion of finned rockets – Stability of flight.

UNIT IV	**ROCKET AERODYNAMICS**	**9**

Description of various loads experienced by a rocket passing through atmosphere – drag estimation – wave drag, skin friction drag, form drag and base pressure drag – Boat-tailing in missiles – performance at various altitudes – conical and bell shaped nozzles – adapted nozzles – Nozzle Configurations; Real Nozzles– rocket dispersion – launching problems.

UNIT V	**STAGING AND CONTROL OF ROCKET VEHICLES**	**9**

Need for multistaging of rocket vehicles – multistage vehicle optimization – stage separation dynamics and separation techniques- aerodynamic and jet control methods of rocket vehicles - SITVC.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Make use of the basic concepts of orbit mechanics to estimate the orbital parameters.

CO2: Apply the methods to calculate the satellite coordinates from orbital elements.

CO3: Illustrate the motion of rocket with metrics.

CO4: Explain the rocket motion by considering the aerodynamics.

CO5: Summarize the different staging and control of the rocket vehicles.

TEXT BOOKS:

1. G.P. Sutton, "Rocket Propulsion Elements", John Wiley & Sons Inc., New York, 5th Edition, 1986.
2. J.W. Cornelisse, "Rocket Propulsion and Space Dynamics", J.W. Freeman & Co., Ltd., London, 1982
3. Craig A. Kluever , "Space Flight Dynamics ", 1st Edition, Wiley, 2018.

REFERENCES:

1. Van de Kamp, "Elements of astromechanics", Pitman Publishing Co., Ltd., London, 1980.
2. E.R. Parker, "Materials for Missiles and Spacecraft", McGraw-Hill Book Co., Inc., 1982.
3. Turner, M. J. L. "Rocket and Spacecraft Propulsion: Principle, Practice and New Developments", Springer Verlag. 2000.

VERTICAL VI

HIGH SPEED COMMUNICATIONS

21PEC36	WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To summarize the importance of improving capacity of wireless channel using MIMO.
- To illustrate the propagation of radio wave and fading measurements.
- To outline the channel impairment mitigation using space-time block codes.
- To interpret the channel impairment mitigation using space-time Trellis codes.
- To explore advanced MIMO system.

UNIT I	CAPACITY OF WIRELESS CHANNELS	9

The crowded spectrum, Need for high data rate, MIMO systems – Array Gain, Diversity Gain, Data Pipes, Spatial multiplexing, MIMO System Model. MIMO System Capacity – Channel known at the transmitter, Channel unknown to the transmitter – Capacity of deterministic channels, Random channels and frequency selective channels.

UNIT II	RADIO WAVE PROPAGATION	9

Radio wave propagation – Macroscopic fading - Free space and outdoor, small scale fading, Fading measurements – Direct pulse measurements, spread spectrum correlation channel sounding, frequency domain channel sounding, Antenna Diversity – Diversity combining methods.

UNIT III	SPACE TIME BLOCK CODES	9

Delay diversity scheme, Alamouti space time code – Maximum likelihood decoding, Ratio combining. Transmit diversity, Space time block codes for real signal constellation and complex signal constellation - Decoding of STBC.

UNIT IV	SPACE TIME TRELLIS CODES	9

Space time coded systems, space time code word design criteria, design of STTC on slow fading channels, design of STTC on Fast Fading channels, performance analysis in slow and fast fading channels, effect of imperfect channel estimation and antenna correlation on performance, comparison of STBC & STTC.

UNIT V	LAYERED SPACE TIME CODES	9

LST transmitter – Horizontal and Vertical LST receiver – ML Receiver, Zero forcing Receiver; MMSE Receiver, SIC Receiver, ZF V-blast Receiver - MMSE V-blast Receiver, Iterative Receiver - Capacity of MIMO – OFDM systems – Capacity of MIMO multiuser systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the importance of improving capacity of wireless channel using MIMO.

CO2: Illustrate the propagation of radio wave and fading measurements.

CO3: Interpret the channel impairment mitigation using space-time block codes.

CO4: Summarize the channel impairment mitigation using space-time Trellis codes.

CO5: Outline the advanced MIMO system & MIMO OFDM systems.

TEXT BOOKS:

1. Mohinder Jankiraman, "Space-time codes and MIMO systems", 1st Edition, Artech House, Boston, London, 2004.
2. Paulraj Rohit Nabar, Dhananjay Gore, "Introduction of space time wireless communication systems", 1st Edition, Cambridge University Press, 2003.
3. Andrea Goldsmith, "Wireless Communication", 1st Edition, Cambridge University Press, 2011

REFERENCES:

1. David Tse and Pramod Viswanath, "Fundamentals of Wireless communication", 1st Edition, Cambridge University Press, 2005.
2. Sergio Verdu, "Multiuser Detection", 1st Edition, Cambridge University Press, 1998.
3. Van Nee, R. and Ramji Prasad, "OFDM for Wireless Multimedia Communications", 1st Edition, Artech House, 2000.

21PEC37	WIRELESS BROADBAND NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer about various networking service aspects of broadband networks.
- To interpret the wireless protocols associated with different layers.
- To explain the significance of LTE and 4G standards
- To summarize the specification and challenges of LTE-A standard.
- To explore the concepts of 5G services.

UNIT I	EVOLUTION OF WIRELESS NETWORKS	9

Evolution of Broadband Wireless; Fixed Broadband Wireless and Mobile Broadband Wireless; WiMAX, 3G & Wi-Fi Systems; Spectrum Options for Broadband Wireless; Technical Challenges for Broadband Wireless - Spectrum Scarcity, Quality of Service, Mobility, Portability, Security, Supporting IP in Wireless. Review of cellular standards, migration and advancement of GSM architecture and CDMA architecture, WLAN – IEEE 802.11and HIPERLAN, Bluetooth.

UNIT II	WIRELESS PROTOCOLS	9

Mobile network layer: Fundamentals of Mobile IP, data forwarding procedures in mobile IP, IPv4, IPv6, IP mobility management, IP addressing , DHCP, Mobile transport layer, Internet protocol(IP), TCP/IP, Bluetooth low energy, ZigBee, 6 LoWPAN, Wi-Fi: 802.11ax, 802.11ac, 802.11n.

UNIT III	LTE AND EVOLUTION TO 4G	9

Overview of 3G and 3GPP. LTE System Overview, The Evolution from UMTS to LTE, Requirements and Targets for LTE; LTE Radio Access – Transmission Scheme, Spectrum Flexibility, Channel Dependent Scheduling and Rate Adaptation, Inter-Cell Interference Combining, Multi Antenna Transmission.; Technologies for LTE; Network Architecture – Overall Architecture Overview, Protocol Architecture.

UNIT IV	4G AND BEYOND	9

Introduction to LTE-A – Requirements and Challenges, network architectures – EPC, UE Categories for LTE Advanced , E- UTRAN architecture - mobility management, resource management, services, channel - logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT V	5G TECHNOLOGIES	9

Introduction to 5G – Use Cases - 5G NR and 5G core network (5GCN) - Spectrum for 5G – 5G deployment - Options, Challenges and Applications. Device-to-Device (D2D) Communication - 5G for Massive Machine Type Communication and Massive IoT- V2X Communication - Full Duplex and Green Communication - mmWave Communications - Massive MIMO networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to,

CO1: Summarize the significance of broadband services.

CO2: Explain the network and transport layer protocols in wireless LANs

CO3: Compare the operation of various cellular technologies

CO4: Interpret the connection oriented services over 4G networks.

CO5: Outline the enabling technologies for 5G networks.

TEXT BOOKS:

1. Kaveh Pahlavan, "Principles of wireless networks", 2nd Edition, Prentice-Hall of India, 2013.
2. Moray Rumney, "LTE and Evolution to 4G Wireless: Design and Measurement Challenges", 2nd Edition, Agilent Technologies, 2013.
3. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies", 1st Edition, CRC Press, 2018.

REFERENCES:

1. Erik Dahlman, Stefan Parkvall, Johan Skold "5G NR: The Next Generation Wireless Access Technology", 1st Edition, Academic Press, 2018.
2. Jonathan Rodriguez, "Fundamentals 5G Mobile Networks", 1st Edition, John Wiley & Sons, 2015.
3. Luis .M, Correia, "Mobile Broadband Multimedia Networks: Techniques, Models and Tools for 4G", Elseiver, 2010.

21PEC38	4G/5G COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explore the network architecture in 4G wireless systems.
- To analyze the issues in OFDM, SC – FDMA modulation schemes.
- To provide adequate knowledge of transmit diversity
- To explain the MIMO spatial Multiplexing.
- To explore new technologies for 5G systems.

UNIT I	4G NETWORK ARCHITECTURE AND OFDM	9

LTE – Evolution to 4G – Network Architecture – Multicast System Architecture – OFDM – Mathematical system model for OFDM system – OFDM for downlink – Capacity of OFDMA –SNR Analysis of OFDM system – Walsh Spread OFDM – Fast Frequency Hopping OFDM

UNIT II	PAPR PROBLEM IN OFDM AND SC– FDMA	9

Introduction to SC – FDMA – SCFDMA for uplink – Hybrid SCFDMA OFDM – PAPR problem in OFDM – Measure of PAPR – PAPR in QAM modulations – PAPR in SCFDMA – PAPR with spectrum shaping – Coverage gain.

UNIT III	TRANSMIT DIVERSITY	9

Transmit Diversity Schemes – Cyclic Delay Diversity – Frequency Shift transmit diversity – time shift transmit diversity – Precoding vector switching – Block codes based transmit diversity – Downlink transmission chain – Codeword to layer Mapping – Transmit diversity precoding

UNIT IV	SPATIAL MULTIPLEXING AND CHANNEL STRUCTURE	9

MIMO Spatial Multiplexing – MIMO capacity – Code words and Layer Mapping – Downlink MIMO transmission chain– MIMO Precoding – CDD based precoding – Open loop spatial multiplexing – Channel Structure and Bandwidth –Frame and Slot structure –– Link adaptation and feedback computation.

UNIT V	OVERVIEW OF NEW TECHNOLOGIES FOR 5G SYSTEMS	9

Introduction – Cloud Radio Access Networks – Cloud computing and Fog computing- Non-orthogonal Multiple Access- Flexible physical layer design-Massive MIMO-Full Duplex communication –Millimeter wave-IoT,M2M and D2D-Energy Harvesting communication-Visible Light Communication-Basics about RAN architecture.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the learners will be able to:

CO1: Explain the hardware requirements of transmitter and receiver for 4G wireless systems.

CO2: Evaluate OFDM and SCDMA based wireless system.

CO3: Evaluate Diversity and Spatial Multiplexing schemes in 4G wireless systems.

CO4: Interpret transceiver for 4G wireless systems specifications.

CO5: Infer the state-of-the-art research on 5G systems.

TEXT BOOKS:

1. Stefania Sesia, Issam Toufik and Matthew Baker, "LTE – The UMTS Long Term Evolution: From Theory to Practice", 2nd Edition, John Wiley & Sons, 2011.
2. Farooq Khan, "LTE for 4G Mobile Broadband Air Interface Technologies and Performance", 1st Edition Cambridge University Press, 2009.
3. Vincent W. S. Wong, Robert Schober, Derrick Wing Kwan Ng, Li-Chun Wang, "Key Technologies for 5G Wireless Systems", 1st Edition, Cambridge University Press, 2017.

REFERENCES:

1. Ralf Kreher and Karsten Gaenger, "LTE Signaling, Troubleshooting and Optimization", 1st Edition, John Wiley & Sons, 2010.
2. Afif Osseiran, Jose F. Monserrat, Patrick Marsch, "5G Mobile and Wireless Communications Technology", 1st Edition, Cambridge University Press, 2016.
3. Anwer Al-Dulaimi, Chih-Lin I, Xianbin Wang, "5G Networks- Fundamental Requirements, Enabling Technologies, and Operations Management″, Wiley, USA, 2018.

21PEC39	COGNITIVE RADIO NEWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the basics of SDR and Cognitive Radio.
- To know the basics of various spectrum sensing techniques.
- To recognize the concepts of cooperative spectrum sensing.
- To outline the functions of MAC layer and Network layer.
- To learn the basics of security management and the various attacks.

UNIT I	INTRODUCTION TO COGNITIVE RADIO	9

Introduction –Software Defined Radio: Architecture–Digital Signal Processor and SDR Baseband architecture – Reconfigurable Wireless Communication Systems – Digital Radio Processing –Cognitive Radio: Cognitive radio Framework – Functions – Paradigms of Cognitive Radio

UNIT II	SPECTRUM SENSING	9

Introduction –Spectrum Sensing – Multiband Spectrum Sensing – Sensing Techniques – Other algorithms – Comparison – Performance Measure & Design Trade-Offs : Receiver operating characteristics – Throughput Performance measure –Fundamental limits and trade-offs

UNIT III	COOPERATIVE SPECTRUM ACQUISITION	9

Basics of cooperative spectrum sensing–Examples of spectrum acquisition techniques – cooperative transmission techniques – sensing strategies– Acquisition in the Presence of Interference: Chase combining HARQ –Regenerative cooperative Diversity– spectrum overlay– spectrum handoff

UNIT IV	MAC PROTOCOLS AND NETWORK LAYER DESIGN	9

Functionality of MAC protocol in spectrum access –classification –Interframe spacing and MAC challenges – QOS – Spectrum sharing in CRAHN –CRAHN models – CSMA/CA based MAC protocols for CRAHN – Routing in CRN– Centralized and Distributed protocols – Geographical Protocol.

UNIT V	TRUSTED COGNITIVE RADIO NETWORKS	9

Trust for CRN :Fundamentals – Models – Effects of Trust Management –Security properties in CRN – Route Disruption attacks –Jamming attacks –PU Emulation attacks.

TOTAL: 45 PERIODS
COURSE OUTCOMES: At the end of the course, the learners will be able to: CO1: Compare SDR and Cognitive radio. CO2: Analyze the various spectrum sensing techniques. CO3: Summarize the cooperative spectrum acquisition. CO4: Interpret the concepts of MAC protocols and network layer. CO5: Outline the various attacks in cognitive radio networks.
TEXT BOOKS 1. Mohamed Ibnkahla, "Cooperative Cognitive Radio Networks: The complete Spectrum Cycle" 1st Edition, CRC press Taylor and Francis Group, 2015. 2. Ahamed Khattab, Dmitri Perkins, Bagdy Byoumi,"Cognitive Radio Networks from Theory to practice" 3rd Edition, Springer, 2014. 3. Kwang– Cheng Chen and Ramjee Prasad, "Cognitive Radio Networks, 1st Edition, Wiley, 2009.
REFERENCES: 1. Alexander M.Wyglinski, Maziar Nekovee, Thomas Hou," Cognitive Radio Communications and Networks". 1st Edition, Elsevier Science, 2009. 2. Bruce Fette, "Cognitive radio technology", 2nd edition, Elsevier, 2009. 3. Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", 2nd Edition, Springer, 2007.

21PEC40	**SPACE TIME WIRELESS COMMUNICATION**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

COURSE OBJECTIVES:

- To explain the concepts of signal and channel models for various multiple antenna techniques.
- To outline the channel capacity of space time wireless channels.
- To explore transmit diversity concept under various channel constraints.

- To demonstrate various receiver structure of multiple antenna configuration.
- To illustrate the receiver structures concepts of multiple antenna systems.

UNIT I	SPACE TIME SIGNAL AND CHANNEL MODEL	9

Space time signal model: SISI, SIMO, MISO and MIMO, Space time channel model: SISO, SIMO, MISO and MIMO, Extended channel models: Spatial fading correlation, LOS component, Cross-polarized antennas and Degenerate channels, Statistical properties of channel: Singular value and Squared Frobenius norm.

UNIT II	CAPACITY OF SPACE TIME WIRELESS CHANNELS	9

Frequency flat fading channel with perfect CSIT, Frequency flat fading channel in the absence of CSIT, Frequency selective fading channel with perfect CSIT, Frequency selective fading channel in the absence of CSIT, Random MIMO channel, Correlated MIMO channel.

UNIT III	SPATIAL DIVERSITY	9

Diversity gain: Coding gain vs diversity gain, Spatial diversity vs time/frequency diversity, transmit antenna diversity: Channel unknown to the transmitter – MISO, Channel known to the transmitter – MISO, Channel unknown to the transmitter – MIMO, Channel known to the transmitter - MIMO, Receive diversity: Selection, Threshold, Equal gain and Maximal ratio combining.

UNIT IV	RECEIVER STRUCTURES	9

Maximum likelihood receiver, Zero forcing receiver, Minimum mean square error, Decision feedback error, D-BLAST and V- BLAST.

UNIT V	SPACE TIME OFDM	9

SISO – OFDM, MIMO – OFDM modulation, Signaling and receivers for MIMO – OFDM: Spatial diversity coding for MIMO – OFDM, SM for MIMO – OFDM and Space-frequency coded MIMO – OFDM

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate signal and channel model multiple antenna systems.

CO2: Develop the channel fadings and capacity of space time channels.

CO3: Explain various diversity techniques.

CO4: Analyze the performance of various receiver structures.

CO5: Summarize the concepts of multi-antenna systems.

TEXT BOOKS:

1. D.Tse and P. Viswanath, "Fundamentals of Wireless Communications", 1st Edition, Cambridge University Press, 2005.
2. Erik. G. Larsson, "Space Time Block Coding for Wireless Communications", 2nd Edition, Cambridge University Press, 2003.
3. William.C.Y.Lee, "Mobile Cellular Telecommunications-Analog and Digital Systems", 2nd Edition, Tata McGraw Hill Edition, 2017.

REFERENCES:

1. A.B.Gershman, N.D.Sidiropoulos, "Space Time Processing for MIMO Communications", 4th Edition, John Wiley, 2005.
2. Mohinder Jankiraman, "Space-time codes and MIMO systems", 1st Edition, Artech House, Boston, London, 2004.
3. Paulraj Rohit Nabar, Dhananjay Gore, "Introduction of space time wireless communication systems", 1st Edition, Cambridge University Press, 2003.

21PEC41	MASSIVE MIMO SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the basics of massive MIMO systems.
- To explain the key technologies on capacity bounding.
- To explore the characteristics of single and multiple cells.
- To gain knowledge on power control techniques of massive MIMO systems.
- To know the recent research trends in massive MIMO systems.

UNIT I	INTRODUCTION TO MIMO	9

Evolution of cellular systems from 1G to 4G and the principles underlying different generations, Engineering requirements and application scenarios for 5G, Role of massive MIMO as a key 5G solution, Characteristics and benefits of massive MIMO systems, signal

and channel models, Differences with respect to point-to-point MIMO and multiuser MIMO, time division and frequency division duplex modes of operation.		
UNIT II	**MATHEMATICAL PRELIMINARIES AND CAPACITY AND CAPACITY BOUNDING TECHNIQUES**	**9**
Circular symmetric complex Gaussian random vectors, Few random matrix results, Wishart distributions, detection and estimation in additive Gaussian noise, Fading channels, capacity for point-to-point scalar channels, point-to-point MIMO channels, and multiuser MIMO channels, discussion on few capacity bounding tools.		
UNIT III	**SINGLE AND MULTIPLE CELL ANALYSIS**	**9**
Uplink training and channel estimation, uplink data transmission, zero-forcing and maximum ratio detection, downlink data transmission, zero-forcing and maximum ratio precoding, derivation of spectral efficiency results; pilot contamination and its effects, asymptotic analysis.		
UNIT IV	**POWER CONTROL IN MASSIVE MIMO SYSTEMS**	**9**
Single cell, multiple cells, max-min fairness; Propagation channels: Conditions for favorable propagation, independent Rayleigh fading, uniformly random line-of-sight channels; Case studies: Examples of single and multiple cell deployment.		
UNIT V	**APPLICATIONS OF MASSIVE MIMO**	**9**
Pilot Decontamination, Effects of hardware impairments, Massive MIMO with FDD operation, Cell-free Massive MIMO; Other potential 5G technologies such as device to device communications and applicability of massive MIMO to small cells and mmwave communications.		
TOTAL : 45 PERIODS		

COURSE OUTCOMES:

At the end of the course, learners should be able to

CO1: Explain the major cellular communication standards and wireless communications networks.

CO2: Illustrate the 5G techniques for the design of communication systems.

CO3: Demonstrate various modulation and multiplexing techniques.

CO4: Outline Machine Learning algorithms in 5G Wireless Communications.

CO5: Summarize the recent research works in massive MIMO systems.

TEXT BOOKS:

1. T. L. Marzetta, E. G. Larsson, H. Yang, and H. Q. Ngo, Fundamentals of Massive MIMO, 1st Edition, Cambridge University Press, 2016.
2. D. Tse and P. Viswanath, Fundamentals of Wireless Communication, 1st Edition, Cambridge University Press, 2005.
3. H. Yang and T. S. Quek, Massive MIMO meets Small Cell: Backhaul and Cooperation, Springer, 2016.

REFERENCES:

1. R. S. Kshetrimayum, Fundamentals of MIMO Wireless Communications, 1st Edition, Cambridge University Press, 2017.
2. W. Xiang, K. Zheng, and X. Xuemin, 5G Mobile communications, Springer, 2017.
3. J. Rodriguez, Fundamentals of 5G Mobile Networks, John Wiley & Sons, 2015.

21PEC42	MILLIMETER WAVE COMMUNICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the characteristics and applications of millimeter wave.
- To illustrate the fundamentals of millimeter wave devices and circuits.
- To know the various components of millimeter wave communications system.
- To interpret the concepts of millimeter wave MIMO systems.
- To infer about antenna design at millimeter wave frequencies.

UNIT I	INTRODUCTION TO MMWAVE COMMUNICATION	9

Millimeter wave characteristics- millimeter wave wireless, implementation challenges, Radio wave propagation for mm wave: Large scale propagation channel effects, small scale channel effects, Outdoor and Indoor channel models, Emerging applications of millimeter wave communications.

UNIT II	MM WAVE DEVICES AND CIRCUITS	9

Millimeter wave generation and amplification: Peniotrons, Ubitrons, Gyrotrons and Free electron lasers. HEMT, models for mm wave Transistors, transistor configurations, Analog mm wave components: Amplifiers, Mixers, VCO, PLL. Metrics for analog mm wave devices, Consumption factor theory, Trends and architectures for mm wave wireless, ADC's and DAC's.

UNIT III	MM WAVE COMMUNICATION SYSTEMS	9

Modulations for millimeter wave communications: OOK, PSK, FSK, QAM, OFDM, Millimeter wave link budget, Transceiver architecture, Transceiver without mixer, Receiver without Oscillator, Millimeter wave calibration, production and manufacture, Millimeter wave design considerations.

UNIT IV	MM WAVE MIMO SYSTEMS	9

Massive MIMO communications, Spatial diversity of antenna arrays, Multiple antennas, Multiple transceivers, Noise coupling in MIMO system, Potential benefits for mm wave systems, Spatial, Temporal and Frequency diversity, Dynamic spatial, frequency and modulation allocation.

UNIT V	ANTENNAS FOR MM WAVE SYSTEMS	9

Antenna beamwidth, polarization, advanced beam steering and beam forming, mm wave design consideration, On-chip and In package mm wave antennas, Techniques to improve gain of on-chip antennas, Implementation for mm wave in adaptive antenna arrays, Device to Device communications over 5G systems, Design techniques of 5G mobile.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the characteristics of millimeter wave.

CO2: Infer the properties of millimeter wave devices and circuits.

CO3: Explain about the usage of millimeter wave communication systems.

CO4: Outline the characteristics of millimeter wave MIMO systems.

CO5: Design antenna for millimeter wave frequencies.

TEXT BOOKS:

1. K.C. Huang and Z. Wang, "Millimeter Wave Communication Systems", 2nd Edition, Wiley-IEEE Press, March 2011.
2. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport and Murdock, "Millimeter Wave Wireless Communication", 4th Edition, Prentice Hall, 2014.
3. Sergey M. Smolskiy Author, Leonid A. Belov and Victor N. Kochemasov, “Handbook of RF, Microwave, and Millimeter-Wave Components”, 1st Edition, Artech House

Microwave Library, 2012.

REFERENCES:

1. Xiang, W; Zheng, K and Shen, X.S; "5G Mobile Communications”, 2nd Edition, Springer, 2016.
2. Chia-Chin Chong, Kiyoshi Hamaguchi, Peter F. M. Smulders and Su-Khiong, “Millimeter – Wave Wireless Communication Systems: Theory and Applications,” 2nd Edition Hindawi Publishing Corporation, 2007.
3. John S. Seybold “Introduction to RF propagation,”John Wiley and Sons, 2005.

VERTICAL VII

SEMICONDUCTOR CHIP DESIGN AND TESTING

21PEC43	WIDE BANDGAP DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the fundamental properties of wide bandgap semiconductors.
- To explain the properties of various photonic devices.
- To summarize various wide bandgap devices.
- To illustrate nanostructure materials and related devices.
- To outline novel heterostructure devices.

UNIT I	FUNDAMENTALS OF WIDE BANDGAP SEMICONDUCTORS	9
Optical Devices - Wide Bandgap Semiconductors Indispensable for Short Wavelength Optical Devices - Characteristics and Trends of Wide Bandgap Semiconductor Optical Devices- Silicon Carbide Electronic Devices - Nitride Compound Semiconductor Electron Devices - Crystals and Band Structure - Optical, Mechanical, and Thermal Properties of Wide Bandgap Semiconductors - Electrical Properties of Wide Bandgap Semiconductors.		
UNIT II	**PHOTONIC DEVICES**	**9**
Physical Properties - Visible LEDs - Ultraviolet Devices - White Light Emitting Devices - Laser Diodes		

UNIT III	ELECTRONIC DEVICES	9
High Frequency Power Devices - High Breakdown Voltage, High Current Density Power Devices - Electron Emitters - Transparent Devices.		
UNIT IV	**NANOSTRUCTURE DEVICES AND MATERIALS**	**9**
Single Photon Devices - GaN Nano column Light Emitting - Wide Bandgap Semiconductor Nanostructures and Devices.		
UNIT V	**NOVEL HETEROSTRUCTURE DEVICES**	**9**
GaN-Based High Temperature Operating Hall Devices - GaN-Based Inter subband Transition Optical Switches - Nitride Photocatalysis.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the fundamental properties of wide bandgap semiconductors.

CO2: Interpret the properties of various photonic devices.

CO3: Summarize various wide bandgap devices.

CO4: Illustrate nanostructure materials and related devices.

CO5: Analyze the characteristics of various heterostructure devices.

TEXT BOOKS:

1. Kiyoshi Takahashi, Akihiko Yoshikawa and Adarsh Sandhu, "Wide Bandgap Semiconductors - Fundamental Properties and Modern Photonic and Electronic Devices", 1st Edition, Springer, 2007.
2. Fei (Fred) Wang, Zheyu Zhang, and Edward A. Jones, "Characterization of Wide Bandgap Power Semiconductor Devices", 1st Edition, The Institution of Engineering and Technology, 2018.
3. B. Jayant Baliga,"Wide Bandgap Semiconductor Power Devices: Materials, Physics, Design and Applications", 1st Edition, Woodhead Publishing, 2019.

REFERENCES:

1. Fan Ren and John C. Zolper, "Wide Energy Bandgap Electronic Devices", 1st Edition, World Scientific, 2004.
2. UttamSingisetti, Towhidur Razzak, Yuewei Zhang, "Wide Bandgap Semiconductor

	Electronics and Devices", 1st Edition, World Scientific Publishing Company; 2019. 3. Fan Ren, Stephen J Pearton," Wide Bandgap Semiconductor-Based Electronics", 1st Edition, IOP Publishing Limited, 2020.

21PEC44	**ASIC DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the concepts of ASIC, CMOS logic and ASIC Design libraries.
- To illustrate the programmable ASIC IO and logic cells.
- To expose programmable ASIC Architecture.
- To learn about logic synthesis, placement and routing in ASIC design.
- To explain the concept of System on Chip (SoC) and its applications.

UNIT I	**INTRODUCTION TO ASICS AND ASIC LIBRARY DESIGN**	**9**

Types of ASICs - Design flow - CMOS transistors - Combinational Logic Cell – Sequential logic cell - Data path logic cell - Transistors as Resistors - Transistor Parasitic Capacitance-Logical effort.

UNIT II	**PROGRAMMABLE ASICS, ASIC LOGIC CELLS AND ASIC I/O CELLS**	**9**

Anti fuse - static RAM - EPROM and EEPROM technology - Actel ACT - Xilinx LCA – Altera FLEX - Altera MAX DC & AC inputs and outputs - Clock & Power inputs - Xilinx I/O blocks.

UNIT III	**PROGRAMMABLE ASIC ARCHITECUTRE**	**9**

Architecture and configuration of Spartan / Cyclone and Virtex / Stratix FPGAs – Micro-Blaze / Nios based embedded systems – Signal probing techniques.

UNIT IV	**LOGIC SYNTHESIS, PLACEMENT AND ROUTING**	**9**

Logic synthesis - ASIC floor planning- placement and routing – power and clocking strategies.

UNIT V	**HIGH PERFORMANCE ALGORITHMS AND CASE STUDIES**	**9**

DAA and computation of FFT and DCT. High performance filters using delta-sigma modulators. Case Studies: Digital camera, SDRAM, High speed data standards.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Describe architecture of programmable devices.

CO2: Outline the concepts of programmable ASIC logic cells.

CO3: Demonstrate the Programmable ASIC Architecture.

CO4: Illustrate the logic synthesis, placement and routing.

CO5: Model real-time case studies of system on chip concepts**.**

TEXT BOOKS:

1. M.J.S. Smith, “Application Specific Integrated Circuits”, 1st Edition, Pearson Education, 2008
2. Farzad Nekoogar and Faranak Nekoogar, “From ASICs to SOCs: A Practical Approach”, 1st Edition, Prentice Hall PTR, 2003.
3. Roger Woods, John McAllister, Dr. Ying Yi, Gaye Lightbod, “FPGA-based Implementation of Signal Processing Systems”, 2nd Edition, Wiley, 2017.

REFERENCES:

1. Douglas J. Smith, “HDL Chip Design, Madison”, 1st Edition, Doone Publications, 2002.
2. Jose E. France, YannisTsividis, "Design of Analog - Digital VLSI Circuits for Telecommunication and Signal Processing", 1st Edition, Prentice Hall, 1994.
3. Khosrow Golshan, “Physical Design Essentials: An ASIC Design Implementation Perspective” 1st Edition, Springer US, 2007.

21PEC45	LOW POWER IC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To analyze various sources of power dissipation in CMOS circuits.

- To optimize the circuit structures for reduced power consumption.
- To apply the special and advance techniques to design CMOS low power circuits.
- To estimate the power for CMOS circuits.
- To analyze the software design for power optimization.

UNIT I	**POWER DISSIPATION CONCEPTS**	**9**
Basic principle of low power design -Low power figure of merits-Sources of power consumption – Physics of power dissipation in CMOS FET devices –Reducing power consumption in memories-SRAM-DRAM.		
UNIT II	**POWER OPTIMIZATION**	**9**
Logic level power optimization – Circuit level low power design – circuit techniques for reducing power consumption in adders and multipliers.		
UNIT III	**DESIGN OF LOW POWER CMOS CIRCUITS**	**9**
Computer arithmetic techniques for low power system – low power clock, Interconnect and layout design –Advanced techniques –adiabatic-pass transistor logic synthesis–asynchronous circuits-Special techniques- power reduction in clock networks-CMOS floating gate- delay balancing.		
UNIT IV	**POWER ESTIMATION**	**9**
Power Estimation technique – Modelling of signals–signal probability using BDD-Statistical techniques-Estimating of glitching power- logic power estimation – power estimation methodologies-Monte Carlo power estimation– Simulation power analysis – Probabilistic power analysis- signal entropy.		
UNIT V	**SYNTHESIS AND SOFTWARE DESIGN**	**9**
Behavioral level transforms - Logic level optimizations for low power-Circuit level. Software design for low power - Sources of Software Power Dissipation - Software for Power Estimation - Software Power Optimization.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Analyze various sources of power dissipation in CMOS circuits

CO2: Develop optimized circuit structures to reduce the power consumption.

CO3: Demonstrate CMOS low power circuits using various techniques CO4: Summarize the power for CMOS circuits. CO5: Make use of software design optimization to reduce the power consumption.
TEXT BOOKS: 1. Dimitrios.S, Chirstian.P, "Designing CMOS Circuits for Low Power", 1st Edition, Kluwer, 2011. 2. Kaushik Roy and S.C.Prasad, "Low power CMOS VLSI circuit design", 1st Edition, Wiley, 2009. 3. John Rabaey," Lowpower design essentials" 1stEdition, Springer, 2009.
REFERENCES: 1. J.B.Kulo and J.H Lou, "Low voltage CMOS VLSI Circuits", 1st Edition, Wiley, 2002. 2. A.P.Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", 1st Edition, Kluwer, 1995. 3. Gary Yeap, "Practical low power digital VLSI design", 1st Edition, Kluwer, 1998. 4. Abdelatif Belaouar and Mohamed Elmasry, "Low power digital VLSI design", 1st Edition, Kluwer, 2012. 5. James B.Kulo, Shih-Chia Lin, "Low voltage SOI CMOS VLSI devices and Circuits", 1st Edition, John Wiley and sons, 2008.

21PEC46	DESIGN FOR TESTABILITY OF VLSI CIRCUITS	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES: • To outline the basic testing process of digital circuits. • To explain the process of generation of test input for combinational and sequential circuits. • To construct circuits for testability for digital circuits. • To outline the test patterns for digital circuits. • To illustrate the methods of fault diagnosis for combinational circuits.					
UNIT I	**FUNDAMENTALS OF TESTING AND FAULT MODELLING**				**9**
Introduction to testing – Faults in Digital Circuits – Modelling of faults – Logical Fault Models					

– Fault detection – Fault Location – Fault dominance – Logic simulation – Types of simulation – Delay models – Gate Level Event – driven simulation		
UNIT II	**TEST GENERATION FOR COMBINATIONAL AND SEQUENTIALCIRCUITS**	**9**
Test generation for combinational logic circuits – Testable combinational logic circuit design – Test generation for sequential circuits – design of testable sequential circuits.		
UNIT III	**DESIGN FOR TESTABILITY**	**9**
Design for Testability – Ad-hoc design – generic scan based design – classical scan based design – system level DFT approaches		
UNIT IV	**SELF TEST AND TEST ALGORITHMS**	**9**
Built-In self Test – test pattern generation for BIST – Circular BIST – BIST Architectures– Testable Memory Design – Test Algorithms – Test generation for Embedded RAMs		
UNIT V	**FAULT DIAGNOSIS**	**9**
Logical Level Diagnosis – Diagnosis by UUT reduction – Fault Diagnosis for Combinational Circuits – Self-checking design – System Level Diagnosis.		
TOTAL : 45 PERIODS		

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Illustrate the testing process and fault modeling for digital circuits.

CO2: Outline the generation of testing circuits for combinational and sequential circuits.

CO3: Develop the test circuits for testing the digital circuits.

CO4: Illustrate the testing algorithms and its patterns.

CO5: Analyze various fault diagnosis processes for combinational circuits.

TEXT BOOKS:

1. M.Abramovici, M.A.Breuer and A.D. Friedman, “Digital Systems and Testable Design”, 1st Edition, Jaico Publishing House, 2001.
2. P.K. Lala, “Digital Circuit Testing and Testability”, 1st Edition, Academic Press, 1997.
3. N.K.Jha, S.Gupta, “Testing of Digital systems”, 1st Edition, Cambridge University Press, 2012.

REFERENCES:

1. M.L.Bushnell and V.D.Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits”, 1st Edition, Kluwer Academic Publishers, 2004.
2. A.L.Crouch, “Design Test for Digital IC’s and Embedded Core Systems”, 1st Edition, Prentice Hall International, 2004.
3. Sobhit Saxena, Suman Lata Tripathi, Sushanta Kumar Mohapatra, “Advanced VLSI Design and Testability Issues”, 1st Edition, CRC Press, 2020.

21PEC47	MIXED SIGNAL IC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the MOS characteristics, large signal model /small signal model and its analysis.
- To interpret the submicron circuit, its process flow and delay elements.
- To infer the characteristics and architectures of different types of data converters.
- To illustrate SNR and filters for data converters.
- To infer about the switched capacitor amplifier circuits.

UNIT I	INTRODUCTION AND BASIC MOS DEVICES	9

Challenges in analog design-Mixed signal layout issues- MOSFET structures and characteristics- large signal and small signal model of single stage Amplifier-Source follower-Common gate stage – Cascode stage – large and small signal analysis of differential amplifier with active load, pole-zero estimation, zero value time constant method, frequency response of CS, cascade amplifiers.

UNIT II	SUBMICRON CIRCUIT DESIGN	9

Submicron CMOS process flow, Capacitors and Resistors, Current mirrors, Digital circuit design, Delay elements – Adders- Op-amp parameters and design.

UNIT III	DATA CONVERTERS	9

Static and dynamic errors in DAC and ADC – Architectures & Characteristics of Sample and Hold- Digital to Analog Converters- DAC- R-2R, weighted DAC, multiplying DAC, segmented DAC and sigma delta DAC. ADC – Flash ADC, pipelined ADC, successive

approximation ADC, sigma delta ADC.		
UNIT IV	**SNR IN DATACONVERTERS**	**9**
Overview of SNR of Data converters- Clock Jitters- Improving techniques averaging – Decimating Filters for ADC- Band pass and High Pass Sinc Filters- Interpolating filters for DAC.		
UNIT V	**SWITCHED CAPACITOR CIRCUITS**	**9**
Resistors, First order low pass circuit, Switched capacitor amplifier, Switched capacitor integrator – Design of flip around sample and hold circuit – pipelined ADC.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the characteristics and model of MOS circuits.

CO2: Illustrate the Submicron circuits and its delay elements.

CO3: Explain the characteristics and architectures of different types of data converters.

CO4: Compare the SNR of data converters.

CO5: Develop switched capacitor circuits.

TEXT BOOKS:

1. J. Jacob Wikner, Mikael Gustavsson and Nianxiong Tan, “CMOS Data Converters for Communications”, 1st Edition, Springer, 2002.
2. Van de Plassche, Rudy J., “CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters”, 2nd Edition, Springer, 2003.
3. Vineeta P.Gejji, “Analog and Mixed mode VLSI Design”, 1st Edition, PHI Learning Pvt. Ltd., 2011.

REFERENCES:

1. Gray, Meyer, Lewis, Hurst, “Analysis and design of Analog IC’s”, 4th Edition, Wiley International, 2002.
2. Phillip E.Allen Douglas R. Holberg, “CMOS Analog Circuit Design”, 3rd Edition, Oxford University Press, 2003.
3. R.Jacob Baker, “CMOS: Mixed-Signal Circuit Design”, 1st Edition, IEEE press series, Wiley, 2008

21PEC48	SYSTEM ON CHIP	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the system architecture and its approach for SOC design.
- To know about the processor architecture.
- To illustrate the memory design for SOC.
- To explain about the interconnect architectures.
- To interpret the reconfigurable technologies.

UNIT I	INTRODUCTION TO THE SYSTEM APPROACH	9

System Architecture, Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing. System level interconnection, an approach for SOC Design, System Architecture and Complexity.

UNIT II	PROCESSORS	9

Processor Selection for SOC, Basic concepts in Processor Architecture, Micro Architecture, Basic elements in Instruction handling. Buffers: minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

UNIT III	MEMORY DESIGN FOR SOC	9

Overview of SOC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SOC Memory System, Models of Simple Processor – memory interaction.

UNIT IV	INTERCONNECT CUSTOMIZATION AND CONFIGURATION	9

Inter Connect Architectures, Bus: Basic Architectures, SOC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SOC Customization: An overview, Customizing Instruction Processor

UNIT V	INTERCONNECT CONFIGURATION	9

Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance-Specific design, Customizable Soft Processor, Reconfiguration - overhead analysis and trade-off analysis on reconfigurable Parallelism

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Outline the concepts of system architecture.

CO2: Illustrate the processor architecture and its basic elements.

CO3: Demonstrate the memory system of SoC.

CO4: Interpret the interconnect architecture and its configuration.

CO5: Analyze the various types of reconfigurable technologies.

TEXT BOOKS:

1. Michael J. Flynn and Wayne Luk," Computer System Design System-on-Chip ", 1st Edition, Wiley India Pvt. Ltd., 2011
2. Ricardo Reis ," Design of System on a Chip: Devices and Components",1st Edition , Springer, 2004.
3. Farimah Farahmandi , Yuanwen Huang ," System-on-Chip Security: Validation and Verification", 1st Edition, Springer, 2020.

REFERENCES:

1. Steve Furber, "ARM System on Chip Architecture", 2nd Edition, Addison Wesley Professional, 2000.
2. Prakash Rashinkar, Peter Paterson and Leena Singh L," System on Chip Verification Methodologies and Techniques",1st Edition, Kluwer Academic Publishers, 2001.
3. Veena S. Chakravarthi, "A Practical Approach to VLSI System on Chip (SoC) Design: A Comprehensive Guide", 1st Edition, Springer International Publishing, 2019.

21PEC49	NETWORKS ON CHIP	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES :

- To outline the basic concepts of network on chip
- To explain the architecture design of NOC.
- To gain knowledge about the routing algorithm and its limitations

• To explore the various test and fault tolerance circuits • To know the various communication available in 3D integration of NOC		
UNIT I	**INTRODUCTION TO NOC**	**9**
Introduction to NoC – OSI layer rules in NoC - Interconnection Networks in Network-on-ChipNetwork-Topologies - Switching Techniques - Routing Strategies - Flow Control Protocol Quality-of-Service-Support		
UNIT II	**ARCHITECTURE DESIGN**	**9**
Switching Techniques and Packet Format - Asynchronous FIFO Design -GALS Style of Communication - Wormhole Router Architecture Design - VC Router Architecture Design – AdaptiveRouter Architecture Design.		
UNIT III	**ROUTING ALGORITHM**	**9**
Packet routing-Qos, congestion control and flow control – router design – network link design – Efficient and Deadlock-Free Tree-Based Multicast Routing Methods - Path-Based Multicast Routingfor 2D and 3D Mesh Networks- Fault-Tolerant Routing Algorithms - Reliable and AdaptiveRoutingAlgorithms		
UNIT IV	**TEST AND FAULT TOLERANCE OF NOC**	**9**
Design-Security in Networks-on-Chips-Formal Verification of Communications in Networks-onChips-Test and Fault Tolerance for Networks-on-Chip Infrastructures-Monitoring Services for Networks-on-Chips		
UNIT V	**THREE DIMENSIONAL INTEGRATION OF NETWORK-ON-CHIP**	**9**
Three-Dimensional Networks-on-Chips Architectures. – A Novel Dimensionally-Decomposed Routerfor On-Chip Communication in 3D Architectures - Resource Allocation for QoS On-ChipCommunication – Networks-on-Chip Protocols-On-Chip Processor Traffic Modeling for Networks-on-Chip		
TOTAL PERIODS : 45		
COURSE OUTCOMES: At the end of this course, learners will be able to • Outline the basic concepts of NOC • Illustrate the various architectures of NOC • Summarize the routing methods and algorithms • Interpret the various tests and fault tolerance methods		

• Explain the 3D networks on chips and their advantages.
TEXT BOOKS: 1. ChrysostomosNicopoulos, Vijaykrishnan Narayanan, Chita R.Das," Networks-on – ChipArchitectures Holistic Design Exploration", 1st Edition,Springer, 2009. 2. Fayezgebali, Haythamelmiligi, HqhahedWatheq E1-Kharashi "Networks-on-Chips theory andpractice",1st Edition, CRC press, 2017. 3. Santanu Kundu, Santanu Chattopadhyay, "Network-on-Chip The Next Generation of System-on-Chip Integration", CRC Press, 2018.
REFERENCES: 1. Konstantinos Tatas and Kostas Siozios, "Designing 2D and 3D Network-on-Chip Architectures",1st Edition, Springer, 2013. 2. Palesi, Maurizio, Daneshtalab, Masoud "Routing Algorithms in Networks-on-Chip" 1stEdition,Springer,2014 3. SantanuKundu, SantanuChattopadhyay "Network-on-Chip: The Next Generation of Systemon-Chip Integration",,1st Edition, CRC Press, 2014.

VERTICAL – VIII

COMPUTATIONAL INTELLIGENCE

21PEC50	**ARTIFICIAL INTELLIGENCE**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

COURSE OBJECTIVE:

- To outline the fundamental strategies for solving problems using AI.
- To implement various AI logics.
- To infer the probabilistic approach for decision making.
- To analyze about various Reinforcement and Untrained Learning approaches.
- To explore the AI and RL concepts for contemporary applications.

UNIT I	**ARTIFICIAL INTELLIGENCE BASED PROBLEM SOLVING**	**12**

Intelligent Agents, Problem Formulation, Uninformed Search Strategies, Heuristics Search Strategies, Local Search Algorithms and optimization problems, Problem Decomposition and Rule Based Systems.		
UNIT II	**KNOWLEDGE AND PLANNING**	**12**
Logic and inferences: Logic Agents, First Order Logic, Forward and Backward chaining. Planning: Forward and Backward Search, Goal Stack Planning.		
UNIT III	**REASONING AND DECISION MAKING**	**12**
Reasoning: Quantifying Uncertainty and Probabilistic Reasoning–Semantics and Inference in Bayesian Networks, Probabilistic Reasoning over time – Hidden Markov Models, Kalman filters. Decision Making: Sequential Decision Problems, Value Iteration, Policy Iteration, Markov Decision Process (MDP).		
UNIT IV	**REINFORCEMENT LEARNING**	**12**
Forms of Learning, Elements of Reinforcement Learning (RL), Agent - Environment Interface, Passive RL, Active RL, Multi-armed Bandit, Monte Carlo Method, Temporal Difference Learning, Eligibility Traces, DQN and Policy Gradient Approaches.		
UNIT V	**AI AND RL APPLICATION**	**12**
Future of AI, RL applications, Case study: Alpha Go, Universal Robots - cobots, Mars Curiosity Rover and Sophia.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Outline various strategies for AI.

CO2: Develop AI logics for planning.

CO3: Make use of Decision Making Rules for developing AI models.

CO4: Analyze various RL algorithms.

CO5: Demonstrate AI and RL based application specific systems.

TEXT BOOKS:

1. Russell, S.J. and Norvig, P., “Artificial intelligence – A modern approach”, 3rd Edition, Pearson, 2015.
2. Richard S. Sutton, Andrew G Barto, “Reinforcement Learning – An Introduction”, 1st

Edition, MIT, Press, 2018. 3. Csaba Szepesvari, "Algorithms for Reinforcement Learning", 1st Edition, Morgan and Claypool Publishers, 2010.
REFERNCES: 1. M. Nagenevtsky, "Artificial Intelligence – a guide to intelligent systems", 3rd Edition, Addison Wesley, 2011. 2. Sebastian Thrun, Wolfram Burgard, and Dieter Fox, "Probabilistic Robotics", 1st Edition, MIT Press, 2005. 3. Deepak Khemani, "A First Course in Artificial Intelligence", 1st Edition, McGraw Hill Education, 2017.

21PEC51	**PATTERN RECOGNITION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To learn the fundamental concepts of Pattern Recognition.
- To know about feature extraction and selection methods.
- To explore about supervised and unsupervised learning concepts.
- To understand the basics of Neural Networks.
- To know about the various applications of Pattern Recognition.

UNIT I	**PATTERN RECOGNITION CONCEPTS**	**9**

Fundamental concepts and blocks of a typical pattern recognition system. Decision functions-role and types, pattern and weight space, properties and implementation of decision functions.

UNIT II	**FEATURE SELECTION**	**9**

Feature identification, selection and extraction. Distance measures, clustering transformation and feature ordering, clustering in feature selection, feature selection through maximization and approximations.

UNIT III	**SUPERVISED AND UNSUPERVISED LEARNING**	**9**

Pattern classification by distance functions. Clusters and cluster seeking algorithms. Pattern classification by likelihood functions. Baye's classifier and performance measures.

UNIT IV	NEURAL NETWORKS	9

Artificial neural network model, Neural network-based pattern associators, Feed forward networks and training by back-propagation- Deep neural networks, convolutional neural networks and recurrent neural networks.

UNIT V	APPLICATIONS OF PATTERN RECOGNITION	9

Applications of statistical and neural network – based pattern classifiers in speech recognition, image recognition and target recognition.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the basics of Pattern Recognition.

CO2: Infer the various feature selection methods.

CO3:Categorize the various pattern recognition techniques into supervised and unsupervised.

CO4: Illustrate the artificial neural network based pattern recognition.

CO5: Relate the applications of pattern recognition.

TEXT BOOKS:

1. Earl Gose, R.Johnson Baugh and Steve Jost, "Pattern Recognition and Image Analysis", Pearson, 2015.
2. Richard O.Duda, Peter E.Hart and David G.Stork, "Pattern Classification", 2nd Edition, Wiley India, 2006.
3. J.I. Tou& R.C. Gonzalez, "Pattern Recognition Principles", Addition-Wesley, 1997.

REFERENCES:

1. Christopher. M. Bishop, "Pattern recognition and machine learning", Springer, 2006.
2. S Theodoridis, K Koutroumbas, "Pattern Recogntion", 4th Edition, Academic Press, 2009.
3. Robert J.Schalkoff, "Pattern Recognition Statistical, Structural and Neural Approaches", John Wiley & Sons Inc., New York, 1992.

21PEC52	SOFT COMPUTING TECHNIQUES	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To explain the types of soft computing techniques.
- To outline the types of Artificial Intelligence and Production Systems.
- To gain the knowledge about different types of perceptions.
- To explain Fuzzy Logic, Various fuzzy systems and their functions.
- To learn the applications and advances of Genetic Algorithms.

UNIT I	INTRODUCTION TO SOFTCOMPUTING	9

Introduction to soft computing, soft computing vs. hard computing, Types of soft computing techniques, Sequential and Parallel Computing. Applications of soft computing: Healthcare, Remote Sensing and Communication Systems.

UNIT II	ARTIFICIAL INTELLIGENCE	9

Introduction, Various types of production systems, characteristics of production systems. Search Techniques: Breadth first search, Depth first search, Hill Climbing, Best first search. A* and AO* Algorithms and control strategies. Knowledge representation issues, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward and backward reasoning, Strong slot and weak slot filler structure.

UNIT III	NEURAL NETWORKS	9

Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference between ANN and human brain, characteristic and applications of ANN, single layer network. Perceptron training algorithm, Linear separability, Widrow & Hebb's learning rule/Delta rule. Introduction of MLP, activation functions, Error calculation, back propagation algorithm, momentum, limitation, characteristics and application of BPAs.

UNIT IV	FUZZY LOGIC AND FUZZY SYSTEMS	9

Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, features of membership functions. Fuzzy propositions, formation, decomposition & aggregation of fuzzy Rules, fuzzy reasoning, fuzzy decision making & Applications of fuzzy logic.

UNIT V	GENETIC ALGORITHM AND APPLICATIONS	9

Fundamental basic concepts: working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion, deletion, mutation operator and Bitwise operator. Generational Cycle, Convergence of GA, Differences & similarities between GA and other traditional methods, Applications & advances in GA.
TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Outline soft computing techniques and their applications.

CO2: Analyze various neural network architectures.

CO3: Explain perceptrons and propagation networks.

CO4: Demonstrate the fuzzy systems and fuzzy rules.

CO5: Analyze the genetic algorithms and their applications.

TEXT BOOKS:

1. S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", 2nd Edition, Wiley Publications, 2011.
2. S. Rajasekaran and G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications", 1st Edition, PHI Publication, 2009.
3. George J Klir and Bo Yuan, "Fuzzy sets & Fuzzy Logic, Theory & Applications", 1st Edition, PHI Publication, 2009.

REFERENCES:

1. N.K.Bose and Ping Liang, "Neural Network fundamental with Graph, Algorithms & Applications", 1st Edition, TMH, 1998.
2. Bart Kosko, "Neural Network & Fuzzy System", 1st Edition, PHI Publication, 2009.
3. Rich E and Knight K, "Artificial Intelligence", 3rd Edition, TMH, 2012.

21PEC53	**MACHINE LEARNING**	**L**	**T**	**P**	**C**
		2	**2**	**0**	**3**

COURSE OBJECTIVES:

- To outline the basic concepts and techniques of Machine Learning.
- To learn about Supervised and Unsupervised Learning Techniques.

- To explain the various Probability Based Learning Techniques.
- To explore the Dimensionality Reduction and Evolutionary Models.
- To interpret the Graphical Models.

UNIT I	**INTRODUCTION TO LEARNING**	**12**

Learning – Types of Machine Learning: Supervised Learning, The Brain and the Neuron, Design a Learning System, Perspectives and Issues in Machine Learning, Concept Learning Task, Concept Learning as Search, Finding a Maximally Specific Hypothesis, Version Spaces and the Candidate Elimination Algorithm, Linear Discriminants, Perceptron, Linear Separability, Linear Regression.

UNIT II	**LINEAR MODELS**	**12**

Multi-layer Perceptron, Going Forwards, Going Backwards: Back Propagation Error- Multi-layer Perceptron in Practice, Examples of using the MLP- Overview. Deriving Back Propagation, Radial Basis Functions and Splines: Concepts, RBF Network. Curse of Dimensionality–Interpolations and Basis Functions–Support Vector Machines.

UNIT III	**TREE AND PROBABILISTIC MODELS**	**12**

Learning with Trees: Decision Trees, Constructing Decision Trees, Classification and Regression Trees. Ensemble Learning, Boosting, Bagging. Different ways to Combine Classifiers, Probability and Learning. Data into Probabilities- Basic Statistics. Gaussian Mixture Models, Nearest Neighbor Methods, Unsupervised Learning, K- means Clustering Algorithms.

UNIT IV	**DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS**	**12**

Dimensionality Reduction, Linear Discriminant Analysis. Principal Component Analysis, Factor Analysis, Independent Component Analysis, Locally Linear Embedding. Isomap, Least Squares Optimization, Evolutionary Learning: Genetic algorithms – Genetic Offspring: - Genetic Operators. Reinforcement Learning – Markov Decision Process

UNIT V	**GRAPHICAL MODELS**	**12**

Markov Chain, Monte Carlo methods. Sampling, Proposal distribution. Graphical models. Bayesian networks, Markov Random Fields, Hidden Markov models, Tracking methods

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Make use of the appropriate machine learning strategy for any given problem.

CO2: Compare supervised, unsupervised and semi-supervised learnings.

CO3: Outline the role of Probabilistic models in learning.

CO4: Explain dimensionality reduction algorithms.

CO5: Illustrate the graph models of machine learning.

TEXT BOOKS:

1. Ethem Alpaydin, " Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", 3rd Edition, MIT Press, 2014.
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/ CRC Machine Learning and Pattern Recognition Series, 2014.
3. Tomm Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2013.

REFERENCES:

1. Jason Bell, "Machine learning- Hands on for Developers and Technical Professionals", 1stEdition, Wiley, 2014.
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", 1stEdition, Cambridge University Press, 2012.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012.

21PEC54	DEEP LEARNING TECHNIQUES	L	T	P	C
		2	2	0	3

COURSE OBJECTIVES:

- To outline the concept of deep learning and fundamental mathematics required for deep learning.
- To infer the modern practical deep networks and their applications.
- To explain the research methods of deep learning.
- To know about the various deep generative models.
- To summarize the applications of deep learning networks.

UNIT I	INTRODUCTION AND PREREQUISITE MATHEMATICS	12

Introduction – Historical trends in deep learning - Linear algebra – Scalars – Vectors –

Matrices and Tensors – Linear dependence and span - Probability and information theory – The chain rule of conditional probability - Bayes rule – Machine learning basics –Supervised and Unsupervised learning algorithms – Stochastic gradient descent.		
UNIT II	**MODERN PRACTICAL DEEP NETWORKS**	**12**
Deep feed forward networks – Gradient based learning – Back propagation and other differentiation algorithms – Regularization for deep learning: Parameter norm penalties – Norm penalties as constrained optimization – Challenges in training deep models – Convolution networks operation – Pooling – Recurrent neural networks – Bidirectional RNNs – Deep recurrent networks – Recursive neural networks.		
UNIT III	**DEEP LEARNING RESEARCH**	**12**
Probabilistic PCA and factor analysis - Independent Component Analysis (ICA) –Auto encoders - Representation learning- Greedy layer-Wise unsupervised pretraining - Transfer learning and Domain adaptation - Semi-supervised disentangling of causal factors - Structured probabilistic models for deep learning -The challenge of unstructured modeling - Using graphs to describe model structure - Sampling from graphical models - Learning about dependencies - Inference and approximate inference.		
UNIT IV	**DEEP GENERATIVE MODELS**	**12**
Boltzmann machines - Restricted Boltzmann machines - Deep belief networks – Deep boltzmann machines - Boltzmann machines for real valued data - Convolutional Boltzmann machines - Boltzmann machines for structured or sequential outputs - other Boltzmann machines – Back propagation through random operations - Directed generative nets - Drawing samples from auto encoders - Generative stochastic networks -Other generation schemes - Evaluating generative models.		
UNIT V	**APPLICATION AND VISUALIZATION**	**12**
Large scale deep learning – Computer vision – Speech recognition – Natural language processing – Other applications - Visualizations - Visual data analysis techniques - Interaction techniques – Social network analysis – Collective inferencing.		
TOTAL: 60 PERIODS		
COURSE OUTCOMES: At the end of the course, learners will be able to CO1: Make use of mathematical concepts to know the fundamentals of deep learning		

algorithms.

CO2: Select a suitable optimization strategy for deep learning implementation.

CO3: Outline the research modes of deep learning.

CO4: Illustrate suitable deep learning models with suitable justification.

CO5: Plan a suitable visualization technique for the deep learning applications.

TEXT BOOKS:

1. Ian Good fellow, Yoshua Bengio and Aaron Courville, “Deep Learning”, 1st Edition, MIT Press, 2016.
2. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, 1st Edition, MIT Press, 2012.
3. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.

REFERENCES:

1. Yusuke Sugomori, "Java Deep Learning Essentials", 1st Edition, PACKT, 2016.
2. Timothy Masters, “Deep Belief Nets in C++ and CUDA C: Volume 1: Restricted Boltzmann Machines and Supervised Feed Forward Networks”, 1st Edition, Springer, 2015.
3. Jeff Heaton, “Artificial Intelligence for Humans, Volume 3: Deep Learning and Neural Networks”, 1st Edition, Heaton Research, 2015

21PEC55	**DIGITAL FORENSICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To outline the fundamentals concepts of digital forensics.
- To know about various stages of investigations.
- To be familiar with the acquisition and identification analysis.
- To explore about the evidence processing in forensics analysis.
- To gain knowledge on the available software and hardware tools.

UNIT I	**FUNDAMENTALS OF FORENSICS**	**9**

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues.

UNIT II	PROCEDURES OF INVESTIGATIONS	9
Understanding Computing Investigations – Procedure for corporate High-Tech investigations, understanding data recovery work station and software, conducting and investigations.		
UNIT III	**ACQUISITION AND ANALYSIS OF DIGITAL EVIDENCE**	**9**
Data acquisition- understanding storage formats and digital evidence, determining the best acquisition method, acquisition tools, validating data acquisitions, performing RAID data acquisitions, remote network acquisition tools, other forensics acquisitions tools.		
UNIT IV	**EVIDENCE PROCESSING AND DIGITAL FORENSICS ANALYSIS**	**9**
Processing crimes and incident scenes, securing a computer incident or crime, seizing digital evidence at scene, storing digital evidence, obtaining digital hash, reviewing case.		
UNIT V	**SOFTWARE AND HARDWARE TOOLS**	**9**
Current computer forensics tools- software, hardware tools, validating and testing forensic software, addressing data-hiding techniques, performing remote acquisitions, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the basics of digital forensics.

CO2: Outline different types of investigations.

CO3: Summarize evidence collection on digital devices.

CO4: Analyze and validate evidences collected from various sources.

CO5: Apply various tools to analyze collected evidence.

TEXT BOOKS:

1. Warren G. Kruse II and Jay G. Heiser, “Computer Forensics: Incident Response Essentials”, Addison Wesley, 2002.
2. Nelson, B, Phillips, A, Enfinger, F, Stuart, C., “Guide to Computer Forensics and Investigations, 2nd Edition., Thomson Course Technology, 2006.
3. Sammons, J, “The basics of digital forensics: The primer for getting started in digital forensics”, Elsevier, 2012.

REFERENCES:

1. Vacca, J, "Computer Forensics, Computer Crime Scene Investigation", 2nd Edition, Charles River Media, 2005, ISBN: 1-58450-389.
2. Nelson, Phillips Enfinger, Steuart, "Computer Forensics and Investigations", 6th Edition, Cengage Learning, 2018.
3. Xiaodong Lin," Introductory Computer Forensics-A Hands on Practical Approach", Springer 2018.

21PEC56	**SWARM INTELLIGENCE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES :

- To outline the fundamentals of swarm intelligence
- To gain knowledge about Ant colony optimization
- To learn about the evolution and principles of Particle swarm optimization
- To explore the artificial bee colony optimization algorithm
- To outline the concepts of herd and grey wolf optimization.

UNIT I	**INTRODUCTION TO SWARM INTELLIGENCE**	**9**

Essence of an Algorithm, Algorithms and Self –Organization, Links between Algorithms and Self-Organization, Characteristics of Meta heuristics; Swarm Intelligence based algorithms – Ant Algorithms; Bee Algorithms; Particle Swarm Optimization and Krill Herd Algorithms; Strategies for state space search in AI- Depth First and Breadth First Search Heuristic Search-Best First Search and Hill Climbing.

UNIT II	**ANT COLONY OPTIMIZATION (ACO)**	**9**

Theoretical Considerations, Combinatorial optimization and meta heuristic, Stigmergy, Convergence Proofs, ACO Algorithm, ACO and Model Based Search, Variations Of ACO: Elitist Ant System (EAS), Min max Ant System (MMAS) and Rank Based Ant Colony System (RANKAS), ACO Algorithm for Travelling Sales Person problem, ACO algorithm for feature selection.

UNIT III	PARTICLE SWARM OPTIMIZATION	9
Principles of Bird Flocking and Fish Schooling, Evolution of PSO, Operating Principles, PSO Algorithm, Neighbourhood Topologies, Convergence Criteria, Variations of PSO.		
UNIT IV	**ARTIFICIAL BEE COLONY (ABC) OPTIMIZATION**	**9**
Behaviour of real bees, ABC Algorithm, Variations of ABC: Abcg best and Abcg best dist, Case Study: Application of ABC algorithm in solving Travelling Salesman Problem, Knapsack Problem and for feature selection.		
UNIT V	**HERD OPTIMIZATION AND GREY WOLF OPTIMIZATION**	**9**
Herding Behaviour of Krill Swarms, Lagrangian Model of Krill Herding, Methodology, Application of Krill Herd Algorithm in Feature Selection. Introduction to Elephant Herd Optimization, Grey Wolf Optimization, Applications of Elephant Herd Optimization and Grey Wolf Algorithm in Feature Selection.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the concepts of swarm intelligence
CO2: Outline the theory of ant colony optimization algorithm
CO3: Explain the principles of particle swarm optimization
CO4: Interpret the applications of ABC optimization algorithm
CO5: Summarize the types of herd and grey wolf optimization

TEXT BOOKS:

1. Xin-She Yang, Zhihua Cui, Renbin Xiao, Amir Hossein Gandomi, Mehmet Karamanoglu, “Swarm Intelligence and Bio-Inspired Computation, Theory and Applications”, Elsevier ,2013.
2. Marco Dorigo and Thomas Stutzle, “Ant Colony Optimization”, MIT Press, Cambridge, England, 2004.
3. Hossein Rezaei, Omid Bozorg-Haddad, Xuefeng Chu, “Grey Wolf Optimization (GWO) Algorithm”, Ist Edition, Springer Singapore

REFERENCES:

1. Ben Coppin, “Artificial Intelligence Illuminated”, Jones and Bartlett Publishers, 2004.

2. Kennedy J and Russel C Eberhart, "Swarm Intelligence", Morgan Kaufmann Publishers, USA, 2001.
3. Dervis Karaboga, Bahriye Akay," A comparative study of Artificial Bee Colony Algorithm" ,Applied Mathematics and Computation , Elsevier Publications, 2009.

ONE CREDIT COURSES

21OCEC01	A PRACTICAL COURSE ON COMMUNICATION SYSTEMS – SIGNAL GENERATION AND ANALYSIS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To develop professionals with understanding of practical aspects of Industry Standard Terminology.
- To understand the concept of baseband signals.
- To interpret the analog and digital modulation schemes.

LIST OF EXPERIMENTS:

1. Study of time domain and frequency domain measurement units used in the Industry.
2. Analog and Digital signal generation.
3. Analysis of ADC and DAC blocks using simulink.
4. Analysis of filters.
5. IF processing.
6. Synchronization and equalization.
7. Analysis of Inter symbol Interference.
8. Study of signal processing techniques.
9. Analysis of baseband signals like Sine, Triangular, Ramp, Pulse.
10. Analog modulated signal generation.
11. Digital modulated signal generation.
12. Higher order IQ modulated signal generation.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Interpret the terminologies of baseband communication

CO2: Design a module for a communication system with necessary constraints.

CO3: Design a block for M-ary digital modulation scheme.

REFERENCES:

1. B.Sklar, "Digital Communication Fundamentals and Applications", 2nd Edition, Pearson Education, 2009.
2. H P Hsu, "Schaum Outline Series -Analog and Digital Communications", 2nd Edition, TMH, 2006.
3. J.G Proakis, "Digital Communication", 4th Edition, TMH, 2001.

21OCEC02	A PRACTICAL COURSE ON RF MEASUREMENTS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES :

- To understand the basic calibration operations in network analyzer.
- To perform analysis of RF filters and amplifiers.
- To measure and troubleshoot the RF transceiver parameters.

LIST OF EXPERIMENTS:

1. S-parameter measurements.
2. Vector network analysis of RF Filter – transmission, reflection, impedance on Smith Chart.
3. Vector network analysis of Amplifier – gain, isolation, gain compression, AM-PM conversion.
4. Vector network & Spectrum analysis of RF divider/combiner – insertion loss, return loss.
5. Study of Spectrum Analyzer settings.
6. Spectrum analysis of Frequency Synthesizer and Mixer – harmonics, inter-modulation, isolation.
7. Study of gain, compression, harmonics and isolation.
8. Measurement and troubleshooting of RF Transceiver.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Make use of vector network analyzer to perform calibration for S parameter measurements.

CO2: Demonstrate convolution, correlation, frequency analysis and sampling.

CO3: Design RF transceivers.

REFERENCES:

1. Agilent Technologies, Inc., Fundamentals of RF and microwave noise figure measurements, Agilent Application Note 57-1, 2010.
2. F. Caspers, RF engineering basic concepts: S-parameters, CAS Proc., 2010, CERN Yellow Report CERN-2011.
3. Agilent Technologies, Inc., Time domain analysis using a network analyzer, Agilent Application Note 1287-12, 2012.

21OCEC03	A PRACTICAL COURSE ON ANTENNA DESIGN AND SIMULATION	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To design the antenna with special geometry elements.
- To design various types of microstrip antennas.
- To design various antenna arrays.

LIST OF EXPERIMENTS:

1. Design and simulation of Patch Antenna.
2. Design and simulation of DGS structure.
3. Design and simulation of Metamaterial Unit Cell and EBG structures.
4. Design and simulation of Implantable Antennas.
5. Design and simulation of Spiral Antenna, Circularly polarized Antenna.
6. Design and simulation of Linear Array, Planar Array.
7. Study of Vector Network Analyzer (VNA).
8. Measurement of antenna parameters using VNA.

PROJECT

1. Any one of the Application Specific Design in Antenna or in RF Circuits

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Design and analyze Patch Antennas and Arrays.
CO2: Design antennas of frequency specific applications.
CO3: Make use of the simulation tools and analyze parameters in the design of array antennas.

REFERENCES:

1. Kraus. J.D, "Antennas", 2nd Edition, Reprint, John Wiley and Sons, 2011.
2. Balanis.A, "Antenna Theory Analysis and Design", 3rd Edition, John Wiley and Sons, New York, 2005.
3. W.L.Stutzman and G.A.Thiele, "Antenna Theory and Design", 2nd Edition John Wiley & Sons NC, 2008.

21OCEC04	A PRACTICAL COURSE ON EMBEDDED SYSTEMS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To expose learners to the field of Embedded Systems.
- To enable learners to implement their creative concepts to work.
- To understand the ARM interfacing and communication protocols

LIST OF EXPERIMENTS:

1. Familiarization of IDE and ARM development board usage and program execution.
2. Program to blink a group of 8 LEDs with a delay.
3. Interface 4-digit seven-segment display to display any four letter word.
4. Interface stepper motor and control its speed and direction.
5. Interfacing of DC motors.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Develop assembly language programs to perform specific tasks using ARM instructions.
CO2: Develop ARM microcontroller applications using Embedded C language.

CO3: Design and develop program to interface external hardware with LPC214x micro controller.

REFERENCES:

1. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guide Designing and Optimizing System Software, Morgan Kaufmann Publishers", Elsevier Inc, 2004.
2. William Hohl, Christopher Hinds, "ARM assembly language Fundamentals and Techniques", 2nd Edition, CRC Press, 2015.
3. Gibson, "ARM Assembly Language An Introduction", 2nd Edition, 2007.

21OCEC05	**A PRACTICAL COURSE ON UAV SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVES:

- To design the quadcopter and UAV.
- To test the propulsion system of UAV systems.
- To simulate the auto pilot system using software.

LIST OF EXPERIMENTS:

1. Design of Multi rotor UAV.
2. Testing and Selection of appropriate propulsion system for Multi rotor UAVs.
3. Integration, Testing and Calibration of Autopilot system in Multi rotor UAVs.
4. Control - PID Calibration of multi rotor flight controller.
5. Simulation of piloting of unmanned systems using flight simulator software.
6. Generation of 3D modeling using visual SFM and Mesh Lab.
7. Design and parameter calculation of fixed wing UAV.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Design and calculation of multi rotor UAV.

CO2: Build and select suitable the propulsion system of UAV systems.

CO3: Model the auto pilot system using flight controller software.

REFERENCES:

1. Paul G Fahlstrom, Thomas J Gleason, Introduction to UAV Systems, 5^{th} Edition, Wiley publications, 2022.
2. Dr. Armand J. Chaput, Design of Unmanned Air Vehicle Systems, 1^{st} Edition, Lockheed Martin Aeronautics Company, 2001
3. Kimon P. Valavanis, Advances in Unmanned Aerial Vehicles: State of the Art and the Road to Autonomy, Springer, 2008

21OCEC06	**ARTIFICIAL NEURAL NETWORKS – A PRACTICAL APPROACH**	**L**	**T**	**P**	**C**
		0	**0**	**2**	**1**

COURSE OBJECTIVES:

- To explore the architecture and learning principles of Neural Networks.
- To develop the various hybrid algorithms involved in Neural Networks.
- To provide adequate knowledge of application of Neural Networks to real time systems.

LIST OF EXPERIMENTS

1. Convolution Neural Network
2. Perceptron learning
3. Multi layer feed forward neural networks
4. Hopfield model for pattern storage task
5. Hopfield model with stochastic update
6. Optimization problems using Hopfield models
7. Mean-field annealing using ANN.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Apply the concept of neural in practical applications.

CO2: Analyze the performance of advanced neural networks.

CO3: Solve real world problems using Neural Techniques.

REFERENCES:

1. Jang J.S.R., Sun C.T, MizutaniE, “Neuro Fuzzy and Soft computing”, Pearson education (Singapore), Reprint 2010.
2. S.Rajasekaran and G.A.Vijayalakshmi Pai “Neural networks, Fuzzy logics, and Genetic algorithms”, Prentice Hall of India, 2013.
3. J.A.Freeman, B.M.Skapura, "Neural Networks, Algorithms Applications and Programming Techniques", Addison–Wesly, 2003.
4. LaureneV.Fausett, “Fundamentals of Neural Networks: Architectures, Algorithms And Applications”, Prentice Hall, 2013.

21OCEC07	REMOTE SENSING IMAGE ANALYSIS USING ENVI PACKAGE	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To understand various components of remote sensing.
- To provide an exposure to GIS and its practical applications
- To understand the image pre-processing techniques in remote sensing.

LIST OF EXPERIMENTS

1. Image resizing and rotation.
2. Image Mosaicking using ENVI.
3. Image Segmentation – Multispectral images.
4. Supervised Classification for Multispectral images.
5. Supervised Classification for Hyperspectral Images.
6. Unsupervised Classification for Multispectral images.
7. Unsupervised Classification for Hyperspectral Images.
8. LANDSAT TM and SPOT data fusion.
9. Anomaly detection.
10. Principal Component Analysis.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Apply the knowledge on Principles of Remote Sensing and GIS.
CO2: Analyze and interpret the remote sensing data.
CO3: Integrate GIS and Remote sensing data for specific applications.

REFERENCES:

1. Lillesand,T.M, Kiefer,R.W and J.W.Chipman, "Remote Sensing and Image Interpretation" 5th Edition, John Willey and Sons Asia Pvt. Ltd., NewDelhi, 2011.
2. AnjiReddy.M. "Text book of Remote Sensing and Geographical Information System" 2nd Edition, BS Publications, Hyderabad, 2010.

21OCEC08	ARDUINO FOR ENGINEERS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To examine the hardware architecture of Arduino board.
- To apply skills on programming and interfacing of peripheral devices with Arduino.
- To utilize the Arduino board for practical applications.

LIST OF EXPERIMENTS

1. Study of Arduino and its types.
2. Arduino IDE for Blink LED - Programming.
3. RGB LED using Arduino - Programming.
4. Temperature monitoring using Arduino.
5. RFID, NFC using Arduino.
6. MQTT protocol using Arduino.
7. Zigbee Protocol using Arduino.
8. Design the circuit to interface LM35 with Arduino UNO controller.
9. Develop the embedded system to activate serial communication of Arduino UNO.
10. Interfacing of analog, digital and ultrasonic sensors with Arduino UNO.

MINI PROJECT-SYSTEM DESIGN WITH ARDUINO

Digital Code Lock – Temperature Monitoring System – Automatic Light System – Ultrasonic Distance meter – Automatic Irrigation System – Home Automation – Line follower Robot – Room Cleaning Robot with ultrasonic sensors
TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Understand the hardware architecture of Arduino.

CO2: Develop a program and interface the Arduino board with peripherals

CO3: Design Arduino based practical real life applications.

REFERENCES:

1. J. M. Hughes, "Arduino: A Technical Reference", 1st Edition, O'Reilly Media, Inc, USA, 2016.
2. Richard Blum, "Arduino Programming in 24 Hours, Sams Teach Yourself", 1st Edition, Pearson Education Inc, 2015.

21OCEC09	IOT FOR HEALTHCARE MONITORING	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To understand the various standards of IoT.
- To design a IoT model interfaced with sensors.
- To understand the practical use cases of IoT in real time applications.

LIST OF EXPERIMENTS:

1. Recording and Remote Monitoring of ECG in standard lead systems using IoT.
2. Recording and Remote Monitoring of Electromyogram signals using IoT .
3. Recording Remote Monitoring of EEG signal signals using IoT.
4. Measurement and Continuous Monitoring of respiratory parameters using Embedded IoT.
5. Measurement of Vital parameters using patient monitoring system and IoT

CASE STUDY:

1. Wireless Patient Monitor system.
2. Wearable Fitness & Activity Monitor Unit.
3. Design of IOT based pulse oximeter.

4. Neo Natal Health Parameter Monitoring Batch.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Illustrate the basic concepts of IOT in healthcare.

CO2: Relate the existing hardware platforms and sensor interfaces for various healthcare based applications.

CO3: Build various applications in healthcare using IOT based approach and substantiate the same with appropriate case studies.

REFERENCES:

1. Enrioco Coira , "Guide to healthcare informatics" , 2nd Edition, Arnold Publication, 2019.
2. Frank Sullivan, Jyreme C Watt, "ABC of Health Informatics", ABC series, 2006.
3. Arshdeep Bahga, Vijay Madisetti, "lnternet of Things-A hands-on approach", Universities Press, 2015.

21OCEC10	WEARABLE DEVICES FOR MEDICAL APPLICATIONS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To identify the need for development of wearable devices and its implications on various sectors.
- To comprehend the design and development of various wearable inertial sensors.
- To explore the usage of various wearable locomotive sensors as assistive devices for tracking and navigation.

LIST OF EXPERIMENTS:

1. Study of electrical activity of heart using wearable ECG system.
2. Study of electrical activity of muscles using wearable EMG system.
3. Study of electrical pattern of brains using wearable EEG system.

4 Study of blood pressure using wearable pressure sensors.

5. Study of respiration rate using accessories.

6. Study of Galvanic Skin Resistance using wearable electrodes.
7. Study of body temperature using wearable temperature sensor.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to

CO1: Outline the need for development of wearable devices and its influence on Various sectors.

CO2: Explain the applications of wearable inertial sensors for biomedical applications.

CO3: Summarize the working principle of wearable assistive devices.

REFERENCES:

1. Toshiyo Tamura and Wenxi Chen, Seamless Healthcare Monitoring", Springer 2018.
2. Edward Sazonov and Michael R. Neuman, "Wearable Sensors-Fundamentals, Implementation and Applications", Elsevier Inc., 2014.
3. Aime Lay- Ekuakille and Subhas Chandra Mukhopadhyay, "Wearable and Autonomous Biomedical Devices and Systems for Smart Environment", Springer 2010.

21OCEC11	DESIGN THINKING	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To outline the design thinking concepts and principles.
- To use design thinking methods in every stage of the problem.
- To apply various methods in design thinking.

UNIT I INTRODUCTION TO DESIGN THINKING

Need for Design - Four Questions, Ten Tools - Principles of Design Thinking - The process of Design Thinking - How to plan a Design Thinking project.

UNIT II IDEATION AND PROTOTYPE

Ideate Phase - The creative process and creative principles - Creativity techniques - Evaluation of ideas - Prototype Phase - Lean Startup Method for Prototype Development - Visualization

and presentation techniques.	
UNIT III	**TESTING AND IMPLEMENTATION**
Test Phase - Tips for interviews - Tips for surveys - Kano Model - Desirability Testing - How to conduct workshops - Requirements for the space - Material requirements - Agility for Design Thinking.	
	TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the key concepts of design thinking.

CO2: Outline design thinking in all stages of problem solving.

CO3: Apply design thinking approach to real world problems.

REFERENCES:

1. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011.
2. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013.
3. Johnny Schneider, "Understanding Design Thinking, Lean and Agile", O'Reilly Media, 2017.
4. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press, 2009.

21OCEC12	**EMOTIONAL INTELLIGENCE**	**L**	**T**	**P**	**C**
		1	**0**	**0**	**1**

COURSE OBJECTIVES:

- To gain knowledge of emotional intelligence and its importance to personal and professional success.
- To increase the level of emotional intelligence.
- To employ the emotions for better decision making.

UNIT I	**CONCEPT OF EMOTIONAL INTELLIGENCE**
Emotion- Meaning, characteristics of emotion, components of emotion-cognitive component,	

physiological component, Behavioural component. Types of emotions, exposing the myths about emotion, physiological or bodily changes accompanying emotions. Development of emotions and emotional maturity, Emotional Intelligence – concept, history, measurement of EI.

UNIT II	INTERPERSONAL AND INTRAPERSONAL AWARENESS

Interpersonal Awareness Introduction, awareness about others-meaning and definition, awareness about others and success, personal life, professional life, development of awareness about others, empathy and reality testing. Interpersonal Management - Managing Interpersonal Relationships, Flexibility, Flexibility and success.

UNIT III	CONFLICT MANAGEMENT AND LEADERSHIP

Conflict Management, stages- pre-negotiation stage, negotiation stage, post negotiation stage, conflict management and success. Co-operation and collaboration, development of the skill of co-operation and collaboration Leadership- leadership – meaning and definition , leadership style and traits - task-oriented and relation oriented styles, authoritarian, democratic and laissez faire styles, Inspirational leadership.

TOTAL: 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the characteristics and components of EI.

CO2: Interpret the problem solving methods in enhancing relationships.

CO3: Illustrate the techniques to enhance collaboration and leadership skills.

REFERENCES:

1. Harvard Business Review, Daniel Goleman, Richard E. Boyatzis, Sydney Finkelstein, Annie McKee, “HBR's 10 Must Reads on Emotional Intelligence”, Harvard Business Review Press, 2015.
2. Chade-Meng Tan, Daniel Goleman, Jon Kabat-Zinn, “Search Inside Yourself”, HarperCollins, 2012.
3. Daniel Goleman, “Emotional Intelligence Why It Can Matter More Than IQ”, Bloomsbury Publishing, 2009
4. Liz Wilson, Stephen Neale & Lisa Spencer-Arnell, “Emotional Intelligence Coaching”. Kogan Page India Private Limited, 2012

MANDATORY COURSES

21MCC01	CONSTITUTION OF INDIA	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- To explain the basic features and fundamental principles of Constitution of India.
- To explain the salient features and characteristics of the Constitution of India.
- To explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers.
- To explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India.
- To explain the Local Self Government – Constitutional Scheme in India.

SYLLABUS:

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States.
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India.
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the meaning of the constitution law and constitutionalism and Historical perspective of the Constitution of India.

CO2: Explain the salient features and characteristics of the Constitution of India, scheme of the fundamental rights and the scheme of the Fundamental Duties and its legal status.

CO3: Explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers between the Union and the States, and Parliamentary Form of Government in India.

CO4: Explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India, and Emergency Provisions.

CO5: Explain the Local Self Government – Constitutional Scheme in India, Scheme of the Fundamental Right to Equality.

TEXT BOOKS:

1. Durga Das Basu,"Introduction to the Constitution of India", LexisNexis Butterworths Wadhwa, 20th Edition, Reprint 2011.
2. Web link: https://www.india.gov.in/my-government/ constitution-India.

21MCC02	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- To explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge.
- To explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.
- To explain about the use of Traditional Knowledge to meet the basic needs of human being.
- To explain the rich biodiversity materials and knowledge preserved for practicing traditional lifestyle.
- To explain the use of Traditional Knowledge in Manufacturing and Industry.

UNIT-I	TRADITIONAL AND MODERN KNOWLEDGE	3
Two Worlds of Knowledge - Phase of Explorers, Sir Arthur Cotton and Irrigation, Smallpox Vaccination, Late Nineteenth Century, Voelcker, Howard and Agriculture, Havell and Indian Art; Indians at the Encounter - Gaekwad of Baroda and Technical Education, Science Education and Modern Industries, Hakim Ajmal Khan and Ayurveda, R. N. Chopra and Indigenous Drugs, Gauhar Jaan and Indian Classical Music; Linking Science and the Rural - Tagore's Sriniketan Experiment, Marthandam, the YMCA Model, Gandhi's Thoughts on Development, Nehru's View of Growth; Post- Independence Era - Modernization and Traditional Knowledge, Social Roots of Traditional Knowledge Activism, Global Recognition for Traditional Knowledge.		
UNIT-II	**PROTECTION AND SHARING**	**3**
For Recognition and Protection - United Nations Educational, Scientific and Cultural Organization (UNESCO), World Health Organization (WHO), International Labour Organization (ILO), UN Working Group on Indigenous Populations, Evolution of Other Organizations; Norms of Sharing - United Nations Environment Programme (UNEP), World Intellectual Property Organization (WIPO), World Trade Organization (WTO); IPR and Traditional Knowledge - Theoretical Background, Positive Protections of TK, Defensive Strategies, IPR Facilitation for TK.		
UNIT-III	**TRADITIONAL KNOWLEDGE FOR BASIC NEEDS**	**3**
Indian Midwifery Tradition—The Dai System, Surface Flow Irrigation Tanks, Housing - A Human Right, Changing Priorities—Niyamgiri. **Biodiversity and Genetic Resources:** Jeevani - The Wonder Herb of Kanis, A Holistic Approach - FRLHT, Basmati - In the New Millennium, AYUSH-Based Cosmetics.		
UNIT-IV	**TRADITIONAL KNOWLEDGE IN MANUFACTURING**	**3**
Drug Discovery, A Sweetener of Bengal, The Sacred Ring of Payyanur, Channapatna Toys.		
UNIT-V	**TRADITIONAL CULTURAL EXPRESSIONS**	**3**
Banarasi Saree, Music, Built and Tangible Heritage, Modern Yoga, Sanskrit and Artificial Intelligence, Climate Change and Traditional Knowledge.		
		TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the concept of Indian Traditional Knowledge along with Indian Modern knowledge.

CO2: Explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.

CO3: Explain about the use of Traditional Knowledge to meet the basic needs of human being.

CO4: Explain the rich biodiversity materials and knowledge preserved for practicing traditional lifestyle.

CO5: Explain the use of Traditional Knowledge in Manufacturing and Industry.

TEXT BOOKS:

1. Nirmal Sengupta "Traditional Knowledge in Modern India Preservation, Promotion, Ethical Access and Benefit Sharing Mechanisms" Springer, 2019.
2. Amit Jha,"Traditional Knowledge System in India", Atlantic Publishers and Distributors Pvt Ltd, 2009.
3. Basanta Kumar Mohanta, Vipin Kumar Singh "Traditional Knowledge System and Technology in India", Pratibha Prakashan, 2012.
4. Kapil Kapoor, Michel Danino "Knowledge Traditions and Practices of India", Central Board of Secondary Education, 2012.

WEB REFERENCES :

1. NPTEL video lecture on "Ayurvedic Inheritance of India", Video link: https://nptel.ac.in/courses/121/106/121106003/#.
2. Youtube video on "Introduction to Indian Knowledge Systems", Video link: https://www.youtube.com/watch?v=LZP1StpYEPM.
3. Youtube video on "12 Great achievements of Indian Civilization", Video link: https://www.youtube.com/watch?v=xmogKGCmclE.

VELAMMAL

COLLEGE OF ENGINEERING & TECHNOLOGY, MADURAI – 625 009

(Autonomous)

(Accredited by NAAC with 'A' Grade and by NBA for 5 UG Programmes)

(Approved by AICTE and affiliated to Anna University, Chennai)

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING

CURRICULUM and SYLLABUS

(I to VIII Semesters)

VELAMMAL COLLEGE OF ENGINEERING & TECHNOLOGY, MADURAI-625009

(Autonomous)

REGULATIONS 2021

B.E. ELECTRICAL AND ELECTRONICS ENGINEERING (CBCS)

CURRICULUM FOR SEMESTERS I TO VIII

SEMESTER – I

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21IP101	Induction Programme (*Common to all B.E./B.Tech. Programmes*)	-	0	0	0	0
THEORY							
2.	21EN101	Professional English-I (*Common to all B.E./B.Tech. Programmes*)	HS	3	2	0	4
3.	21MA101	Matrices and Calculus (*Common to all B.E./B.Tech. Programmes*)	BS	3	2	0	4
4.	21PH101	Engineering Physics (*Common to all B.E./B.Tech. Programmes*)	BS	3	0	0	3
5.	21CH101	Engineering Chemistry *(Common to all B.E. / B.Tech..Programmes)*	BS	3	0	0	3
6.	21CS101	Problem Solving and Python Programming (*Common to all B.E./B.Tech. Programmes*)	ES	3	0	0	3
7.		Cambridge Course*	EE	1	0	0	1
PRACTICAL COURSES							
8.	21CS102	Problem Solving and Python Programming Laboratory (*Common to all B.E./B.Tech. Programmes*)	ES	0	0	4	2
9.	21PC101	Physics and Chemistry Laboratory *(Common to all B.E. / B.Tech.Programmes)*	BS	0	0	4	2
Total Credits							**22**

***Naan Mudhalvan Scheme Course**

SEMESTER – II

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21EN102	English –II *(Common to all B.E./B.Tech. Programmes)*	HS	3	0	0	3
2.	21MA102	Vector calculus and Complex Variables (*Common to B.E. CIVIL Engg., EEE&MECH Engg.*)	BS	3	2	0	4
3.	21PH105	Physics for Electrical Engineering	BS	3	0	0	3
4.	21ME101	Engineering Graphics *(Common to all B.E./B.Tech. Programmes)*	ES	2	0	2	3
5.	21EE101	Electric Circuit Analysis	PC	3	2	0	4
6.	21CH103	Environmental Science *(Common to all B.E./B.Tech.Programmes)*	BS	2	0	0	2
7.	21MC101	Basic Civil and Mechanical Engineering	ES	3	0	0	3
PRACTICAL COURSES							
8.	21EM101	Engineering Practices Laboratory *(Common to all B.E./B.Tech. Programmes)*	ES	0	0	4	2
9.	21EE102	Electric Circuits Laboratory	PC	0	0	4	2
Total Credits							**26**

SEMESTER – III

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21MA202	Transform Techniques and its Applications	BS	3	2	0	4
2.	21EE201	Field Theory	PC	3	2	0	4
3.	21EE202	DC Machines and Transformers	PC	3	0	0	3
4.	21EE203	Transmission and Distribution	PC	3	0	0	3
5.	21EE204	Electronic Devices and Circuits	PC	3	0	0	3
6.	21EE205	Digital Logic Circuits	PC	3	0	0	3
7.		Microsoft Office Fundamentals*	EE	1	0	0	1
PRACTICAL COURSES							
8.	21EE206	DC Machines and Transformers Laboratory	PC	0	0	4	2
9.	21EE207	Electronic Devices and Digital Laboratory	PC	0	0	4	2
Total Credits							**25**

SEMESTER – IV

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21MA207	Statistics and Numerical Methods	BS	3	2	0	4
2.	21EE208	Measurements and Instrumentation	PC	3	0	0	3
3.	21EE209	Induction and Synchronous Machines	PC	3	0	0	3
4.	21EE210	Control Systems	PC	3	2	0	4
5.	21EE211	Integrated Circuits	PC	3	0	0	3
THEORY WITH PRACTICAL COURSE							
6.	21EE212	Microprocessors, Microcontrollers and Interfacing	PC	3	0	2	4
PRACTICALCOURSES							
7.	21EE213	Induction and Synchronous Machines Laboratory	PC	0	0	4	2
8.	21EE214	Integrated Circuits and Instrumentation Laboratory	PC	0	0	4	2
Total Credits							**25**

***Naan Mudhalvan Scheme Course**

SEMESTER –V

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21EE301	Power System Analysis	PC	3	0	0	3
2.	21EE302	Power Electronics	PC	3	0	0	3
3.	21EE303	Digital Signal Processing	PC	3	0	0	3
4.	21PEEXX	Professional Elective – I	PE	3	0	0	3
5.	21PEEXX	Professional Elective – II	PE	3	0	0	3
6.		Naan Mudhalvan Scheme Course*	EE	2	0	0	2
7.	21MCC01	Constitution of India	MC	1	0	0	0
8.		Internship#	EE	0	0	0	1
THEORY WITH PRACTICAL COURSES							
9.	21EE304	Embedded Systems	PC	2	0	2	3
10.	21CS308	C and Data Structures	ES	2	0	2	3
PRACTICAL COURSES							
11.	21EE305	Power Electronics Laboratory	PC	0	0	4	2
12.	21EN301	Professional Communication Laboratory *(Common to all B.E./B.Tech. Programmes)*	HS	0	0	2	1
Total Credits							**25**

***Internet of Things /Electric Vehicle Charging system /Industry 4.0/ Machine Learning / Smart Energy Grid/ AR VR Development**

 # Two weeks Internship

SEMESTER – VI

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21EE306	Protection and Switchgear	PC	3	0	0	3
2.	21PEEXX	Professional Elective – III	PE	3	0	0	3
3.	21PEEXX	Professional Elective – IV	PE	3	0	0	3
4.	21XXXXX	Open Elective-I	OE	3	0	0	3
5.	21XXXXX	Open Elective-II	OE	3	0	0	3
6.		Naan Mudhalvan Scheme Course*	EE	2	0	0	2
7.	21MCC02	Essence of Indian Traditional Knowledge	MC	1	0	0	0
8.	21OCEEXX	One Credit Course	EE	0	0	2	1

THEORY WITH PRACTICAL COURSE							
9.	21EE307	Renewable Energy Systems	PC	2	0	2	3
PRACTICAL COURSE							
10.	21EE308	Control Systems and Electrical Drives Laboratory	PC	0	0	4	2
Total Credits							**21**

SEMESTER – VII

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21EE401	Power System Operation and Control	PC	3	0	0	3
2.	21XXXXX	Open Elective-III	OE	3	0	0	3
3.	21XXXXX	Open Elective-IV	OE	3	0	0	3
4.		Naan Mudhalvan Scheme Course*	EE	2	0	0	2
PRACTICAL COURSES							
5.	21EE402	Power System Laboratory	PC	0	0	4	2
6.	21EE403	Project Work I	EE	0	0	4	2
Total Credits							**13**

***Internet of Things /Electric Vehicle Charging system /Industry 4.0/ Machine Learning / Smart Energy Grid/ AR VR Development**

SEMESTER – VIII

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21PEEXX	Professional Elective – V	PE	3	0	0	3
2.	21PEEXX	Professional Elective – VI	PE	3	0	0	3
PRACTICAL COURSE							
3.	21EE404	Project Work II	EE	0	0	20	10
Total Credits							**16**

SEMESTERWISE CREDIT DISTRIBUTION

	I	II	III	IV	V	VI	VII	VIII	Total Credits
HS	4	3	-	-	1	-	-	-	**8**
BS	12	9	4	4	-	-	-	-	**29**
ES	5	8	-	-	3	-	-	-	**16**
PC	-	6	20	21	14	8	5	-	**74**
PE	-	-	-	-	6	6	-	6	**18**
OE	-	-	-	-	-	6	6	-	**12**
EE	1	-	1	-	1+(2*)	1+(2*)	2+(2*)	10	**16**
Total	22	26	25	25	25	21	13	16	**173**

Naan Mudhalvan Scheme Course- Subject to guidelines provided by Government of Tamilnadu

S.No.	**Topic**
1	Humanities and Social Sciences including Management (HS)
2	Basic Sciences (BS)
3	Engineering Sciences including workshop, drawing, basics of electrical/mechanical/computer etc. (ES)
4	Professional Core Courses (PC)
5	Professional Elective : Courses relevant to chosen specialization/ branch (PE)
6	Open Electives : Courses from other technical and/or emerging courses (OE)
7	Project work, Seminar and Internship in Industry –Employability Enhancement Courses (EE)
8	Mandatory Course (MC)
9	One Credit Courses (OC)

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I: POWER ENGINEERING

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21PEE01	Energy Utilization & Conservation	PE	3	0	0	3
2.	21PEE02	Smart Grid	PE	3	0	0	3
3.	21PEE03	Power Quality	PE	3	0	0	3
4.	21PEE04	Restructured Power Systems	PE	3	0	0	3
5.	21PEE05	Power System Transients	PE	3	0	0	3
6.	21PEE06	Distributed Generation and Micro Grid	PE	3	0	0	3
7.	21PEE07	Energy Management and Auditing	PE	3	0	0	3
8.	21PEE08	Power System Dynamics	PE	3	0	0	3

VERTICAL II: POWER CONVERTERS AND DRIVES

S.No	Course Code	Course Title	Category	L	T	P	C
1.	21PEE09	Modern Power Converters	PE	3	0	0	3
2.	21PEE10	Switched Mode Power Converters	PE	3	0	0	3
3.	21PEE11	Power Electronics for Renewable Energy Systems	PE	3	0	0	3
4.	21PEE12	Special Electrical Machines	PE	3	0	0	3
5.	21PEE13	Solid State Drives and Control	PE	3	0	0	3
6.	21PEE14	Digital Control of Electrical drives	PE	3	0	0	3
7.	21PEE15	Wind Energy Conversion System	PE	3	0	0	3
8.	21PEE16	Flexible AC Transmission System	PE	3	0	0	3

VERTICAL III: EMBEDDED SYSTEM ENGINEERING

S.No	Course Code	Course Title	Category	L	T	P	C
1.	21PEE17	Microcontroller Based System Design	PE	3	0	0	3
2.	21PEE18	Real Time Operating systems	PE	3	0	0	3
3.	21PEE19	Pervasive Devices and Technology	PE	3	0	0	3
4.	21PEE20	Embedded Linux for IoT	PE	3	0	0	3
5.	21PEE21	Embedded Automotive System	PE	3	0	0	3
6.	21PEE22	Internet of Things in Medicine	PE	3	0	0	3
7.	21PEE23	Sensors and Transducers	PE	3	0	0	3

VERTICAL IV: ELECTRIC VEHICLE TECHNOLOGY

S.No	Course Code	Course Title	Category	L	T	P	C
1.	21PEE24	Electric Vehicle Architecture	PE	3	0	0	3
2.	21PEE25	Electric Vehicle Design, Mechanics and Control	PE	3	0	0	3
3.	21PEE26	Electric Hybrid Vehicles	PE	3	0	0	3
4.	21PEE27	Motor and Power Converters for Electric Vehicles	PE	3	0	0	3
5.	21PEE28	Electric Vehicle Charging System	PE	3	0	0	3
6.	21PEE29	Testing of Electric Vehicles	PE	3	0	0	3
7.	21PEE30	Renewable Energy Engineering	PE	3	0	0	3

VERTICAL V: MODERN CONTROL TECHNOLOGIES

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21PEE31	Non Linear Control System	PE	3	0	0	3
2.	21PEE32	Logic and Distributed Control System	PE	3	0	0	3
3.	21PEE33	Process Modeling and Simulation	PE	3	0	0	3
4.	21PEE34	Computer Control of Processes	PE	3	0	0	3
5.	21PEE35	System Modelling and Identification	PE	3	0	0	3
6.	21PEE36	Process Control	PE	3	0	0	3
7.	21PEE37	Robotics and Control	PE	3	0	0	3

VERTICAL VI: INDUSTRIAL SYSTEMS

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21PEE38	Nanomaterial for Energy Harvesting Applications	PE	3	0	0	3
2.	21PEE39	Energy Storage Systems	PE	3	0	0	3
3.	21PEE40	Industrial Instrumentation	PE	3	0	0	3
4.	21PEE41	Industrial Electrical and Electronics Engineering	PE	3	0	0	3
5.	21PEE42	Analytical Instrumentation	PE	3	0	0	3
6.	21PEE43	Soft Computing Techniques and Applications	PE	3	0	0	3
7.	21PEE44	Design of Electrical Installations	PE	3	0	0	3

MANDATORY COURSES

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21MCC01	Constitution of India	MC	1	0	0	0
2.	21MCC02	Essence of Indian Traditional Knowledge	MC	1	0	0	0

ONE CREDIT COURSES

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21OCEE01	Softwares for Electrical Engineering	OC	0	0	2	1
2.	21OCEE02	ANN applications to Electrical Engineering	OC	0	0	2	1
3.	21OCEE03	Solar Power Engineering	OC	0	0	2	1
4.	21OCEE04	Testing and Calibration System	OC	0	0	2	1
5.	21OCEE05	Hybrid Energy Systems	OC	0	0	2	1
6.	21OCEE06	Design Thinking	OC	1	0	0	1

SEMESTER-I

21IP101	INDUCTION PROGRAMME *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	0	0

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfil his/her responsibility as an engineer, as a citizen and as a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. "

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be

through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.
Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity
Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules
This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People
Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area
A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations
They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities
About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.
Induction Programme is totally an activity based programme and **therefore there shall be no tests / assessments** during this programme.

REFERENCE:

Guide to Induction program from AICTE

21EN101	PROFESSIONAL ENGLISH-1 (*Common to all B.E./B.Tech. Programmes*)	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To develop learners skills in listening and responding effectively
- To apply basic grammar for better communication
- To employ reading passages for understanding vocabulary
- To construct logical sentences and participate in pair presentation, extempore
- To organize ideas for various compositions in writing

UNIT I	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	15

Listening – Listening for general information - Specific details **-** Conversation: Introduction to classmates **-** Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form; **Speaking -** Self Introduction; Introducing a friend; Conversation - Politeness strategies; Telephone conversation; Leave a voicemail; Leave a message with another person; asking for information to fill details in a form; **Reading -** Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails; **Writing -** Writing emails / letters introducing oneself; **Grammar -** Present Tense (simple, continuous); Question types: Wh/ Yes or No/ and Tags **Vocabulary -** Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II	NARRATION AND SUMMATION	15

Listening - Listening to podcast, anecdotes / stories / event narration; documentaries and interviews with celebrities; **Speaking -** Narrating personal experiences / events; Interviewing a celebrity; Reporting / and summarizing of documentaries / podcasts/ interviews; **Reading** - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs; **Writing** - Guided writing - Paragraph writing Short Report on an event (field trip etc.); **Grammar** - Past tense (Simple, continuous); Subject-Verb Agreement; and Prepositions; **Vocabulary** - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III	DESCRIPTION OF A PROCESS / PRODUCT	15

Listening - Listen to a product and process descriptions; a classroom lecture; and advertisements about a products; **Speaking** - Picture description; Giving instruction to use the product; Presenting a product; and Summarizing a lecture; **Reading** - Reading advertisements, gadget reviews; user manuals; **Writing** - Writing definitions; instructions; and Product /Process description; **Grammar** - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect, Present and past perfect continuous tenses; **Vocabulary** - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words)

UNIT IV	CLASSIFICATION AND RECOMMENDATIONS	15

Listening - Listening to TED Talks; Scientific lectures; and educational videos; **Speaking** – Small Talk; Mini presentations and making recommendations; **Reading** - Newspaper articles; Journal reports - Non Verbal Communication (tables, pie charts etc,) **Writing** - Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode) **Grammar** - Articles; Pronouns - Possessive & Relative pronouns; **Vocabulary** - Collocations; Fixed / Semi fixed expressions		
UNIT V	**EXPRESSIONS**	**15**
Listening - Listening to debates/ discussions; different viewpoints on an issue; and panel discussions; **Speaking** - Group discussions, Debates, and Expressing opinions through Simulations & Role-play; **Reading** - Reading editorials; and Opinion Blogs; **Writing** - Essay Writing (Descriptive or narrative); **Grammar** - Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences; **Vocabulary** - Cause & Effect Expressions - Content vs. Function words.		
		TOTAL: 75 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Listen and comprehend complex academic texts

CO2: Read and infer the denotative and connotative meanings of technical texts

CO3: Write definitions, descriptions, narrations and essays on various topics

CO4: Speak fluently and accurately in formal and informal communicative contexts

CO5: Express their opinions effectively in both oral and written medium of communication

TEXT BOOKS:

1. Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University. English for Science & Technology. Cambridge University Press, 2021
2. Board of Editors, Department of English, Anna University. English for Engineers & Technologists. Orient Blackswan Private Ltd, 2020.
3. Board of Editors, Department of English, Anna University. Using English Orient Blackswan Private Ltd, 2017

REFERENCES:

1. Meenakshi Raman & Sangeeta Sharma. Technical Communication – Principles And Practices Oxford University Press, New Delhi, 2016
2. Lakshminarayanan K.R. A Course Book On Technical English. SciTech Publications (India) Pvt. Ltd., 2012
3. Ayesha Viswamohan. English For Technical Communication (With CD). McGraw Hill Education, ISBN: 0070264244. 2008.
4. Kulbhusan Kumar, RS Salaria, Effective Communication Skill. Khanna Publishing House, First Edition, 2018.
5. Dr.V.Chellammal. Learning to Communicate. Allied Publishing House, New Delhi, 2003.

21MA101	**MATRICES AND CALCULUS** (*Common to all B.E./B.Tech. Programmes*)	L	T	P	C
		3	**2**	**0**	**4**

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To explain the students about differential calculus.
- To demonstrate the functions of several variables technique to solve problems in many engineering branches.
- To demonstrate the various techniques of integration.
- To prepare the student to use mathematical tools in evaluating multiple integrals and their applications.

UNIT I	**MATRICES**	**12**

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II	**DIFFERENTIAL CALCULUS**	**12**

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.

UNIT III	**FUNCTIONS OF SEVERAL VARIABLES**	**12**

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV	**INTEGRAL CALCULUS**	**12**

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT V	**MULTIPLE INTEGRALS**	**12**

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

TOTAL : 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Use the matrix algebra methods for solving engineering problems.

CO2: Apply differential calculus tools in solving various application problems.
CO3: Make use of differential calculus ideas on several variable functions.
CO4: Identify suitable methods of integration in solving practical problems.
CO5**:** Solve practical problems of areas, volumes using multiple integrals.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
3. James Stewart, "Calculus: Early Transcendentals", 8th Edition, Cengage Learning, New Delhi, 2015.

REFERENCES:

1. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", 7th Edition, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 2009.
2. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", 5th Edition, Narosa Publications, New Delhi, 2016.
3. Ramana. B.V., "Higher Engineering Mathematics", 6th Edition, McGraw Hill Education Pvt. Ltd, New Delhi, 2010.
4. Thomas. G. B., Hass. J and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

21PH101	**ENGINEERING PHYSICS** (*Common to all B.E./B.Tech. Programmes*)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To illustrate the students effectively to achieve an understanding of mechanics.
- To infer the students to gain knowledge of electromagnetic waves and its applications.
- To explain the basics of oscillations, optics and lasers.
- To outline the importance of quantum physics.
- To relate the students towards the applications of quantum mechanics.

UNIT I	MECHANICS	9

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum– double pendulum –Introduction to nonlinear oscillations.

UNIT II	ELECTROMAGNETIC WAVES	9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.		
UNIT III	**OSCILLATIONS, OPTICS AND LASERS**	**9**
Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave – sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference– Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.		
UNIT IV	**BASIC QUANTUM MECHANICS**	**9**
Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in an infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.		
UNIT V	**APPLIED QUANTUM MECHANICS**	**9**
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.		
		TOTAL: 45 PERIODS

OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the importance of mechanics.

CO2: Extend their knowledge in electromagnetic waves.

CO3: Illustrate a strong foundational knowledge in oscillations, optics and lasers.

CO4: Interpret the importance of quantum physics.

CO5: Summarize quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow, "An Introduction to Mechanics", First Edition, McGraw Hill Education, 2017.
2. E.M.Purcell and D.J.Morin, "Electricity and Magnetism", Third Edition, Cambridge University Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", Seventh Edition, McGraw-Hill, 2017.

REFERENCES

1. R.Wolfson. “Essential University Physics”, Volume 1 & 2. , First Edition (Indian Edition) Pearson Education, 2009.
2. Paul A. Tipler, “Physics” - Volume 1 & 2, First Edition (Indian Edition), CBS Publishers & Distributors, 2004.
3. K.Thyagarajan and A.Ghatak. “Lasers: Fundamentals and Applications”, Second Edition, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R. Resnick and J. Walker, “Principles of Physics”, 10^{th} Edition (Indian Edition), Wiley, 2015.
5. N.Garcia, A.Damask and S.Schwarz, “Physics for Computer Science Students”, First Edition, Springer Verlag, 2012.

21CH101	**ENGINEERING CHEMISTRY** (*Common to all B.E./B.Tech. Programmes*)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe water quality parameters and water treatment techniques.
- To discuss basic principles and preparatory methods of nanomaterials.
- To demonstrate the basic concepts and applications of phase rule and composites.
- To identify different types of fuels, their preparation, properties and combustion characteristics.
- To illustrate the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I	WATER AND ITS TREATMENT	9

Water: Sources and impurities, **Water quality parameters:** Definition and significance of- colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination)**.Desalination of brackish water**: Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. **Treatment of boiler feed water**: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II	NANOCHEMISTRY	9

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials**: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. **Applications** of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III	PHASE RULE AND COMPOSITES	9
Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process. **Composites: Introduction**: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). **Properties and applications of**: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. **Hybrid composites** - definition and examples.		
UNIT IV	**FUELS AND COMBUSTION**	**9**
Fuels: Introduction: Classification of fuels; **Coal and coke**: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:** Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Power alcohol and biodiesel.** **Combustion of fuels: Introduction**: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; **Ignition temperature**: spontaneous ignition temperature, Explosive range; **Flue gas analysis** - ORSAT Method. **CO_2 emission and carbon foot print.**		
UNIT V	**ENERGY SOURCES AND STORAGE DEVICES**	**9**
Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. **Solar energy conversion:** Principle, working and applications of solar cells**; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H_2-O_2 fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO 1: Infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO 2: Describe the basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO 3: Apply the knowledge of phase rule and composites for material selection requirements.

CO 4: Identify suitable fuels for engineering processes and applications.

CO 5: Demonstrate different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P.C.Jain and Monica Jain, "Engineering Chemistry", 17th Edition, Dhanpat Rai

Publishing Company (P) Ltd, New Delhi, 2018.

2.Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company Ltd, NewDelhi, 2008.

3. S.S. Dara, "A text book of Engineering Chemistry", 12th Edition, S. Chand Publishing, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B.B. Rath and James Murday, "Text book of nanoscience and nanotechnology", Universities Press-II M Series in Metallurgy and Materials Science, 2018.
2. O.G.Palanna, "Engineering Chemistry" 2nd Edition, McGraw Hill Education (India) Private Limited, 2017.
3. Friedrich Emich, "Engineering Chemistry", Scientific International PVT, LTD, New Delhi, 2014.
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", 2nd Edition, Cambridge University Press, Delhi, 2019
5. O.V. Roussak and H.D. Gesser, "Applied Chemistry-A Text Book for Engineers and Technologists", 2nd Edition, Springer Science Business Media, New York, 2013.

21CS101	PROBLEM SOLVING AND PYTHON PROGRAMMING	L	T	P	C
	(Common to all B.E./B.Tech. Programmes)	3	0	0	3

COURSE OBJECTIVES:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

UNIT-I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.

UNIT-II	DATA TYPES, EXPRESSIONS, STATEMENTS	9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT-III	CONTROL FLOW, FUNCTIONS, STRINGS	9
Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-else-if-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.		
UNIT-IV	**LISTS, TUPLES, DICTIONARIES**	**9**
Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.		
UNIT-V	**FILES, MODULES, PACKAGES**	**9**
Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).		
		TOTAL :45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Make use of design approaches to solve computational problems.

CO2: Develop and execute basic Python programs using expressions and input/output statements.

CO3: Utilize strings, functions and control statements to develop real world problems.

CO4: Construct programs using Python data types like lists, tuples and dictionaries.

CO5: Prepare a Python application by incorporating files and exceptions.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher, "Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
3. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc- Graw Hill, 2018.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", 1st Edition, Pearson Education, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", 3rd Edition, MIT Press, 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019

21CS102	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.,)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.,- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error,voter’s age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.,

TOTAL:60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1:Develop algorithmic solutions to simple computational Problems

CO2: Illustrate and execute basic Python programs using simple statements.

CO3: Build program for scientific problems using strings, functions and control statements.
CO4: Utilize compound data types lists, tuples and dictionaries for real-time applications.
CO5: Experiment the python packages, files and exceptions for developing software applications

21PC101	PHYSICS AND CHEMISTRY LABORATORY *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To explain the proper use of various kinds of physics laboratory equipment.
- To extend how data can be collected, presented and interpreted in a clear and concise manner
- To infer problem solving skills related to physics principles and interpretation of experimental data.
- To summarize error in experimental measurements and techniques used to minimize such error.
- To translate the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS: PHYSICS LABORATORY (Any 7 Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – Determination of the velocity of sound and compressibility of liquids
10. Post office box - Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

OUTCOMES: At the end of the course, learners will be able to:

CO1:.Explain the functioning of various physics laboratory equipment

CO2: Relate the graphical models to analyze laboratory data

CO3: Interpret mathematical models as a medium for quantitative reasoning and describing physical reality.

CO4: Explain Access, process and analyze scientific information.

CO5: Translate students to solve problems individually and collaboratively

REFERENCES :

1. “Physics Laboratory Manual”, Department of Physics, Velammal College of Engineering & Technology, Madurai (2021)
2. P. Mani, “Physics Laboratory”, Dhanam Publications, 2021.

CHEMISTRY LABORATORY

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters such as acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electro analytical techniques such as pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles.
- To analyze the quality of coal sample using proximate analysis.

List of Experiments (Any 7 experiments)

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.
2. Determination of types and amount of alkalinity in water sample.
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler’s method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate. (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel.

15. Proximate analysis of Coal.	
	TOTAL: 30 PERIODS

COURSE OUTCOMES : At the end of the course, learners will be able to

CO1: To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.

CO2: To determine the amount of metal ions through volumetric and spectroscopic techniques.

CO3: To analyse and determine the composition of alloys.

CO4: To learn simple method of synthesis of nanoparticles.

CO5: To quantitatively analyse the impurities in solution by electro analytical techniques.

Text Book:

J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, “Vogel’s Textbook of Quantitative Chemical Analysis” 2009.

SEMESTER-II

<table>
<tr><td rowspan="2">21EN102</td><td rowspan="2">ENGLISH-II
(Common to all B.E./B.Tech. Programmes)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:
• To develop strategies and skills for enhance learners' ability to read and comprehend engineering and technology texts.
• To foster their ability to write convincing job applications and effective reports.
• To develop their speaking skills to make them confident in technical presentations and participate in group discussions.
• To strengthen their Listening skill which will help them comprehend lectures and talks in their areas of specialization.
• To create awareness about the need for soft skills.</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION TO TECHNICAL ENGLISH</td><td>9</td></tr>
<tr><td colspan="6">Listening - Factual and Academic speeches; Speaking - Asking for and Giving Directions; Reading - Technical Texts from Newspapers/Websites; Writing – Statements, Definitions, Issue Based Writing, Instructions, Checklist, Recommendations; Vocabulary Development- Technical Vocabulary; Grammar - Error spotting, Compound Words; Soft Skills - Leadership Skills.</td></tr>
<tr><td>UNIT II</td><td colspan="4">READING AND STUDY SKILLS</td><td>9</td></tr>
<tr><td colspan="6">Listening - Listening to Longer Technical Talks and Completing Exercises Based on Them; Speaking - Describing a General Process; Reading - Reading Longer Technical Texts, Identifying the Various Transitions in a Text, Paragraphing; Writing - Interpreting Charts, Graphs; Vocabulary Development - Vocabulary Used in Formal Letters/Emails and Reports; Grammar - Impersonal Passive Voice, Numerical Adjectives; Soft Skills – Teamwork.</td></tr>
<tr><td>UNIT III</td><td colspan="4">TECHNICAL WRITING AND GRAMMAR</td><td>9</td></tr>
<tr><td colspan="6">Listening - Listening to Classroom Lectures, Talks on Engineering /Technology; Speaking - Introduction to Technical Presentations; Reading - Longer Texts both General and Technical, Practice in Speed Reading; Writing - Describing a Technical Process; Vocabulary Development - Sequence Words, Misspelt Words; Grammar - Embedded Sentences ; Soft Skills - Decision Making</td></tr>
<tr><td>UNIT IV</td><td colspan="4">JOB APPLICATIONS</td><td>9</td></tr>
<tr><td colspan="6">Listening - Listening to Documentaries and Making Notes; Speaking - Mechanics of Presentations; Reading - Reading for Detailed Comprehension; Writing - Email Etiquette, Job Application, Cover Letter, Resume Preparation(softcopy and hard copy), Analytical Essay Writing; Vocabulary Development - Finding Suitable Synonyms, Paraphrasing; Grammar – Clauses, 'If' Conditionals; Soft Skills - Time Management.</td></tr>
</table>

UNIT V	GROUP DISCUSSION AND REPORT WRITING	9
Listening - TED Talks; **Speaking** - Participating in a Group Discussion; **Reading** - Reading and Understanding Technical Articles; **Writing** - Writing Reports, Survey Report, Accident Report, Minutes of a Meeting; **Vocabulary Development** - Verbal Analogies; **Grammar** - Reported Speech; **Soft Skills** - Conflict Resolution.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES : At the end of the course, learners will be able to

CO1: Read and interpret information in technical texts

CO2: Construct convincing job applications, resume and effective reports

CO3: Organize the technical ideas effectively in spoken and written forms

CO4: Interpret spoken language in lectures and talks

CO5: Demonstrate basic soft skills in life

TEXT BOOKS:

1. Board of Editors, "Fluency in English-A Course book for Undergraduate Engineers and Technologist" Orient Blackswan Pvt Ltd, Hyderabad: 2018
2. Jawahar, Jewelcy & Rathna.P., "Communicative English Workbook" VRB Publishers Pvt Ltd., Chennai, 2018.
3. Board of Editors, Department of English, Anna University, Chennai. Mindscapes-English for Technologists and Engineers. Orient Black Swan Pvt Ltd, Chennai, 2012.

REFERENCES:

1. Verma, Shalini, " Technical Communication for Engineers" Vikas Publishing House Pvt Ltd., New Delhi, 2015
2. Raman, Meenakshi & Sharma, Sangeeta, " Technical Communication English Skills for Engineers" Oxford University Press, 2008.
3. Rizvi, Ashraf.M, "Effective Technical Communication" MC Graw Hill Education Pvt Ltd., New Delhi, 2016.

21MA102	VECTOR CALCULUS AND COMPLEX VARIABLES **(*Common to B.E. CIVIL Engg., EEE&MECH Engg.*)**	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To explain the students with the concepts of vector calculus, needed for problem solving in all engineering disciplines.
- To choose the effective mathematical methods for finding the solutions of partial differential equations.
- To identify and develop the standard techniques of complex variables.
- To apply with confidence, in application areas such as heat conduction, elasticity, fluid

dynamics and flow of electric current. • To prepare the student to acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.		
UNIT I	**VECTOR CALCULUS**	**12**
Gradient , Divergence and Curl – Directional derivation – Irrotational and solenoidal vector fields –Vector integration – Greens theorem in a plane , Gauss Divergence theorem and Stoke's theorem (excluding proof) – Simple applications involving cubes and rectangular parallelepiped		
UNIT II	**PARTIAL DIFFERENTIAL EQUATIONS**	**12**
Formation of partial differential equations – Solutions of standard types of first order PDE : f(p, q) = 0, f(z ,p,q)=0, z=px+ qy + f(p,q), f(x, p) = f(y, q) – Lagrange's linear equations – linear partial differential equations of second and higher order with constant coefficients of homogeneous type.		
UNIT III	**ANALYTIC FUNCTIONS**	**12**
Analytic functions – necessary and sufficient conditions for analyticity-properties – Harmonic conjugates- construction of analytic function – conformal mapping –Mapping by functions-Bilinear transformation $w = c + z\ , az\ , \frac{1}{z}, z^2$.		
UNIT IV	**COMPLEX INTEGRATION**	**12**
Complex Integration – Cauchy's integral theorem and integral formula (excluding proof)-Taylor series and Laurent's series –Residues – Cauchy's residue Theorem (excluding proof) – Application of Residue theorem to evaluate real integrals around unit circle and semi- circle (excluding poles on the real axis).		
UNIT V	**ORDINARY DIFFERENTIAL EQUATIONS**	**12**
Linear equations of second order with constant and variable coefficients-Homogeneous equations of Euler type – Equations reducible to homogeneous form –Variation of parameters-Simultaneous first order with constant coefficients.		
		TOTAL: 60 PERIODS
COURSE OUTCOMES: At the end of the course, learners will be able to CO1: Apply the concept of vector calculus which naturally arises in many engineering Problems. CO2: Solve the Partial Differential Equations by using various techniques. CO3: Construct an analytic function using the properties of analytic function. CO4: Apply suitable formula to evaluate the given integral. CO5: Use a suitable method , solve the given differential equation of first & second order.		

TEXT BOOKS:

1. Kreyszig Erwin, "Advanced Engineering Mathematics ", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. James Stewart, " Calculus: Early Transcendentals", 8th Edition, Cengage Learning New Delhi, 2015.
3. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson Education, 2018.

REFERENCES :

1. B.S.Grewal, " Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2015.
2. P. Kandasamy , Thilagavathy and K.Gunavathy, " Engineering Mathematics Vol-II", 3rd Edition, S. Chand Limited, 2015.
3. P. Kandasamy , Thilagavathy and K.Gunavathy, " Engineering Mathematics Vol-III", 3rd Edition, S. Chand Limited, 2015

21PH105	**PHYSICS FOR ELECTRICAL ENGINEEIRNG**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the basics of dielectric materials and insulation.
- To illustrate the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To infer knowledge on physics of semiconductors, determination of charge carriers and device applications.
- To summarize the different optical properties of materials, optical displays and applications.
- To translate the significance of nano structures, quantum confinement to nano device applications.

UNIT I	**DIELECTRIC MATERIALS AND INSULATION**	**9**

Matter polarization and relative permittivity: definition - Dipole moment and polarization vector Polarization mechanisms: electronic, ionic, orientation, interfacial and total polarization - Frequency dependence - Local field and Causius-Mossotti equation - Dielectric constant and dielectric loss - Gauss's law and boundary conditions - Dielectric strength, introduction to insulation breakdown in gases, liquids and solids - Capacitor materials - Typical capacitor constructions - Piezo and pyroelectric crystals (qualitative).

UNIT II	**ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS**	**9**

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Quantum free electron theory: tunneling - Degenerate states - Fermi-Dirac statistics - Density of energy states - Electron effective mass - concept of hole. Magnetic materials: dia,

para and ferromagnetic effects - Domain theory of ferromagnetism - Hysteresis - Quantum interference devices - GMR devices.		
UNIT III	**SEMICONDUCTORS AND TRANSPORT PHYSICS**	**9**
Intrinsic Semiconductors – Energy band diagram - Direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - Extrinsic semiconductors - Carrier concentration in n-type & p-type semiconductors - Variation of carrier concentration with temperature - Carrier transport in Semiconductors: Drift, mobility and diffusion - Hall effect and devices - Ohmic contacts - Schottky diode.		
UNIT IV	**OPTICAL PROPERTIES OF MATERIALS**	**9**
Classification of optical materials - Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells - Optoelectronic devices: light detectors and solar cells - light emitting diode - laser diode - optical processes in organic semiconductor devices - excitonic state - Electro-optics and nonlinear optics: Modulators and switching devices.		
UNIT V	**NANO DEVICES**	**9**
Density of states for solids - Significance between Fermi energy and volume of the material - Quantum confinement - Quantum structures - Density of states for quantum wells, wires and dots - Band gap of nanomaterials - Tunneling - Single electron phenomena - Single electron Transistor. Conductivity of metallic nanowires - Ballistic transport - Quantum resistance and conductance - Carbon nanotubes: Properties and applications - Spintronic devices and applications - Optics in quantum structures - quantum well laser.		
	TOTAL: 45 PERIODS	
OUTCOMES: At the end of the course, learners will be able to: CO1:Explain the basics of dielectric materials and insulation. CO2:Infer the electrical and magnetic properties of materials and their applications. CO3:Relate the semiconductor physics and functioning of semiconductor devices. CO4:Summarize the optical properties of materials and working principles of various optical devices. CO5:Translate the importance of nanotechnology in nano devices.		
TEXT BOOKS: 1. S.O. Kasap, "Principles of Electronic Materials and Devices", 4^{th} Edition (Indian Edition), McGraw Hill Education, 2020. 2. R.F. Pierret, "Semiconductor Device Fundamentals", 1^{st} Edition (Indian Edition) Pearson, 2006. 3. G.W.Hanson. "Fundamentals of Nanoelectronics", 1^{st} Edition (Indian Edition) Pearson Education, 2009.		
REFERENCES		

1. Laszlo Solymar, Walsh, Donald, Syms and Richard R.A., “Electrical Properties of Materials”, Indian Edition, Oxford University Press, 2015. 2. Jasprit Singh, “Semiconductor Optoelectronics: Physics and Technology”, First Edition (Indian Edition), McGraw-Hill Education, 2019. 3. Charles Kittel, “Introduction to Solid State Physics”, Seventh Edition, (Indian Edition), Wiley, 2019. 4. Mark Fox, “Optical Properties of Solids”, Standard Edition, Oxford University Press, 2001. 5. Parag K. Lala, “Quantum Computing: A Beginner's Introduction”, First Edition (Indian Edition) , McGraw-Hill Education, 2020.

21ME101	ENGINEERING GRAPHICS (Common to all B.E./B.Tech. Programmes)	L	T	P	C
		2	0	2	3
COURSE OBJECTIVES:					
• To sketch the projection of points, lines and planes. • To sketch the projection of simple solids • To sketch the projection of sectioned solids and development of lateral surfaces • To sketch the isometric and perspective views of simple solids. • To sketch the orthographic projection of various objects freehandly.					
UNIT I	**PROJECTIONS OF POINTS, LINES AND PLANE SURFACE**	**9**			
Importance of graphics in engineering applications – Use of drafting instruments - Lettering and dimensioning. Introduction to Orthographic projections - Principles -Principal planes-First angle projection. Projection of points located in all quadrants. Projection of straight lines inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method. Projection of planes (regular polygonal and circular surfaces) inclined to both the principal planes by rotating object method. (Not for Examination)					
UNIT II	**PROJECTION OF SOLIDS**	**9**			
Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.					
UNIT III	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**	**9**			
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and					

cones.		
UNIT IV	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**9**
Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- Perspective projection of simple solids- Prisms, pyramids and cylinders by visual ray method .		
UNIT V	**FREEHAND SKETCHING**	**9**
Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects. Introduction to drafting packages and demonstration. (Not for examination).		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Construct the orthographic projections of points, straight lines and plane surfaces.

CO2: Sketch the orthographic projections of simple solids

CO3: Sketch the orthographic projections of sectional solids and lateral surfaces of the solids.

CO4: Construct the isometric projections and perspective projections of simple solids.

CO5: Sketch the orthographic projection of objects using freehand.

TEXT BOOKS:

1. Natarajan K.V., “A text book of Engineering Graphics”, 31st Edition, Dhanalakshmi Publishers, Chennai, 2018.
2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, 15th Edition, New Age International (P) Limited, 2018.
3. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, 53rd Edition, Charotar Publishing House, 2014.

REFERENCES:

1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, 2nd Edition, Tata McGraw Hill Publishing Company Limited, 2013.
2. Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, 2nd Edition, Oxford University, Press, New Delhi, 2015.
3. Shah M.B., and Rana B.C., “Engineering Drawing”, 2nd Edition, Pearson, 2009.

21EE101	ELECTRIC CIRCUIT ANALYSIS	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To explain the electric circuits and its analysis.

- To interpret circuit equations using network theorems.
- To illustrate phenomenon of resonance in coupled circuits.
- To outline the transient response of circuits.
- To summarize the phasor diagrams and analysis of three phase circuits.

UNIT I	**BASIC CIRCUITS ANALYSIS**	**15**
Resistive elements - Ohm's Law- Resistors in series and parallel circuits – Kirchhoff's laws – Mesh current and node voltage - Method of analysis for DC and AC circuits - Phasor Diagram – Power, Power Factor and Energy.		
UNIT II	**NETWORK REDUCTION AND THEOREMS FOR DC AND AC CIRCUITS**	**15**
Network reduction: voltage and current division, source transformation – Star delta conversion. Thevenin's and Norton's Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem –Millman's theorem.		
UNIT III	**TRANSIENT RESPONSE ANALYSIS**	**15**
Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. sinusoidal input.		
UNIT IV	**THREE PHASE CIRCUITS**	**15**
A.C. circuits - Advantages of three phase system - Generation of three phase voltages - Phase sequence - Average and RMS value - Analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced and unbalanced – Phasor diagram of voltages and currents – power measurement in three phase circuits.		
UNIT V	**RESONANCE AND COUPLED CIRCUITS**	**15**
Series and parallel resonance –Their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Analysis of single tuned and Double tuned coupled circuits.		
	TOTAL: 75 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Analyze electrical circuits using electric circuit laws

CO2: Choose circuit theorems for solving a given electric circuits.

CO3: Examine steady state and transient response on electric circuit.

CO4: Experiment with resonant circuits and coupled circuits.

CO5: Solve three phase star and delta connected systems with balanced and unbalanced loads.

TEXT BOOKS:

1. Charles K. Alexander, Mathew N.O. Sadiku, "Fundamentals of Electric Circuits", 5th Edition, McGraw-Hill, 2013.
2. William H. HaytJr, Jack E. Kemmerly and Steven M. Durbin, "Engineering CircuitsAnalysis", 9th Edition, McGraw-Hill publishers, New Delhi, 2020.

3. Sudhakar A and Shyam Mohan S.P., “Circuits and Network Analysis and Synthesis”, 5thEdition, McGraw-Hill, 2017.
4. NageswaraRaoT., “Circuit Theory”,5thEdition, A.R.Publication, 2017.

REFERENCES

1. Chakrabarti A, “Circuits Theory (Analysis and synthesis), 7thEdition, DhanpatRai& Sons, NewDelhi ,2018.
2. Allan H. Robbins, Wilhelm C. Miller, “Circuit Analysis Theory and Practice”, 5thEdition, CengageLearning India, 2013.
3. Mahadevan, K., Chitra, C., “Electric Circuits Analysis”, 2nd Edition, Prentice-Hall of India Pvt Ltd., New Delhi, 2018.
4. Jegatheesan, R., “Analysis of Electric Circuits,” 6thEdition, McGraw-Hill, 2018.
5. James W. Nilsson, Susan Riedel, “Electric Circuits”, 11th Edition, Pearson,2018.

21CH103	**ENVIRONMENTAL SCIENCE**	**L**	**T**	**P**	**C**
	(Common to all B.E / B.Tech. Programmes)	**2**	**0**	**0**	**2**

COURSE OBJECTIVES:

- To describe the structure and function of an ecosystem and biodiversity
- To interpret the environmental impacts of natural resources.
- To demonstrate causes, effects and control measures of different types of pollution.
- To manipulate the importance of disaster management, environmental ethics and values.
- To dramatize the important social issues and sustainable practices.

UNIT-I	**ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY**	**6**

Multidisciplinary nature of environmental studies - ecosystem- general structure and function of an ecosystem- ecological succession-biodiversity-types-values of biodiversity- endangered and endemic species-red data book- hot spots of biodiversity-criteria- hot spots in India-threats to biodiversity(man-animal conflicts, habitat loss, poaching)-case studies-conservation of biodiversity- in-situ and ex-situ conservation.

UNIT-II	**NATURAL RESOURCES AND ITS ENVIRONMENTAL IMPACTS**	**6**

Natural resources-forest resource-ecological functions – causes, effects and control measures of deforestation-water resource-sources-conflict over water-dams benefits and problems-food resource-overgrazing- impacts of over grazing- impacts of modern agriculture-energy resource-environmental impacts of wind mills and solar panels- role of an individual in conservation of natural resources.

UNIT III	**ENVIRONMENTAL POLLUTION AND CONTROL**	**6**

Air pollution-causes, effects and control methods - water pollution- causes, effects-waste water

treatment-soil pollution-causes, effects-solid waste management–e-waste- causes, effects and management-Pollution control acts-air(prevention and control of pollution) act,1981-water(prevention and control of pollution) act,1974- wildlife (protection) act,1972 - e-waste management rules,2016-case studies - role of an individual in control of pollution.		
UNIT IV	**DISASTER MANAGEMENT AND ENVIRONMENTAL ETHICS**	**6**
Disaster management-causes, effects and management of- flood, landslide, earthquake and tsunami-case studies- environmental ethics- value education-traditional value systems in India-water conservation-rain water harvesting-watershed management.		
UNIT V	**SOCIAL ISSUES AND SUSTAINABLE PRACTICES**	**6**
Unsustainable development- social issues-climate change-causes, effects and control measures-global warming-causes, effects and control measures-Acid rain-causes, effects and control measures-ozone layer depletion-causes, effects and control measures-nuclear accident and holocausts-EIA-Sustainable development-goals-target- green buildings- ISO 14000 series.		
		TOTAL: 30 PERIODS

COURSE OUTCOMES : At the end of the course, learners will be able to

CO1: Explain the concept, structure and function of an ecosystem and biodiversity.

CO2: Demonstrate the environmental impacts of natural resources.

CO3: Illustrate the suitable management method for pollution control.

CO4: Relate the proper way of managing disaster with environmental ethics.

CO5: Apply social issues and adopt suitable sustainable practices.

TEXT BOOKS:

1.Kaushik, A &Kaushik. C.P, “Environmental Science and Engineering”, 6th Edition, New Age International, 2018.
2.Garg S.K &Garg, Ecological and Environmental studies, Khanna Publishers, 2015.
3.Wright &Nebel, Environmental science towards a sustainable future, 12thEditon, Prentice Hall of India Ltd, 2015.

REFERENCE BOOKS:

1. ErachBharucha, “Text book of Environmental studies for Undergraduate courses”, 3rd Edition, UGC, 2021.
2. Ravi P. Agrahari, Environmental ecology, Biodiversity, climatic change & Disaster management, 1st Edition, McGraw Hill, 2020
3. Benney Joseph, “Environmental Science and Engineering”, 1st Edition, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017.

21MC101	BASIC CIVIL AND MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss the significance of the Civil and Mechanical Engineering Profession in satisfying the societal needs.
- To demonstrate the building materials and components used for construction.
- To compare different manufacturing processes and types of power plants.
- To explain the components of IC engines and their working principles.
- To explain the working principle of Refrigeration & Air-conditioning system

UNIT I	OVERVIEW OF CIVIL ENGINEERING	9

Civil Engineering contributions to the welfare of Society - Specialized sub disciplines in Civil Engineering – Structural, Construction, Geotechnical, Environmental, Transportation and Water Resources Engineering – National building code – Terminologists: Plinth area, Carpet area, Floor area, Buildup area, Floor space index.

UNIT II	CIVIL ENGINEERING MATERIALS AND BUILDING COMPONENTS	9

Civil Engineering Materials: Bricks – Stones – Sand – Cement – Concrete – Steel - Timber – Modern Materials, Thermal and Acoustic Insulating Materials, , Building plans – Setting out of a Building - Foundations: Types of foundations - Bearing capacity and settlement – Brick masonry – Stone Masonry – Beams – Columns.

UNIT III	MANUFACTURING PROCESSES AND POWER PLANTS	9

Materials for engineering components, stress, strain, Factor of safety. foundry - green sand mould casting. Metal joining – Arc welding and Gas welding-Classification of Power Plants- Working principle of steam, Gas, Diesel, Hydro -electric and Nuclear Power plants

UNIT IV	INTERNAL COMBUSTION ENGINES	9

Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines. Working principle of High Pressure Boilers- Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps.

UNIT V	REFRIGERATION AND AIR CONDITIONING SYSTEM	9

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system–Layout of typical domestic refrigerator–Window and Split type room Air conditioner.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Outline the Profession of Civil Engineering.

CO2: Summarize the planning of materials used for construction of building and its process.

CO3:Differentiate the Manufacturing Processes and power plants.
CO4:Discuss the Working Principles of IC Engine.
CO5: Describe the components of refrigeration and air conditioning cycle.

TEXT BOOKS:

1. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering", 4th Edition, Tata McGraw Hill, New Delhi 2018.
2. Venugopal K and Dr. V. Prabhu Raja "Basic Civil and Mechanical Engineering", Third Edition, Anuradha Publishers, Kumbakonam 2018.
3. Dr.R.Vaidyanathan and P.Perumal "Basic Civil and Mechanical Engineering", 2nd Edition, Laxmi Publishers Newdelhi,2016

REFERENCES:

1. Palanikumar, K. "Basic Civil and Mechanical Engineering", 2nd Edition, Cengage learning, 2012.
2. Ramamrutham S., "Basic Civil Engineering", 2nd Edition, Dhanpat Rai Publishing Co. Pvt. Ltd. 2013.
3. Seetharaman S., "Basic Civil Engineering", 2nd Edition, Anuradha Agencies, 2005
4. Shantha Kumar SRJ, "Basic Mechanical Engineering", 1st Edition, Hi-tech Publications, Mayiladuthurai, 2000.
5. Ramesh Babu.V., "Basic Civil and Mechanical Engineering", 1st Edition, VRB publisers pvt Ltd, 2017.

21EM101	ENGINEERING PRACTICES LABORATORY *(Common to all B.E / B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To draw pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- To demonstrate the basic switch board wiring, fluorescent lamp wiring and stair case wiring using various electrical components.
- To choose various joints in steel plates using arc welding work and machining various simple processes like turning, drilling, tapping in parts
- To build a tray out of metal sheet using sheet metal work.
- To develop electronic circuit and testing for soldering and desoldering using PCB board.

LIST OF EXPERIMENTS:

GROUP – A (CIVIL & ELECTRICAL)

PART – I

CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

- Sawing,
- Planning and Making joints like T-Joint, Cross lap and Dovetail joint.

PART – II

ELECTRICAL ENGINEERING PRACTICES

- Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
- Staircase wiring
- Fluorescent Lamp wiring with introduction to CFL and LED types.
- Energy meter wiring and related calculations/ calibration
- Study of Iron Box wiring and assembly
- Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
- Measurement of resistance to earth of an electrical equipment.

GROUP – B (MECHANICAL & ELECTRONICS)

PART III

MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

- Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
- Practicing gas welding.

BASIC MACHINING WORK:

- Usage of Spanners and screw drivers
- Facing and Turning.
- Taper Turning

ASSEMBLY WORK:

- Assembling a centrifugal pump.
- Assembling a household mixer.
- Assembling an air conditioner.

SHEET METAL WORK:

- Making of a square tray

FOUNDRY WORK:

- Demonstrating basic foundry operations.

PART IV

ELECTRONIC ENGINEERING PRACTICES

SOLDERING WORK:

- Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

- Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

- Study elements of smart phone.
- Assembly and dismantle of computer / laptop

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build various plumbing joints

CO2: Develop various carpentry joints.

CO3: Construct various wiring electrical joints in common household electrical wire work.

CO4: Construct various welded joints, sheet metal and basic machining operations

CO5: Develop the electronic circuit for soldering and testing using PCB board.

21EE102	ELECTRIC CIRCUITS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To analyze various electric circuits using PSpice/ MATLAB/P-SIM.
- To apply basic electric circuit laws in electrical circuits.
- To experiment basic circuit theorems in electrical networks.
- To utilize the software for simulation of RL, RC and RLC circuits.
- To compare the frequency response of series and parallel resonant circuits

LIST OF EXPERIMENTS

1. Verification of Kirchhoff's voltage law.
2. Verification of Kirchhoff's current law.
3. Verification of Thevenin's theorem & Norton's theorem.
4. Verification of Superposition theorem & Maximum Power transfer Theorem.
5. Experimental validation of transient response of R-L, R-C circuit with DC and AC input.

6. Experimental validation of transient response of R-L-C circuit with DC and AC input
7. Design of series resonant circuit.
8. Design of parallel resonant circuit.
9. Verification of three phase balanced and unbalanced networks.
10. Measurement of Power in three phase circuits.
11. Simulation of three phase balanced and unbalanced star, delta network circuits.
12. Study of Analog and digital oscilloscope and measurement of sinusoidal voltage, frequency and power factor.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply basic circuit laws for electric circuit parameters calculation

CO2: Choose circuit theorems for finding electric circuits parameters.

CO3: Classify the response of RL, RC and RLC circuits with AC and DC inputs.

CO4: Demonstrate the power and energy parameters for single and three phase AC circuits

CO5: Analyze the time and frequency response of series and parallel resonance circuits.

SEMESTER – III

21MA202	TRANSFORM TECHNIQUES AND ITS APPLICATIONS	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To discuss the various methods to find the Laplace transform of the given function.
- To solve the given ODE problems using Laplace transform that occur in Electrical engineering discipline.
- To develop Z transform techniques to solve difference equations for discrete time systems.
- To explain the concept of Fourier transform techniques and its inverse
- To construct the Discrete Fourier transforms of the given sequence in Electrical engineering field.

UNIT I — LAPLACE TRANSFORM — 12

Laplace transform- conditions for existence –Transform of elementary functions –Basic properties –First shifting theorem –Transform of derivatives on $t\,f(t), f(t)/t$ and periodic functions- Transform of unit step function and impulse functions. Inverse Laplace transform by partial fraction method.

UNIT II — APPLICATIONS OF LAPLACE TRANSFORM — 12

Convolution theorem (excluding proof)-Initial and finial value theorems-Solutions of linear ODE of second order with constant coefficients using Laplace transform techniques-Application problems using Laplace Transform in Electrical Engineering.

UNIT III — Z- TRANSFORM — 12

Z- Transform – Elementary properties – Inverse Z- Transforms (using partial fractions and residues) – Convolution theorem –Initial value and Final value theorem- Formation of difference equations – Solution of difference equations using Z-transform-Application problems using Z-Transform in Electrical Engineering.

UNIT IV — FOURIER TRANSFORM — 12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transform – Properties – Transforms of simple functions – convolution theorem – Parseval's identity.

UNIT V — APPLICATIONS OF FOURIER TRANSFORM — 12

Application of Fourier transform to Boundary value problems, Discrete Fourier transform and its properties, Inverse Discrete Fourier transform and its properties - Discrete Time Fourier Transform and its properties -Inverse Discrete Time Fourier Transform and its properties -Application problems using Fourier Transform in Electrical Engineering.

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Calculate interpret the Laplace Transform and inverse Laplace Transform of different functions.

CO2 :Apply Laplace Transform technique to solve second order differential equations with elementary functions.

CO3: Solve the given difference equations using Z Transform.

CO4: Use Fourier Transform techniques to calculate the given integral.

CO5**:** Choose suitable Fourier transform techniques to evaluate the given integral in wide variety of situations in Electrical Engineering.

TEXT BOOKS:

1. Erwin Kreyszig, "Advanced Engineering Mathematics ", 10th Edition, John Wiley, India, 2016.
2. R.C. Wylie, and Barrett, L.C., "Advanced Engineering Mathematics ", 6th Edition, Tata McGraw Hill Education Pvt. Ltd, New Delhi, 2012.
3. John A.Gubner, Probability and Random Process for Electrical and Computer Engineers, 3rd Edition, Cambridge University Press, New York, 2012.

REFERENCES:

1. B.S.Grewal, "Higher Engineering Mathematics", 44th edition, Khanna Publisher, Delhi.
2. Peter V.O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning India Private Limited, Delhi.
3. Li Tan, Digital Processing Fundamentals and Applications, 1st Edition, Academic Press, 2008.
4. P.Ramesh babu, Digital Signal processing, 4th Edition, SciTech Publications of India, 2013. (Unit II **:**1.39 - 1.53, 4.1 – 5.11.4) & (Unit V**:** 2.1 – 2.11)
5. T.Nageshwara Rao, Circuit Theory, 1st Edition, ARS Publications, (Unit III: 11.1-11.51), 2015.

21EE201	**FIELD THEORY**	**L**	**T**	**P**	**C**
		3	**2**	**0**	**4**

COURSE OBJECTIVES:

- To summarize the basic mathematical concepts related to electromagnetic vector fields.
- To explain the concepts of Electrostatic fields, electric flux density, electrical potential, capacitance, energy density and their applications.
- To infer the concept of Magneto static fields, magnetic flux density, vector potential, Inductance and its applications.
- To illustrate the different methods of EMF generation and Maxwell's equations of static and time varying field.
- To interpret the concepts of Electromagnetic waves and characterizing parameters

UNIT I	**COORDINATE SYSTEM AND INTRODUCTION TO ELECTROSTATICS**	**15**
Sources and effects of electromagnetic fields – Coordinate Systems – Vector fields –Gradient, Divergence, Curl – theorems and applications - Coulomb's Law –Force.		
UNIT II	**ELECTROSTATICS AND APPLICATIONS**	**15**
Electric field intensity – Field due to discrete and continuous charges – Gauss's law and applications. Electric potential – Electric field and equipotential plots, Uniform and Non-Uniform field, Utilization factor – Electric field in free space, conductors, dielectrics - Dielectric polarization – Dielectric strength - Electric field in multiple dielectrics – Boundary conditions, Poisson's and Laplace's equations, Capacitance, Energy density, Applications. Simulation of Electric fields using FEM Packages.		
UNIT III	**MAGNETOSTATICS AND APPLICATIONS**	**15**
Lorentz force, magnetic field intensity (H) – Biot–Savart's Law - Ampere's Circuit Law – H due to straight conductors, circular loop, infinite sheet of current, Magnetic flux density (B) – B in free space, conductor, magnetic materials – Magnetization, Magnetic field in multiple media – Boundary conditions, scalar and vector potential, Poisson's Equation, Magnetic force, Torque, Inductance, Energy density, Applications. Simulation of Magnetic fields using FEM Packages.		
UNIT IV	**MOTIONAL/ TRANSFORMER EMF AND MAXWELL EQUATION OF ELECTRODYNAMIC FIELDS**	**15**
Magnetic Circuits - Faraday's law – Transformer and motional EMF – Displacement current - Maxwell's equations (differential and integral form) – Relation between field theory and circuit theory – Applications.		
UNIT V	**ELECTROMAGNETIC WAVES AND ITS PROPAGATION**	**15**
Electromagnetic wave generation and equations – Wave parameters; velocity, intrinsic impedance, propagation constant – Waves in free space, lossy and lossless dielectrics, conductors- skin depth - Poynting vector – Plane wave reflection and refraction.		
		TOTAL: 75 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1:Outline the basic mathematical concepts related to electromagnetic vector.

CO2:Summarize the basic concepts of electrostatic fields, electrical potential, energy density capacitance and their applications.

CO3:Infer the knowledge in magneto static fields, magnetic flux density, vector potential, Inductance and its applications.

CO4: Classify methods of EMF generation and Maxwell's equations of Electrodynamic fields.

CO5:Illustrate the basic concepts of electromagnetic waves and characterizing parameters.

TEXT BOOKS:

1. Mathew N.O. Sadiku, "Principles of Electromagnetics", 6th Edition, Oxford University Press Inc. Asian edition, 2015.
2. William H. Hayt and John A. Buck, "Engineering Electromagnetics", Special Indian Edition, McGraw Hill, 2014.
3. Kraus and Fleish, "Electromagnetics with Applications", McGraw Hill International Editions, 5thEdition, 2010.
4. K A Gangadhar, "Electromagnetic Field Theory", 8thEdition, Khanna Publishers, 2015

REFERENCES

1. V.V.Sarwate, "Electromagnetic fields and waves", 1stEdition, Newage Publishers, 2018
2. J.P.Tewari, "Engineering Electromagnetics - Theory, Problems and Applications", 2nd Edition, Khanna Publishers.
3. Joseph. A.Edminister, "Schaum's Outline of Electromagnetics", 3rd Edition (Schaum's Outline Series), McGraw Hill, 2010.
4. S.P.Ghosh, LipikaDatta, "Electromagnetic Field Theory", 1stEdition, McGraw Hill Education(India) Private Limited, 2012.

21EE202	DC MACHINES AND TRANSFORMERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the magnetic-circuit analysis and introduce magnetic materials.
- To develop constructional details, the principle of operation, prediction of performance, the methods of testing the transformers and three phase transformer connections.
- To explain the working principle of electrical machines using the concepts of electromechanical energy conversion principle and derive expressions for generated voltage and torque developed in all Electrical Machines.
- To summarize the working principle of DC machines as Generator types, their no-load/load characteristics, starting and methods of speed control of motors.
- To outline various losses taking place in DC Motor and to study the different testing methods to evaluate their performance.

UNIT I	MAGNETIC CIRCUITS AND MAGNETIC MATERIALS	9

Magnetic circuits –Laws governing magnetic circuits - Flux linkage, Inductance and energy – Statically and dynamically induced EMF - Torque – Properties of magnetic materials – Power loss in ferromagnetic materials -Hysteresis and Eddy Current losses - AC excitation - Introduction to permanent magnets- Transformer as a magnetically coupled circuit

UNIT II	TRANSFORMERS	9
Construction – Principle of operation – Equivalent circuit parameters – Phasor diagrams, losses – Testing – Efficiency and voltage regulation- All day efficiency-Polarity test - Three phase transformers-connections – Scott Connection-Phasing of transformer– Parallel operation of three phase transformers-auto transformer – Tap changing transformers- Tertiary winding-Instrument transformers		
UNIT III	**ELECTRO-MECHANICAL ENERGY CONVERSION AND CONCEPTS IN ROTATING MACHINES**	**9**
Energy in magnetic system – Torque equations – Single and multiple excited magnetic field systems-Magnetic fields in rotating machines – Vital role of air gap-rotating mmf waves – Magnetic saturation and leakage fluxes		
UNIT IV	**DC GENERATORS**	**9**
Construction and components of DC Machine – Principle of operation - Lap and wave windings-EMF equations– Circuit model – Armature reaction –Methods of excitation-Commutation - Interpoles compensating winding –Characteristics of DC generators-Parallel operation of DC generators		
UNIT V	**DC MOTORS**	**9**
Principle and operations - types of DC Motors – Speed Torque Characteristics of DC Motors-Starting and speed control of DC motors –Plugging, dynamic and regenerative braking- Losses & efficiency – Condition for maximum efficiency – Testing of DC machines – Retardation test- Swinburne's test and Hopkinson's test-applications of DC Motor.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1:Explain the magnetic-circuits.

CO2:Build the knowledge in constructional details of transformers.

CO3:Develop the concepts of electromechanical energy conversion.

CO4:Show the working principles of DC Generator.

CO5:Illustrate the working principle of DC Motor.

TEXT BOOKS:

1. Nagrath, I.J. and Kothari.D.P., "Electric Machines", 6thEdition, McGraw-Hill Education, 2019.
2. P. S. Bimbhra, "Electrical Machines",4thEdition, Khanna Publishing, 2018.
3. Fitzgerald. A.E., Charles KingselyJr, Stephen D.Umans, "Electric Machinery", 7thEdition, McGraw- HillEducation, 2020.
4. Theraja B.L., "A Textbook of Electrical Technology, Volume II", 24thEdition, S. Chand Publication, 2018.

REFERENCES

1. B.R. Gupta, "Fundamental of Electric Machines", 4th Edition, New age International Publishers 2017.
2. S.K. Bhattacharya, "Electrical Machine",4th Edition McGraw - Hill Education, ,2018
3. Theodore Wildi, "Electrical Machines, Drives, and Power Systems", 7th Edition, Pearson Education., 2017.
4. Ashfaq Husain, HarroonAshfaq, "Electrical Machines", 4th Edition,DhanpatRai& Sons Ltd, 2018

21EE203	TRANSMISSION AND DISTRIBUTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the structure of electric power system with transmission line parameters.
- To utilize the methodology for regulation and efficiency in transmission lines.
- To illustrate mechanical design of transmission lines and insulator strings.
- To outline the types, construction and grading of cables.
- To summarize the types of substations and methods of grounding.

UNIT I	**TRANSMISSION LINE PARAMETERS**	**9**
Structure of power System - parameters of single and three phase transmission lines with single and double circuits - resistance, inductance and capacitance of solid, stranded and bundled conductors, symmetrical and unsymmetrical spacing and transposition - application of self and mutual GMD; Skin and Proximity effects -Typical configurations, conductor types and electrical parameters of EHV lines.		
UNIT II	**MODELLING AND PERFORMANCE OF TRANSMISSION LINES**	**9**
Performance of transmission lines - short line, medium line and long line - equivalent circuits, phasor diagram, attenuation constant, phase constant, Surge impedance Loading (SIL) - transmission efficiency and voltage regulation, real and reactive power flow in lines - Power Circle diagrams – ABCD parameters of transmission lines.		
UNIT III	**MECHANICAL DESIGN OF LINES**	**9**
Mechanical design of over head lines – Line Supports –types of towers – stress and sag Calculation – effects of wind and ice loading. Insulators – types - voltage distribution in insulator string - improvement of string efficiency - testing of insulators - formation of Corona – Critical Voltages – effect on line performance.		
UNIT IV	**UNDERGROUND CABLES**	**9**
Underground cables - types of cables – construction of single core and 3 core cables - insulation resistance – potential Gradient - capacitance of Single-core and 3 core cables - grading of cables - power factor and heating of cables– DC cables.		
UNIT V	**DISTRIBUTION SYSTEMS**	**9**

Distribution Systems – General Aspects – Kelvin's Law – AC and DC distributions - Techniques of voltage Control and power factor improvement – distribution Loss –types of substations -methods of grounding –EHVAC, HVDC and FACTS (Qualitative treatment only).

	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Outline the importance and the functioning of transmission line parameters.

CO2: Identify the performance of transmission lines based on the length and environmental aspects.

CO3: Explain the mechanical design of transmission lines and formation of corona.

CO4: Illustrate about the insulators and cables based on the transmission voltage capacity.

CO5: Compare the concepts of electric distribution system such as EHVAC, HVDC and FACTS.

TEXT BOOKS:

1. D.P.Kothari, I.J.Nagarath, "Power System Engineering", 3rdEdition, McGraw-Hill Publishing Company limited, New Delhi, 2019.
2. S.N. Singh, "Electric Power Generation, Transmission and Distribution", 4thEdition, Prentice Hall of India Pvt. Ltd, New Delhi, 2016.
3. C.L.Wadhwa, "Electrical Power Systems", 6thEdition, New Academic Science Ltd, 2019.
4. V.K.Mehta, Rohit Mehta, "Principles of power system", 1stEdition revised. S Chand & Company Ltd, New Delhi, 2019.

REFERENCES:

1. B.R.Gupta, 'Power System Analysis and Design' S. Chand, New Delhi, 5th Edition, 2008.
2. Luces M.Fualkenberry, WalterCoffer,'Electrical Power Distribution and Transmission', 1st Edition, Pearson Education, 2007.
3. ArunIngole, "Power transmission and distribution", 1st Edition, Pearson Education, 2017.
4. J.Brian, Hardy and Colin R.Bayliss 'Transmission and Distribution in Electrical Engineering', Newnes; 4th Edition, 2012.
5. G.Ramamurthy, "Handbook of Electrical power Distribution," 1st Edition, Universities Press, 2013.

21EE204	ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES: • To explain the structure of basic Electronic Devices. • To infer the operation and applications of Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET). • To summarize the concept of amplifiers and its biasing. • To interpret the gain and frequency response of different amplifiers. • To demonstrate the working principle of various wave shaping circuits.		
UNIT I	**DIODES, SPECIAL DIODES AND APPLICATIONS**	**9**
PN Junction diode, V-I characteristics, applications, Half wave and full wave rectifiers with filter, clipper and clamper circuits. Zener diodes, working principle, Breakdown mechanism-application- Light Emitting Diode (LED), photo diode.		
UNIT II	**BIPOLAR AND UNIPOLAR JUNCTION TRANSISTOR**	**9**
Bipolar Junction Transistor (BJT) and Uni Junction Transistor (UJT) – structure, operation and V-I characteristics – Junction Field Effect Transistor (JFET) – structure, operation and V-I characteristic, Current Equation, Metal Oxide Semiconductor Field Effect Transistor (MOSFET) – structure, operation and V-I characteristic – types of MOSFET-Applications of BJT and UJT.		
UNIT III	**AMPLIFIERS**	**9**
BJT small signal model – biasing – analysis of Common Emitter (CE), Common Base (CB), Common Collector (CC) amplifiers – Gain and frequency response – MOSFET small signal model – biasing – analysis of Common source and source follower – gain and frequency response.		
UNIT IV	**MULTISTAGE AMPLIFIERS AND DIFFERENTIAL AMPLIFIER**	**9**
BIMOS cascade amplifier, differential amplifier – common mode and differential mode analysis – tuned amplifiers – single tuned amplifier – gain and frequency response, power amplifier.		
UNIT V	**FEEDBACK AMPLIFIERS, OSCILLATORS AND WAVE GENERATING CIRCUITS**	**9**
Advantages of negative feedback – voltage / current, series and shunt feedback – positive feedback – Condition for oscillations, Phase shift – Wien bridge, Hartley, Colpitt and Crystal oscillators- Multivibrator - Astable- Monostable- Bistable.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES: At the end of the course, learners will be able to CO1: Outline the structure, operation and V- I characteristics of various PN diodes. CO2: ExplainV-I characteristics of Bipolar Junction Transistor (BJT) and Field Effect Transistor (FET).		

CO3: Identify the transistor application as amplifiers. CO4: Infer the operation, characteristics and gain of multistage and differential amplifiers. CO5: Summarize the operation of feedback amplifiers with their applications.
TEXT BOOKS: 1. David A. Bell, "Electronic devices and circuits", 5th Edition Prentice Hall of India, 2004. 2. S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", 3rd Edition, Tata McGraw Hill 2012. 3. Floyd, "Electron Devices", 5th Edition, Pearson Asia, 2001. 4. Robert L. Boylestad, "Electronic Devices and Circuit theory", 11th Edition, Pearson Asia 2012.
REFERENCES 1. Adel S. Sedra , Kenneth C. Smith, "Microelectronic Circuits: Theory and Applications", 7th Edition, Oxford press, 2017. 2. Donald A. Neamen, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill, 2003. 3. Dale R. Patrick , Stephen W. Fardo, "Electricity and Electronics Fundamentals", 2nd Edition , The Fairmont Press Inc, 2008. 4. Jacob Millman , Christos Halkias , "Electronic Devices And Circuits", 4th Edition, McGraw Hill India, 2015.

21EE205	**DIGITAL LOGIC CIRCUITS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To summarize the various number systems and digital logic families.
- To build combinational logic circuits using K-map.
- To model synchronous sequential circuits using flip flops.
- To develop asynchronous sequential circuits using flip flops.
- To demonstrate the hardware functionality using Programmable Logic Devices (PLDs) and Hardware Description Language (HDL) at system level.

UNIT I	**NUMBER SYSTEMS AND DIGITAL LOGIC FAMILIES**	**9**

Review of number systems, binary codes, error detection and correction codes (Parity and Hamming code) - Digital Logic Families -comparison of Resistor Transistor Logic (RTL), Diode Transistor Logic (DTL), Transistor Transistor Logic (TTL), Emitter Coupled Logic (ECL) and Metal Oxide Semiconductor (MOS families) –operation- characteristics.

UNIT II	**COMBINATIONAL LOGIC DESIGN**	**9**

Combinational logic-Representation of logic functions- Sum of product (SOP) and Product of sum (POS) forms. Simplification of logic functions through Karnaugh map (K-maps), Implementation of Decoders, Encoders, Multiplexers and Demutiplexers using logic gates, Code converters, Adders, Subtractors.		
UNIT III	**SYNCHRONOUS SEQUENTIAL CIRCUITS**	**9**
Sequential logic- Set Rest (SR), Jack Killby (JK), Delay (D) and Toggle (T) flip flops - level triggering and edge triggering - counters - asynchronous and synchronous type - Modulo counters - Shift registers - design of synchronous sequential circuits – Moore and Mealy models- State diagram-State reduction.		
UNIT IV	**ASYNCHRONOUS SEQUENTIAL CIRCUITS**	**9**
Asynchronous sequential logic circuits-Transition Stability, flow Stability-race conditions, hazards &errors in digital circuits- analysis of asynchronous sequential logic circuits.		
UNIT V	**PROGRAMMABLE LOGIC DEVICES AND HARDWARE DESCRIPTION LANGUAGE (HDL)**	**9**
Introduction to Programmable Logic Devices: Programmable Read Only Memory (PROM) – Programmable Logic Array (PLA) –Programmable Array Logic (PAL)-Field Programmable gate Array (FPGA). Introduction to Hardware Description Language (HDL): Digital design process flow – Entities - Architecture –Concurrent and Sequential statements - Behavioral, Dataflow, and structural modeling-simple HDL codes.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Outline the various number systems and different logic families.

CO2:Build combinational logic circuits using basic gates and simplification using Karnaugh maps.

CO3: Model synchronous sequential circuits using flip flops.

CO4: Develop asynchronous sequential circuits using flip flops.

CO5: Explain the hardware functionality at system level using Programmable Logic device (PLD) and Hardware Description Language (HDL).

TEXT BOOKS:

1. M. Morris Mano , Michael D. Ciletti, “Digital Design - With an Introduction to the Verilog HDL, VHDL, and System Verilog”, 6th Edition, McGraw Hill,2018.
2. Rabaey, “Digital Integrated Circuits: A design perspective”, 2ndEdition, Pearson Education, 2016.
3. Thomas L. Floyd, “Digital Fundamentals”, 11thEdition, Pearson Education, 2017.
4. S. Salivhanan, S. Arivazhagan, “Digital Circuits and Design”,5thEdition, Oxford University Press, 2018.

REFERENCES:
1. Leach, Malvino, Saha, “Digital Principles and Applications”, 8thEdition,McGraw Hill, 2014. 2. William Keitz, “Digital Electronics-A Practical Approach with VHDL”, 9thEdition, Pearson, 2011. 3.Samir Palnitkar, “Verilog HDL- A guide to digital design and synthesis”, 2ndEdition, Pearson education, 2003. 4. Ronald J. Tocci , “Digital Systems”, 10thEdition, Pearson education, 2009.

21EE206	DC MACHINES AND TRANSFORMERS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To identify the performance characteristics of DC Generator.
- To develop the performance characteristics of DC Motor.
- To experiment with DC machines to predetermine their performance.
- To make use of speed control techniques in DC motors.
- To build the performance characteristics of Transformers.

LIST OF EXPERIMENTS

1. Open circuit and load characteristics of DC shunt generator- critical resistance and critical speed.
2. Load characteristics of DC compound generator with differential and cumulative connections.
3. Load test on DC shunt motor.
4. Load test on DC compound motor.
5. Load test on DC series motor.
6. Swinburne’s test and speed control of DC shunt motor.
7. Hopkinson’s test on DC motor – generator set.
8. Load test on single-phase transformer and three phase transformers.
9. Open circuit and short circuit tests on single phase transformer.
10. Sumpner’s test on single phase transformers.
11. Separation of no-load losses in single phase transformer.
12. Transformer polarity and vector group test.

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Identify the performance characteristics of DC Generator.

CO2: Develop the performance characteristics of DC Motor.

CO3: Experiment with DC machines to predetermine their performance. CO4: Make use of speed control techniques in DC motors. CO5: Build the performance characteristics of Transformers.

21EE207	ELECTRONIC DEVICES AND DIGITAL LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To identify the behavior of semiconductor devices and its applications.
- To develop the VI characteristics of bipolar and unipolar devices.
- To build combinational and sequential circuits using digital IC.
- To model synchronous and asynchronous counters.
- To construct shift registers.

LIST OF EXPERIMENTS

1. Characteristics of diode and its applications
2. Characteristics of a current controlled devices and its applications
3. Characteristics of voltage controlled devices and its applications
4. Characteristics of Uni Junction Transistor (UJT) and generation of sawtooth waveforms using UJT.
5. Design and implementation of Boolean Functions, Adder and Subtractor circuits.
6. Design and implementation of code converters: Binary to Gray code converter and vice-versa
7. Design and implementation of multiplexer and demultiplexer
8. Design and implementation of parity generator and parity checking
9. Design and implementation of encoders and decoders
10. Design and implementation of 3-bit counters.
11. Design and implementation of 4-bit shift registers

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Identify the VI characteristics of semiconductor diodes.
CO2: Develop the VI characteristics of bipolar and unipolar devices.
CO3: Construct combinational circuits using basic gates.
CO4: Model synchronous and asynchronous counters using JK flip flop.
CO5: Build shift registers using delay flipflop.

SEMESTER – IV

21MA207	STATISTICS AND NUMERICAL METHODS	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To discuss the basic concepts of statistics.
- To demonstrate the basic concepts of solving algebraic and transcendental equations.
- To explain the numerical techniques of interpolation in various intervals.
- To make use of numerical techniques to evaluate the approximation of derivatives and integral which plays an important role in engineering and technology disciplines.
- To develop the knowledge of various numerical techniques and methods of solving ordinary differential equations.

UNIT I	STATISTICS	12

Measures of central tendency – Mean – Median – Mode – Geometric mean and Harmonic mean – Measures of dispersion – range - Quartile deviation – mean deviation and standard deviation – correlation – coefficient of correlation - lines of regression.

UNIT II	SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS	12

Solution of algebraic and transcendental equations – Methods of False position– Newton Raphson method- Crout's method-Types of Errors approximations-Solution of linear system of equations – Gauss Jordan method – Iterative method-Gauss Seidel - Eigen values of a matrix by Power method .

UNIT III	INTERPOLATION AND APPROXIMATION	12

Difference Operators-Forward, Backward, Shift operator- Interpolation with equal intervals - Newton's forward and backward difference formulae-Interpolation with unequal intervals - Lagrange's interpolation – Newton's divided difference interpolation.

UNIT IV	NUMERICAL DIFFERENTIATION AND INTEGRATION	12

Approximation of derivatives using interpolation polynomials - Numerical integration using Newton's Cote's formula, Trapezoidal, Simpson's 1/3 rule, 3/8th rule – Two point and three point Gaussian quadrature formulae.

UNIT V	INITIALVALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS	12

Single Step methods – Taylor's series method – Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first order equations - Multi step methods – Milne's and Adams-Bash forth predictor corrector methods for solving first order equations.

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Experiment the various measures of central tendency and measures of dispersion.

CO2: Apply the basic concepts and techniques of solving algebraic and transcendental

equations. CO3: Apply the numerical techniques of interpolation and error approximations in various intervals in real life situations CO4: Make use of a suitable numerical techniques to evaluate the approximation of derivatives and integral. CO5**: S**olve the IVPs in ODE using single step and multi-step methods.
TEXT BOOKS: 1. Johnson, R.A., Miller, I and Freund J, "Probability and Statistics for Engineers", 8th Edition, Pearson Education, Asia, 2015. 2. Steven C. Chapra, Raymond P. Canale, "Numerical Methods for Engineers", 6th Edition, MC Graw Hill Higher Education, 2010. 3. Burden,R.L and Faires,J.D,"Numerical Analysis", 9th Edition, Cengage Learning, 2016. 4. Gerald.C.F and Wheatley.P.O.,"Applied Numerical Analysis", 6th Edition, Pearson Education , 2006
REFERENCES: 1. Joe.D. Hoffman, Steven Frankel, Numerical Methods for Engineers and Scientists" 3rd Edition, CRC Press, 2015. 2. Mathews,J.H. "Numerical Methods for Mathematics, Science and Engineering ", 2nd Edition, Prentice Hall,1992. 3. S.K.Gupta, "Numerical methods for Engineers", 1st Edition, New Age Internationals Private Ltd Publishers, 2015.

21EE208	**MEASUREMENTS AND INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES: • To explain the basic functional elements of instrumentation • To demonstrate various electrical and electronic instruments • To outline various measurement techniques • To summarize various storage and display devices • To illustrate various transducers principle and data acquisition systems					
UNIT I	**QUALITIES OF MEASUREMENTS**				**9**
Functional elements of an instrument – Static and dynamic characteristics – Errors in measurement – Statistical evaluation of measurement data – Standards and calibration.					
UNIT II	**ELECTRICAL AND ELECTRONICS INSTRUMENTS**				**9**
Principle and types of analog and digital voltmeters, ammeters, multimeters – Single and three phase wattmeters and energy meters – Magnetic measurements – Determination of B-H curve and measurements of iron loss – Instrument transformers – Instruments for measurement of					

frequency and phase.		
UNIT III	**COMPARATIVE METHODS OF MEASUREMENTS**	**9**
D.C potentiometers, D.C & A.C bridges, transformer ratio bridges, self-balancing bridges. Interference & screening – Multiple earth and earth loops - Electrostatic and electromagnetic Interference – Grounding techniques.		
UNIT IV	**STORAGE AND DISPLAY DEVICES**	**9**
Magnetic disk and tape – Recorders, digital plotters and printers, CRT display, digital CRO, LED, LCD & Dot matrix display – Data Loggers.		
UNIT V	**TRANSDUCERS AND DATA ACQUISITION SYSTEMS**	**9**
Classification of transducers – Selection of transducers – Resistive, capacitive & inductive Transducers – Piezoelectric, Hall effect, optical and digital transducers – Elements of data acquisition system – Smart sensors-Thermal Imagers.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Outline the basic concepts about measurement and instrumentation.

CO2: Illustrate the operating principles of MI and MC meters.

CO3: Classify the methods of measurements for Resistance, Inductance and Capacitance using bridges.

CO4: Interpret elements of digital storage & display devices.

CO5: Explain the functioning of transducers and data acquisition systems.

TEXT BOOKS:

1. A.K. Sawhney, "A Course in Electrical & Electronic Measurements & Instrumentation", 5^{th} Edition, DhanpatRai and Co, 2010.
2. J. B. Gupta, "A Course in Electronic and Electrical Measurements", 2^{nd} Edition, S.K.Kataria & Sons, Delhi, 2013.
3. Doebelin E.O. and Manik D.N., "Measurement Systems – Applications and Design", Special Indian Edition, McGraw Hill Education Pvt. Ltd., 2007.
4. H.S. Kalsi, "Electronic Instrumentation", 3^{rd} Edition, McGraw Hill, 2010.

REFERENCES

1. D.V.S. Murthy, "Transducers and Instrumentation", 2^{nd} Edition, Prentice Hall of India Pvt Ltd, 2015.
2. David Bell, "Electronic Instrumentation & Measurements", 3^{rd} Edition, Oxford University Press, 2013.
3. Martin Reissland, "Electrical Measurements", 2^{nd} Edition, New Age International (P) Ltd., Delhi, 2001.
4. Alan. S. Morris, "Principles of Measurements and Instrumentation", 2^{nd} Edition, Prentice Hall of India, 2003.

21EE209	INDUCTION AND SYNCHRONOUS MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify the operation and performance of three phase induction motor.
- To illustrate the speed control techniques in three-phase induction motors.
- To develop operation and performance of single phase induction motors.
- To construct the performance of salient and non – salient type synchronous generators.
- To build the operation and performance of synchronous motor.

UNIT I	THREE PHASE INDUCTION MOTOR	9

Constructional details – Types of rotors - Principle of operation – Slip – Torque-Slip characteristics - Condition for maximum torque – Load test- Losses and efficiency- Cogging and crawling - No load and blocked rotor tests - Equivalent circuit - Separation of losses - Circle diagram – Double cage induction motors –Induction generators– Introduction to Synchronous Induction Motor

UNIT II	STARTING AND SPEED CONTROL OF THREE PHASE INDUCTION MOTOR	9

Need for starting – Types of starters – DOL, Rotor resistance, Autotransformer and Star- delta starters -Korndorfer starter– Speed control – Voltage control, Frequency control and pole changing – Cascaded connection-V/f control – Slip power recovery scheme-Braking of three phase induction motor: Plugging, dynamic braking and regenerative braking.

UNIT III	SINGLE PHASE INDUCTION MOTORS AND SPECIAL MACHINES	9

Constructional details of single phase induction motor – Double field revolving theory and operation – Equivalent circuit – No load and blocked rotor test – Performance analysis – Starting methods of single-phase induction motors – Capacitor-start capacitor run Induction motor- Shaded pole induction motor - Repulsion motor - Hysteresis motor - AC series motor- Servo motors- Stepper motors - Linear Induction Motor.

UNIT IV	SYNCHRONOUS GENERATOR	9

Constructional details – Salient and non-salient types of rotors –Winding factors- EMF equation – Synchronous reactance – Armature reaction – Phasor diagrams of non-salient pole synchronous generator connected to infinite bus –Parallel operation of Alternators - Synchronization and load division- Synchronizing torque -Change of excitation and mechanical input- Voltage regulation – EMF, MMF, ZPF and A.S.A methods – Steady state power- angle characteristics– Two reaction theory –Slip test- Capability Curves

UNIT V	SYNCHRONOUS MOTOR	9

Principle of operation – Torque equation – Operation on infinite bus bars - V and Inverted V curves – Power input and power developed equations – Starting methods – Current loci for constant power input, constant excitation and constant power developed-Hunting – Natural frequency of oscillations – Damper windings- Synchronous condenser – Introduction to Permanent Magnet Synchronous Motor

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Build the construction and working principle of Three phase Induction Motor

CO2: Summarize the speed control techniques of three phase induction motors.

CO2: Model the single phase induction motor with construction and working principle

CO4: Identify the construction and working principle of Synchronous Generator.

CO5: Develop knowledge on Synchronous motor.

TEXT BOOKS:

1. Nagrath, I.J. and Kothari.D.P., "Electric Machines", 6th Edition, McGraw-Hill Education, 2019.
2. P. S. Bimbhra, "Electrical Machines", 4th Edition, ,Khanna Publishing, 2018
3. A.E. Fitzgerald, Charles Kingsley, Stephen. D. Umans, "Electric Machinery", 2nd Edition, McGraw Hill publishing Company Ltd, 2003.
4. Theraja B.L., "A Textbook of Electrical Technology", Volume II, 24th Edition, S. Chand Publication, 2018

REFERENCES

1. B.R. Gupta, "Fundamental of Electric Machines", 4th Edition, New age International Publishers, 2017.
2. S.K. Bhattacharya, "Electrical Machines", 4th Edition, McGraw - Hill Education, ,2018
3. M. G. Say, "Performance and Design of Alternating Current Machines", 3rd Edition, CBS Publishers & Distributors Pvt. Ltd., New Delhi, 2002.
4. Miller, T.J.E., "Brushless Permanent Magnet and Reluctance Motor Drives", 1st Edition, Clarendon Press, 1989.

21EE210	CONTROL SYSTEMS	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To explain the use of transfer function models for analysis of physical systems and introduce the control system components.
- To infer the time response of systems and steady state error analysis.
- To summarize the open loop and closed–loop frequency responses of systems.
- To illustrate stability analysis and design of compensator networks.
- To outline the state variable representation of physical systems

UNIT I	REPRESENTATION OF VARIOUS SYSTEMS	15
Elements and Types of Control Systems - Effect of Feedback Systems - Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems. Determination of transfer function by block diagram reduction technique and signal flow graph.		
UNIT II	**TIME RESPONSE OF FEEDBACK CONTROL SYSTEMS**	**15**
Standard test signals - Unit step response of First and Second Order Systems - Time response specifications - Time response specifications of second order systems - steady state error and error constants -Introduction to PI, PD and PID Controllers and its effects (excluding design).		
UNIT III	**FREQUENCY DOMAIN ANALYSIS AND STABILITY**	**15**
Correlation between time and frequency response - Bode Plot -Experimental determination of transfer function. Introduction to Polar Plots (Inverse Polar Plots excluded) - Mathematical preliminaries - Nyquist Stability criterion - assessment of relative stability: gain margin and phase margin		
UNIT IV	**STABILITY ANALYSIS & COMPENSATION TECHNIQUES**	**15**
Concepts of stability - Necessary conditions for Stability-Routh-Hurwitz stability criterion - Introduction to Root-Locus Techniques - The root locus concept - Construction of root loci – Design of lag, lead and lead-lag compensating networks.		
UNIT V	**STATE VARIABLE ANALYSIS**	**15**
Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability.		
	TOTAL: 75 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Develop transfer function of systems based on the knowledge of Mathematics, Science and Engineering fundamentals.

CO2: Apply the various time domain and frequency domain techniques to assess the system performance.

CO3: Identify the effect of various compensation in frequency domain.

CO4: Make use of knowledge about various stability techniques to different applications

CO5: Solve Controllability and Observability using state space representation.

TEXT BOOKS:

1. Nagarath, I.J. and Gopal, M., "Control Systems Engineering", 4th Edition, New Age International Publishers, 2017.
2. Benjamin C. Kuo, "Automatic Control Systems", 9th Edition, Wiley, 2009.
3. M.Gopal, "Control System: Principle and design", 4th Edition, McGraw Hill Education, 2012.
4. Katsuhiko Ogata, "Modern Control Engineering", 5th Edition, Pearson Education, 2015.

REFERENCES
1. Richard C.Dorfand Bishop, R.H., “Modern Control Systems”, 12th Edition, Pearson Education, 2010.
2. John J.D., Azzo Constantine, H. and HoupisSttuart, N Sheldon, “Linear Control System Analysis and Design with MATLAB”, 5th Edition, CRC Taylor& Francis Reprint 2017.
3. RamesC.Panda and T. Thyagarajan, “An Introduction to Process Modelling Identification and Control of Engineers”, 2nd Edition, Narosa Publishing House, 2017.
4. A.Nagoorkani, “Control systems”, 3rd Edition, RBA Publications 2017.

21EE211	**INTEGRATED CIRCUITS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:
- To outline the fabrication steps of integrated circuits and characteristics of Op-Amp
- To demonstrate the basic applications of Op-amp based circuits.
- To summarize the function of Op-Amp as comparator, wave generator and data converter.
- To explain the internal structure of special ICs such as 555 Timers, PLL circuits.
- To illustrate the functional blocks and applications of IC voltage regulator

UNIT I	**INTEGRATED CIRCUIT (IC) FABRICATION AND OPERATIONAL AMPLIFIER CHARACTERISTICS**	**9**

IC classification, fundamental of monolithic IC technology, epitaxial growth, masking and etching, diffusion of impurities. Realization of monolithic ICs and packaging. Fabrication of diodes, capacitance, resistance, Field Effect Transistors (FETs) and Photo Voltaic (PV) Cell. Ideal Operational amplifier of characteristics, DC characteristics and AC characteristics, differential amplifier; frequency response of Op-Amp

UNIT II	**APPLICATIONS OF OPAMP**	**9**

Basic applications of Op-Amp – Inverting and Non-inverting Amplifiers, summer, differentiator and integrator- Voltage – Current (V/I) and Current –Voltage (I/V) converters, Instrumentation amplifier, AD623 Instrumentation Amplifier and its application as load cell weight measurement - Log and Antilog Amplifiers-First and second order active filters

UNIT III	**COMPARATOR, WAVE GENERATOR AND CONVERTER**	**9**

Comparators, multivibrators, waveform generators, clippers, clampers, rectifiers, peak detector, Sample and Hold (S&H) circuit, Digital to Analog (D/A) converter, Analog to Digital (A/D) converters using Op-Amps.

UNIT IV	**SPECIAL ICs**	**9**

Functional block, characteristics of 555 Timer and its Pulse Width Modulation (PWM) application - IC566 Voltage Controlled Oscillator (VCO) IC565-Phase Locked Loop (PLL), AD633 Analog multiplier IC.

UNIT V	IC REGULATORS	9
IC voltage regulators –LM78XX, LM79XX; Fixed voltage regulators its application as Linear power supply - LM317, 723 Variable voltage regulators, switching regulator- Switched Mode Power Supply (SMPS).		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Explain the steps involved in IC fabrication and characterization of Op-Amp

CO2: Outline the basic applications of Op-Amp.

CO3: Summarize the role of Op-Amp in wave generator, comparator and converter circuit.

CO4: Classify special ICs namely Timers and Phase locked Loop (PLL) circuits with their applications.

CO5: Interpret the role of ICs in voltage regulating circuits.

TEXT BOOKS:

1. D. Roy Choudhary, Sheil B. Jani, "Linear Integrated Circuits", 5th Edition , New Age, 2018.
2. S. Salivahanan, "Linear Integrated Circuits", 2nd Edition, Tata McGraw Hill, 2015.
3. Ramakant A. Gayakwad, "Op-Amps and Linear Integrated Circuits", 4th Edition, Pearson education, 2015.
4. Robert F. Coughlin, Fredrick F. Driscoll, "Op-amp and Linear ICs", 6th Edition, Pearson education, 2012.

REFERENCES:

1. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", 4th Edition, McGraw Hill, 2016.
2. David A. Bell, "Operational Amplifiers & Linear ICs", 3rd Edition, Oxford Higher education, 2011.
3. G B Clayton, Steve Winder, "Operational Amplifiers", 5th Edition, Newnes, 2003.
4. William D. Stanley, "Operational Amplifiers with Linear Integrated Circuits", 4th Edition, Pearson education, 2004.

21EE212	MICROPROCESSORS, MICROCONTROLLERS AND INTERFACING (Theory with Practical Course)	L	T	P	C
		3	0	2	4

OBJECTIVES:

- To illustrate the architecture of 8086 Microprocessor for programming concepts.
- To apply the interfacing concepts of IO/Memory and Serial / Parallel Communication with 8086 processor.
- To explain the architecture for programming in 8051 Microcontroller.
- To develop programming skills using 8051 Microcontroller.
- To infer the interfacing concepts of real time applications using microcontrollers.

UNIT I	ARCHITECTURE OF 8086 & ASSEMBLY LANGUAGEPROGRAMMING	9
Microprocessor Families – 8086 –Architecture – Instruction set – Addressing Modes – Bus Cycles – Assembly Language Programming of 8086 – Assembler Directives – Interrupts and its applications.		
UNIT II	**PERIPHERAL INTERFACING**	**9**
External Memory Interface – Programmable Peripheral Interface (8255) – Serial Communication Interface (8251) –Keyboard and Display Interface (8279) – Programmable Timer Controller (8254) – Programmable interrupt controller (8259).		
UNIT III	**8051 MICROCONTROLLER**	**9**
8051 Microcontroller –Architecture –Special Function Registers – Addressing modes-Instruction classification– Assembly Language Programming.		
UNIT IV	**8051 MICROCONTROLLER INTERFACING**	**9**
Ports – I/ O Interfacing –8051 Timer/ Counter mode selection – USART – Interrupt controller - DAC – ADC – Keyboard display Interfacing.		
UNIT V	**SYSTEM DESIGN USING MICROCONTROLLERS**	**9**
8051 Interfacing – Sensor Interfacing – RTC interfacing (DS1307) using I^2C standard – Relay, motor control- DC & Stepper Motor interfacing – Traffic Light Controller & Digital Weighing Machine control.		
	TOTAL: 45 PERIODS	
PRACTICAL COURSE		**15**

LIST OF EXPERIMENTS

Develop the 8086 Assembly Language Programming (ALP) for

1. Basic arithmetic and Logical operations
2. Code conversion, decimal arithmetic and Matrix operations.

Build the interfacing circuits for different I/Os with8086 microprocessor using

3. Serial interface and Parallel interface
4. Key board and Display Interface

Develop the 8051 Assembly Language Programming(ALP) and C programming for

5. Basic arithmetic and Logical operations
6. Finding Square and Cube of the given number program
7. Timer mode selection Programming
8. ADC / DAC interfacing
9. Keyboard display interfacing Programming
10. Unpacked BCD to ASCII

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Develop assembly language program for 8085 & 8086 Microprocessor.

CO2: Build assembly language program and embedded C language program for 8051 Microcontroller.
CO3: Experiment with embedded C language program for MSP430 Microcontroller.
CO4: Make use of peripheral devices to interface 8086 microprocessor, 8051 and MSP430 Microcontroller.
CO5: Identify real time applications using 8086 microprocessor based systems, 8051 and MSP430 Microcontroller based systems.

TEXT BOOKS:

1. Douglas V Hall, "Microprocessors and Interfacing", 3rd Edition, McGraw Hill Education, 2012.
2. Muhammad Ali Mazidi, "The 8051 Microcontroller and Embedded Systems using Assembly and C", 2nd Edition, Pearson India, 2007.
3. John Peatman, "Design with 8051 Microcontroller", 4th Edition, Pearson Publications, 1997.
4. Krishna Kant, "Microprocessor and Microcontrollers", 1st Edition, Prentice Hall of India, New Delhi, 2007.

REFERENCES:

1. A.K. Ray and K.M. Burchandi, "Intel Microprocessors Architecture Programming and Interfacing", 1st Edition, McGraw Hill, 2000.
2. Sunil Mathur, "Microprocessor 8086: Architecture, Programming and Interfacing", PHI Learning Pvt.Ltd., 5th Edition,2011.
3. Kenneth Ayala, "The 8051 Microcontroller", 3rd Edition, Delmar Cengage Learning, 2004.
4. A. NagoorKani, "Microprocessors and Microcontrollers", 1st Edition, McGraw Hill Education, 2012.

21EE213	INDUCTION AND SYNCHRONOUS MACHINES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To experiment with 3 phase alternators to find voltage regulation by EMF, MMF, ZPF and ASA methods.
- To solve for direct axis reactance of salient pole alternator using slip test.
- To develop the characteristics of V and Inverted V curves in synchronous motors.
- To identify the performance characteristics of single phase and three phase induction motor.
- To build the characteristics of single phase and three phase induction motor.

LIST OF EXPERIMENTS

1. Regulation of three phase alternator by EMF and MMF methods

2. Regulation of three phase alternator by ZPF and ASA methods
3. Regulation of three phase salient pole alternator by slip test
4. Measurements of negative sequence and zero sequence impedance of alternators
5. V and Inverted V curves of Three Phase Synchronous Motor
6. Load test on three-phase induction motor
7. No load and blocked rotor tests on three-phase induction motor (Determination of equivalent circuit parameters).
8. Separation of No-load losses of three-phase induction motor
9. Load test on single-phase induction motor
10. No load and blocked rotor test on single-phase induction motor
11. Harmonic Analysis of Three Phase Induction Motor
12. Study of Induction motor Starters

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Experiment with 3 phase alternators to find voltage regulation by EMF, MMF, ZPF and ASA methods.

CO2: Solve for direct axis reactance of salient pole alternator using slip test.

CO3: Develop the characteristics of V and Inverted V curves in synchronous motors

CO4: Identify the performance characteristics of single phase and three phase induction motor

CO5: Construct the characteristics of single phase and three phase induction motor

21EE214	INTEGRATED CIRCUITS AND INSTRUMENTATION LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To model characteristics of inverting and non-inverting operational amplifier.
- To identify the performance of wave generating circuit using IC 555 timer.
- To build P, PI and PID controllers.
- To solve unknown values of R, L and C bridge using DC & AC bridge.
- To develop characteristics of transducers.

LIST OF EXPERIMENTS

1. Verify the operation of inverting and non-inverting amplifier
2. Verify the operation of adder and comparator using IC741
3. Design of integrator and differentiator using IC741
4. Design of Astable and Monostable multivibrator using NE/SE 555 timer
5. Design of P, PI & PID Controllers
6. Characteristics of Synchro Transmitter & Receiver
7. Determination of Transfer function DC Motor

8. Design of Lag, Lead & Lag-Lead Compensator
9. Measurement of unknown value of resistance, inductance and Capacitance Bridge Networks using AC and DC Bridges.
10. Identify the characteristics Dynamics of Sensors/Transducers.
    a. Pressure
    b. Displacement
11. Signal Conditioning of Analog to Digital and Digital to Analog converters.

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Model adder, comparator, differentiator and integrator using IC 741.

CO2: Make use of linear ICs for verifying the function of voltage regulator, astable and mono-stable multivibrators.

CO3: Build P, PI, PID controllers and compensators.

CO4: Solve for unknown passive elements using D.C and A.C Bridges.

CO5: Develop the characteristics of energy meter, transducers and converters.

SEMESTER - V

21EE301	POWER SYSTEM ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To model the power system under steady state operating condition
- To utilize iterative techniques for power flow analysis
- To make use of Thevenin's theorem for symmetrical fault analysis
- To apply symmetrical components for unsymmetrical faults
- To make use of modified Euler method for stability problem in power system

UNIT I	INTRODUCTION TO POWER SYSTEM	9

Need for system planning and operational studies - Power scenario in India - Power system components - Representation - Single line diagram - per unit quantities - p.u. impedance diagram - p.u. reactance diagram - Network graph, Bus incidence matrix, Primitive parameters, Bus admittance matrix from primitive parameters - Formation of bus admittance matrix of large power network.

UNIT II	POWER FLOW ANALYSIS	9

Bus classification - Formulation of Power Flow problem in polar coordinates - Power flow solution using Gauss Seidel method - Handling of Voltage controlled buses - Power Flow Solution by Newton Raphson method

UNIT III	SYMMETRICAL FAULT ANALYSIS	9

Assumptions in short circuit analysis - Symmetrical short circuit analysis using Thevenin's theorem - Bus Impedance matrix building algorithm (without mutual coupling) - Symmetrical fault analysis through bus impedance matrix - Post fault bus voltages - Fault level - Current limiting reactors.

UNIT IV	UNSYMMETRICAL FAULT ANALYSIS	9

Symmetrical components - Sequence impedances - Sequence networks - Analysis of unsymmetrical faults at generator terminals: LG, LL and LLG - unsymmetrical fault occurringat any point in a power system - computation of post fault currents in symmetrical component and phasor domains.

UNIT V	STABILITY ANALYSIS	9

Classification of power system stability – Rotor angle stability - Swing equation - Swing curve - Power-Angle equation - Equal area criterion - Critical clearing angle and time - Classical step-by-step solution of the swing equation – modified Euler method

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Construct admittance matrix of the power system under steady state condition
CO2: Apply Gauss-Siedel and Newton Raphson techniques for power flow analysis
CO3: Utilize Thevenin's theorem for symmetrical fault analysis
CO4: Solve Line to ground fault, Line to line fault and double line to ground faults using sequence networks
CO5: Make use of equal area criterion for stability problem in power system

TEXT BOOKS:

1. Nagrath, I.J. and Kothari. D.P, "Modern Power System Analysis", 4th Edition, McGraw-Hill Education, 2011.
2. Hadi Saadat, "Power System Analysis", 2nd Edition, Tata McGraw Hill Education, 2002.
3. John J. Grainger, William D. Stevenson. Jr, "Power System Analysis", 3rd Edition, McGraw Hill Education, 2015.
4. J. Duncan Glover, Mulukutla S.Sarma, Thomas J. Overbye, "Power System Analysis & Design", 5thEdition, Cengage Learning, 2012.

REFERENCES

1. Pai M A, "Computer Techniques in Power System Analysis", 2nd Edition, Tata McGraw-Hill Education, 2007.
2. Gupta B.R., "Power System - Analysis and Design", 6th Edition, S. Chand Publishing, 2001.
3. Kundur P., "Power System Stability and Control", 10th reprint edition, Tata McGraw Hill Education, 2010
4. Arthur Bergen, Vijay Vittal, "Power Systems Analysis ", 2nd Edition, Pearson publication, 1999.

21EE302	POWER ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To summarize the different types of power semiconductor devices and their switching characteristics.
- To explain the operation, characteristics and performance parameters of Phase controlled converters.
- To outline the operation, switching techniques and basics topologies of DC-DC converters.
- To relate the different modulation techniques of pulse width modulated inverters.
- To illustrate the operation of AC to AC voltage converters.

UNIT I	POWER SEMICONDUCTOR DEVICES	9
Ideal and Practical static Characteristics - Power Diodes, SCR, TRIAC, MOSFET, IGBT, GTO- Switching characteristics: SCR, MOSFET, IGBT, Driver and protection circuits - Introduction to Modern power Devices.		
UNIT II	**PHASECONTROLLED CONVERTERS**	**9**
2 pulse / 3 pulse and 6 pulse converters – Effect of source inductance – performance parameters – Reactive power control of converters, Firing schemes for converter– Dual converters- Applications.		
UNIT III	**DC TODC CONVERTERS**	**9**
Time ratio control and current limit control - Step-down and Step-up chopper – Switching mode regulators Buck, Boost, Buck-Boost – Introduction to Fly back Converters – concept of resonant switching- Applications.		
UNIT IV	**DC TO AC CONVERTERS**	**9**
Single-phase and three-phase [120^o& 180^o mode] inverters – Voltage and harmonic control – PWM techniques – Sinusoidal PWM, Modified sinusoidal PWM and multiple PWM – Introduction to space vector modulator– current source inverter- Applications.		
UNIT V	**AC TO AC CONVERTERS**	**9**
Single-phase and three-phase AC voltage controllers – Multistage sequence control – single phase and three phase cyclo-converters– Introduction to Matrix converters-Application.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Summarize the types of power semiconductor switches.

CO2: Explain the performance parameters of Phase controlled converters.

CO3: Relate the working of various types of DC to DC converters.

CO4: Outline the concept of different PWM techniques.

CO5: Demonstrate the control of AC to AC converters.

TEXT BOOKS:

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", 3rd Edition, Prentice Hall India, New Delhi, 2004.
2. Ned Mohan, T.M.Undeland, W.P.Robbins, "Power Electronics: Converters, applications and design", 3rd Edition, John wiley and Sons, 2006.
3. P.S.Bimbra, "Power Electronics", 3rd Edition, Khanna Publishers, 2003
4. M.D. Singh and K.B. Khanchandani, “Power Electronics,” Mc Graw Hill India, 1st Edition 2013.

REFERENCES

1. Cyril.W.Lander, "Power Electronics", 3rd Edition, McGraw Hill International, 1993.
2. Bimal K.Bose. "Modern Power Electronics and AC Drives", 1st Edition Pearson

Education, 2002.
3. Philip T.Krein, "Elements of Power Electronics", 1st Edition, Oxford University Press, 2004.
4. Joseph Vithayathi, “Power electronics Principles and application”, McGraw Hill series 6th Edition, 2013.

21EE303	DIGITAL SIGNAL PROCESSING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the concepts of Signals and systems & their mathematical representation.
- To outline the discrete time systems.
- To demonstrate the transformation techniques & their computation.
- To explain filters and their design for digital implementation.
- To summarize programmability digital signal processor & quantization effects.

UNIT I	INTRODUCTION	9

Classification of systems: Continuous, discrete, linear, causal, stability, dynamic, recursive, time variance; classification of signals: continuous and discrete, energy and power; mathematical representation of signals; spectral density; sampling techniques, quantization, quantization error, Nyquist rate, aliasing effect.

UNIT II	DISCRETE TIME SYSTEM ANALYSIS	9

Z-transform and its properties, inverse z-transforms; difference equation – Solution by z-transform, application to discrete systems – Stability analysis, frequency response – Convolution – Discrete Time Fourier transform ,magnitude and phase representation

UNIT III	DISCRETE FOURIER TRANSFORM AND COMPUTATION	9

Discrete Fourier Transform- Properties, magnitude and phase representation – Computation of DFT using FFT algorithm – DIT &DIF using radix 2 FFT – Butterfly structure

UNIT IV	DIGITAL SIGNAL PROCESSORS	9

Introduction – Architecture – Features – Addressing Formats – Functional modes – Introduction to Commercial DS Processors.

UNIT V	APPLICATIONS OF DIGITAL SIGNAL PROCESSING	9

Introduction-Applications of DSP in Biomedical Engineering-Voice Processing-Applications to RADAR-Applications to image processing-Introduction to wavelets-Wireless Communication.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1. Explain the importance of Fourier transform, digital filters and DS Processors.

CO2. Summarize the knowledge on Signals and systems & their mathematical representation.

CO3. Illustrate the transformation techniques and their computation.

CO4. Compare the types of filters and their design for digital implementation.

CO5. Outline the various applications of digital signal processing

TEXT BOOKS:

1. J.G. Proakis and D.G. Manolakis, "Digital Signal Processing Principles, Algorithms and Applications", 1st Edition, Pearson Education, New Delhi, PHI. 2003.
2. S.K. Mitra, "Digital Signal Processing – A Computer Based Approach", 1st Edition, McGraw Hill Edu, 2013.
3. Lonnie C.Ludeman ,"Fundamentals of Digital Signal Processing", 1st Edition, Wiley,2013.
4. Robert Schilling & Sandra L.Harris, Introduction to Digital Signal Processing using Matlab", 1st Edition, Cengage Learning,2014

REFERENCES

1. Poorna Chandra S, Sasikala. B , "Digital Signal Processing" , 1st Edition, Tata Mc Graw Hill ,2013.
2. B.P.Lathi, "Principles of Signal Processing and Linear Systems", 1st Edition, Oxford University Press, 2010.
3. Taan S. ElAli, "Discrete Systems and Digital Signal Processing with Mat Lab", 1st Edition, CRC Press, 2009.
4. SenM.kuo, woonsenggan, "Digital Signal Processors, Architecture, Implementations & Applications", 1st Edition, Pearson, 2013.
5. DimitrisG.Manolakis, Vinay K. Ingle, "Applied Digital Signal Processing" , 1st Edition, Cambridge, 2012.

21EE304	EMBEDDED SYSTEMS (Theory with Practical Course)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain the building blocks of embedded system.
- To illustrate the interfacing of embedded network.
- To summarize the various embedded development strategies
- To develop the programs to interface memory, I/Os with processor.
- To build the embedded system blocks for simple applications

UNIT I	INTRODUCTION TO EMBEDDED SYSTEMS	6
Introduction to Embedded Systems –Structural units in Embedded Processor, selection of processor & memory devices- DMA — Memory management methods- Timer and Counting devices.		
UNIT II	**EMBEDDED NETWORKING**	**6**
Embedded Networking: Introduction, I/O Device Ports & Buses–CAN Bus -Serial Peripheral Interface (SPI) — Inter Integrated Circuits (I2C) –need for device drivers.		
UNIT III	**EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT**	**6**
Embedded Product Development Life Cycle- objectives, different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design.		
UNIT IV	**RTOS BASED EMBEDDED SYSTEM DESIGN**	**6**
Introduction to basic concepts of RTOS- Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication shared memory, message passing-, Inter process Communication.		
UNIT V	**EMBEDDED SYSTEM APPLICATION AND DEVELOPMENT**	**6**
Case Study of Washing Machine- Automotive Application- Smart card System Application-ATM machine –Digital camera.		
		TOTAL:30 PERIODS
PRACTICAL COURSE		**15**
LIST OF EXPERIMENTS		
1. Interfacing ADC and DAC. 2. Interfacing real time clock and serial port. 3. Interfacing EPROM and interrupt. 4. Interrupt performance characteristics of ARM and FPGA. 5. Implementing Zigbee protocol with ARM.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES: At the end of the course, learners will be able to: CO1: Outline the concepts of embedded systems. CO2: Demonstrate the embedded networking for bus communication. CO3: Illustrate the various Embedded firmware development. CO4: Apply the programs to interface memory, I/Os with processor. CO5: Develop the embedded system blocks for simple applications		
TEXT BOOKS: 1. Rajkamal, "Embedded System-Architecture, Programming, Design", 2nd Edition,Mc Graw Hill, 2013.		

2. Peckol, “Embedded system Design”, 1st Edition, John Wiley & Sons, 2010.
3. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef, and Philippe Gerum, “Building Embedded Linux Systems” 2nd Edition, SPD -O’Reilly Publications, 2008.
4. C.M. Krishna, Kang, G.Shin, “Real Time Systems”, 3rdEdition, McGraw Hill, 1997.

REFERENCES

1. Shibu. K.V, “Introduction to Embedded Systems”, 1st Edition,Tata Mcgraw Hill,2009.
2. Han-Way Huang, “Embedded system Design Using C8051”, 2nd Edition,Cengage Learning,2009.
3. Jan Axelson “Embedded Ethernet and Internet Complete”, 2nd Edition, Penram publications, 2003.
4. Bhaskar Krishnamachari, “Networking wireless sensors”, 1st Edition, Cambridge press, 2005.

21CS308	**C AND DATA STRUCTURES**	**L**	**T**	**P**	**C**
		2	**0**	**2**	**3**

COURSE OBJECTIVES:

- To explain the concepts of C programming using arrays.
- To describe the concepts of function and structure for problem solving.
- To make use of the concept List, Stack, Queues ADTs.
- To illustrate Tree and Graph data structure for solving real time problems
- To choose different searching and sorting algorithms.

UNIT-I INTRODUCTION TO C **9**

Structure of C Program-Pre-processor Directives-Compilation and Linking Processes-Data types-Storage classes-Constants-Variables-Operators-Expressions-Input/output Statements--Arrays: Declaration-Initilization-1-Dimensional Array-Two Dimensional Arrays.

Suggested Activities:

- Practice of C programming using statements, expressions, decision making and iterative statements
- Practice of C programming using Arrays

UNIT-II FUNCTIONS, POINTERS AND STRUCTURES **9**

Functions: Pass by value-Pass by reference and Recursion-Pointer definition-Initialization-pointer arithmetic-Structures-Definition-Structure with Structure-Programs using structures

Suggested Activities:

- Call by value & Call by reference
- Passing Structure Members as arguments to Function
- Implement C programs using Pointers and Structures

UNIT-III LINEAR DATA STRUCTURES **9**

Abstract Data Type(ADT)-Stacks ADT and Queues ADT -Array- based Implementation-Linked List-Linked List based Implementation of stack and queues-Evaluation of Expression-Linked list

based Polynomial Addition. **Suggested Activities:** • Array implementation of List ADT • Array implementation of Stack and Queue ADTs • Linked list implementation of List, Stack and Queue ADTs • Applications of List, Stack and Queue ADTs		
UNIT-IV	**NON LINEAR DATA STRUCTURE**	**9**
Trees - Binary trees - Binary tree representation and traversals - Binary Search Tree Applications of trees. Graph - Definitions - Representations - Breadth first traversal - Depth first traversal **Suggested Activities:** • Implementation of Binary Trees and operations of Binary Trees • Implementation of Binary Search Trees		
UNIT-V	**SEARCHING AND SORTING ALGORITHMS**	**9**
Liner Search-Binary Search- Bubble sort –Insertion Search-Merge sort-Quick Sort-Hash Tables-Overflow Handling. • Implementation of searching techniques • Implementation of Sorting algorithms : Insertion Sort, Quick Sort, Merge Sort • Implementation of Hashing – any two collision techniques		
		TOTAL:45 PERIODS
COURSE OUTCOMES: At end of the course, learners will be able to: CO1: Develop C programs for simple applications using basic constructs and arrays. CO2: Construct C programs involving functions, recursion, pointers & structures. CO3: Build abstract data types for linear data structures. CO4: Categorize the different non-linear data structures to resolve problems. CO5: Solve the problems using various sorting algorithms and hashing techniques.		
TEXT BOOKS: 1. ReemaThareja, "Programming in C", 2nd Edition,Oxford University Press, 2016. 2. ReemaThareja, "Data Structures Using C", Second Edition , Oxford University Press, 2011 3. Ellis Horowitz, SartajSahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", 2^{nd} Edition, Universities Press, 2011.		
REFERENCES: 1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018. 2. Yashwant Kanetkar, "Let us C", 17^{th} Edition, BPB Publications, 2020. 3. Mark Allen Weiss,"Data Structures and Algorithm Analysis in C", 2^{nd} Edition, Pearson Education, 2010.		

21EE305	POWER ELECTRONICS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To demonstrate the performance and characteristics of power semiconductor devices, converters and inverters
- To experiment with the characteristics of different power switching devices.
- To analyze the operation of AC/DC fully and half controlled converters
- To apply the chopper circuits in switching devices.
- To identify the output of inverters for different duty cycle

LIST OF EXPERIMENTS

1. Characteristics of SCR and TRIAC
2. Characteristics of MOSFET and IGBT
3. Characteristics of GTO
4. AC to DC fully controlled converter
5. AC to DC half-controlled converter
6. Step down and step up MOSFET based choppers
7. IGBT based single-phase PWM inverter
8. IGBT based three-phase PWM inverter
9. Resonant DC-to-DC converter
10. Permanent magnet brushless BLDC motor
11. Simulation of Power electronic circuits (Single phase three phase -semi converter, full converter, DC-DC converters, AC volt controller.)
12. Study of battery charger, UPS and SMPS.

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Experiment with the characteristics curves of different switching devices.

CO2: Make use of power devices for AC/DC fully and half controlled converter design.

CO3:Analyze the operation of switching devices in chopper circuits

CO4:Identify the output of inverters for different duty cycle

CO5:Apply suitable simulation tool for power electronic circuits

21EN301	PROFESSIONAL COMMUNICATION LABORATORY *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To demonstrate communication skills that can lead to improved interpersonal relationships.
- To plan to set and achieve goals with focus.
- To organize themselves in work life to face the professional set up with confidence.
- To interpret ideas and participate in group discussion with positive attitude.
- To develop their confidence and help learners to attend interviews successfully.

UNIT I	COMMUNICATION AND PROFESSIONAL ETIQUETTES	6

Importance and Types of Communication Verbal communication -Presentation skills- Non-Verbal communication - Personal Appearance, Posture, Gestures, Facial Expressions, Eye Contact and Space Distancing - Professional Etiquette

UNIT II	GOAL SETTING AND MOTIVATION	6

Short term and Long term Goals- Strategies to set and achieve goals- Motivation

UNIT III	TIME AND STRESS MANAGEMENT	6

Importance of Time - Time Management Skills - Sources of Stress - Managing Stress - Analysis of the Case Studies on time and stress management

UNIT IV	GROUP DISCUSSIONS AND POSITIVE ATTITUDE	6

Group Discussions - Leadership Qualities - Decision Making - Problem Solving - Negotiation Skills - Positive Attitude

UNIT V	RESUME MAKING AND INTERVIEW SKILLS	6

Preparing Resume - E - Resume - Covering Letter – Job Application through email - Career Portfolio - Types of Interviews - Mock Interviews

TOTAL: 30 PERIODS

COURSE OUTCOMES: **At the end of the course, learners will be able to:**

CO1: Demonstrate effective communication skills through presentations.

CO2: Utilize their knowledge of motivation in setting and achieving goals.

CO3: Examine time and stress management.

CO4: Formulate their ideas into an effective communication in formal contexts.

CO5: Develop a well-composed resume and face interviews confidently.

TEXTBOOKS:

1. Dhanavel S P, "English and Soft Skills", First Edition , Orient BlackSwan Ltd, Hyderabad : 2012.
2. Dr. Tobin Porterfield & Bob Graham ,"The 55 Soft Skills That Guide Employee and Organizational Success," Mason – West Publishing House , (January 4, 2018)
3. Prashant Sharma, "Soft Skills Personality Development for Life Success, " BPB Publications, New Delhi, January 2018.

REFERENCES:

1. M. Ashraf Rizvi, “Effective Technical Communication,” Tata McGraw Hill Education Pvt. Ltd. New Delhi, 2016.
2. Mohan Krishna & Meera Banerji, “Developing Communication Skills,” First Edition, Trinity Press, 2017.
3. N. Krishnaswami& T. Sriraman, “Creative English for Communication,” Third Edition, Laxmi Publications Private Limited, 2017.

SEMESTER-VI

21EE306	PROTECTION AND SWITCHGEAR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To summarize the causes of abnormal operating conditions such as faults, lightning and switching surges of the power apparatus
- To infer the characteristics and functions of relays and protection schemes.
- To explain about the apparatus protection of generators, transformers and motors.
- To outline the static and numerical relays
- To illustrate the different types of circuit breakers.

UNIT I	PROTECTION SCHEMES	9
Principles and need for protective schemes – nature and causes of faults – types of faults –Effects of faults– Methods of Grounding - Zones of protection and essential qualities of protection – Protection scheme.		
UNIT II	**ELECTROMAGNETIC RELAYS**	**9**
Operating principles of relays - Universal relay – Torque equation – R-X diagram – Electromagnetic Relays – Over current, Directional, Distance, Differential, Negative sequence and Under frequency relays		
UNIT III	**APPARATUS PROTECTION**	**9**
Current transformers and Potential transformers and their applications in protection schemes - Protection of transformer, generator, motor, bus bars and transmission line.		
UNIT IV	**STATIC RELAYS AND NUMERICAL PROTECTION**	**9**
Static relays – Phase, Amplitude Comparators – Synthesis of various relays using Static comparators – Block diagram of Numerical relays – Over current protection, transformer differential protection, distant protection of transmission lines.		
UNIT V	**CIRCUIT BREAKERS**	**9**
Physics of arcing phenomenon and arc interruption - DC and AC circuit breaking – re-striking voltage and recovery voltage - rate of rise of recovery voltage - resistance switching - current		

chopping - interruption of capacitive current - Types of circuit breakers – air blast, air break, oil, SF6, MCBs, MCCBs and vacuum circuit breakers – comparison of different circuit breakers – Rating and selection of Circuit breakers.

	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Summarize Electromagnetic and Static Relays.

CO2: Explain the causes of abnormal operating conditions of the apparatus and system

CO3: Outline the characteristics and functions of relays and protection schemes

CO4: Illustrate the apparatus protection, static and numerical relays

CO5: Interpret the knowledge on functioning and suitability of circuit breaker.

TEXT BOOKS:

1. Sunil S.Rao, "Switchgear and Protection", 1st Edition, Khanna Publishers, New Delhi, 2008.
2. B.Rabindranath and N.Chander, "Power System Protection and Switchgear", 1st Edition, New Age International (P) Ltd., 2011.
3. BadriRam,B.H. Vishwakarma, "Power System Protection and Switchgear", 2nd Edition, New Age International Pvt Ltd Publishers, 2011.
4. Y.G.Paithankar and S.R.Bhide, 'Fundamentals of power system protection', 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2010.

REFERENCES:

1. C.L.Wadhwa, "Electrical Power Systems", 6th Edition, New Age International (P) Ltd., 2010
2. Ravindra P.Singh, 'Switchgear and Power System Protection', 1st Edition, PHI Learning Private Ltd., NewDelhi, 2009.
3. Rohit Metha and VK Metha, "Principles of Power Systems" 1st Edition, S.Chand Publishers, 2005.
4. S.L.Uppal, "Electrical Power"1st Edition, Khanna Publishers, 1985.

		L	T	P	C
21EE307	**RENEWABLE ENERGY SYSTEMS (Theory with Practical Course)**	**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

- To explain the various renewable energy sources
- To illustrate the working principle of wind power plants
- To summarize the various types of solar thermal and solar PV systems
- To interpret the biomass conversion and mini/micro hydro power plant.
- To experiment with the characteristics of solar, wind and hybrid and energy generation.

UNIT I	**RENEWABLE ENERGY (RE) SOURCES**	**6**
Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.		
UNIT II	**WIND ENERGY**	**6**
Power in the Wind – Types of Wind Power Plants(WPPs)–Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.		
UNIT III	**SOLAR PV AND THERMAL SYSTEMS**	**6**
Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver Power Plants, Solar Ponds.- Thermal Energy storage system with PCM- Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.		
UNIT IV	**BIOMASS ENERGY**	**6**
Introduction-Bio mass resources –Energy from Bio mass: conversion processes-Biomass Cogeneration-Environmental Benefits. Mini/micro hydro power: Classification of hydropower schemes, Essential components of hydroelectric system.		
UNIT V	**OTHER ENERGY SOURCES**	**6**
Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Ocean Thermal Energy Conversion (OTEC)- Fuel cell : Principle of working- various types - construction and applications. Energy Storage System- Hybrid Energy Systems.		
	TOTAL: 30 PERIODS	
PRACTICAL COURSE		**15**

LIST OF EXPERIMENTS

1. Experiment on “V-I Characteristics and Efficiency of 1KWp Solar PV System”.
2. Experiment on “Shadowing effect & diode based solution in 1KWp Solar PV System”.
3. Experiment on Performance assessment of Grid connected and Standalone 1KWp Solar Power System.
4. Experiment the relationship between the tip speed ratio and power coefficient of the turbine at different wind speed
5. Experiment on Performance Assessment of Hybrid (Solar-Wind) Power System.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course, learners will be able to:

CO1: Summarize various renewable energy sources and technologies

CO2: Illustrate the wind power plant working principle

CO3: Outline the solar PV and solar thermal power plant and its types

CO4: Explain the hydro power plant and biomass conversion

CO5: Experiment with the performance and characteristics of solar, wind and hybrid energy generation.

TEXT BOOKS:

1. Joshua Earnest, Tore Wizeliu, 'Wind Power Plants and Project Development', 1st Edition PHI Learning Pvt. Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", 2nd Edition PHI Learning Pvt. Ltd, New Delhi, 2013.
3. Scott Grinnell, "Renewable Energy & Sustainable Design", 1st Edition CENGAGE Learning, USA, 2016.
4. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", 2nd Edition PHI Learning Private Limited, New Delhi, 2011.

REFERENCES

1. A.K.Mukerjee and Nivedita Thakur," Photovoltaic Systems: Analysis and Design", 2nd Edition PHI Learning Private Limited, New Delhi, 2011
2. Richard A. Dunlap," Sustainable Energy" 1st Edition Cengage Learning India Private Limited, Delhi, 2015.
3. Godfrey Boyle, "Renewable energy", Open University, 2nd Edition Oxford University Press in association with the Open University, 2004.
4. A.Shunmugalatha, M.Devaki and R.Saranya, Renewable Energy Systems, 1st Edition Technical publication, 2020.

21EE308	CONTROL SYSTEMS & ELECTRICAL DRIVES LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To experiment with different controllers.
- To utilize the time domain and frequency domain for linear time invariant system.
- To develop the characteristics of Synchro-Transmitter- Receiver.
- To model the DC Motor using digital simulation.
- To construct the speed control of the synchronous motor drive using simulation.

LIST OF EXPERIMENTS

CONTROLSYSTEMS:

1. P, PI and PID controllers
2. Modelling of Systems – Machines, Sensors and Transducers
3. Design of Lag, Lead and Lag-Lead Compensators
4. Position Control Systems
5. Synchro-Transmitter- Receiver and Characteristics

6. Simulation of Control Systems by Mathematical development tools.

ELECTRICAL DRIVES:

1. Stepper motor drive
2. Servo motor drive
3. Simulation of vector control of 3 phase induction motor.
4. Simulation of starting of DC motor
5. Simulation of speed control of the synchronous motor drive.
6. BLDC motor drive using digital simulation.

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Build the characteristics of controllers.
CO2: Analyze the modeling of systems.
CO3: Solve the characteristics of Compensators.
CO4: Experiment with the output of BLDC Motor drive using digital simulation.
CO5: Make use of speed control of the three phase induction motor drive using simulation.

SEMESTER-VII

		L	T	P	C
21EE401	**POWER SYSTEM OPERATION AND CONTROL**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To apply the concepts of power system operation and control with its cost parameters.
- To illustrate about Real power-frequency interaction
- To explain the concept of Reactive power-voltage control and actions to be implemented.
- To solve the problems related to Economic operation of power system.
- To outline the role of computer for real time operation and control of power systems.

UNIT I	**INTRODUCTION**	**9**

Electricity regions in India - Indian Power Exchanges – National and Regional load dispatching centers –requirements of good power system - necessity of voltage and frequency regulation – real Power vs frequency and reactive power Vs voltage control loops - Load curve, load duration curve, Load distribution parameters, relative merits & demerits, Capital & Operating Cost of different power plants, Power tariff types, load forecasting, Site selection criteria- basic concepts of load dispatching.

UNIT II	**REAL POWER - FREQUENCY CONTROL**	**9**

Basics of speed governing mechanisms and modeling - speed load characteristics - regulation of two generators in parallel-Load Frequency Control (LFC) of single area system-static and dynamic analysis of uncontrolled and controlled cases - LFC of two area system - tie line modeling – block

diagram representation of two area system - tie line with frequency bias control – state variable model - integration of economic dispatch control with LFC.		
UNIT III	**REACTIVE POWER – VOLTAGE CONTROL**	**9**
Generation and absorption of reactive power - basics of reactive power control – Automatic Voltage Regulator (AVR) – brushless AC excitation system – block diagram representation of AVR loop - static and dynamic analysis – stability compensation – voltage drop in transmission line - methods of reactive power injection - tap changing transformer, SVC (TCR + TSC) and STATCOM for voltage control		
UNIT IV	**ECONOMIC OPERATION OF POWER SYSTEM**	**9**
Statement of economic dispatch problem - input and output characteristics of thermal plant - incremental cost curve - optimal operation of thermal units without and with transmission losses (no derivation of transmission loss coefficients) - base point and participation factors method - statement of unit commitment (UC) problem - constraints on UC problem – solution of UC problem using priority list.		
UNIT V	**COMPUTER CONTROL OF POWER SYSTEMS**	**9**
Need of computer control of power systems-concept of energy control centers and functions – PMU - system monitoring, data acquisition and controls - System hardware configurations - SCADA and EMS functions - state estimation problem – measurements and errors - weighted least square estimation - various operating states - state transition diagram.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Build the various power system operation problems for different loading conditions

CO2: Illustrate the need and importance of load frequency control.

CO3: Explain the various control actions for maintaining the voltage profile under dynamic loading conditions.

CO4: Solve the optimum scheduling and cost of generators using economic dispatch and unit commitment concepts.

CO5: Explain the various control actions for monitoring the Power system security.

TEXT BOOKS:

1. Olle. I.Elgerd, "Electric Energy Systems theory - An introduction", 34th Reprint, McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
2. Allen. J. Wood and Bruce F. Wollen berg, "Power Generation, Operation and Control", 1st Edition, John Wiley & Sons, Inc., 2016.
3. Abhijit Chakrabarti and Sunita Halder, "Power System Analysis Operation and Control", 3rd Edition, PHI learning Pvt. Ltd., New Delhi, 2010.
4. K Uma Rao, "Power system operation and control", 1st Edition, Wiley-India, 2013.

REFERENCES:

1. Kothari D.P. and Nagrath I.J., “Power System Engineering”, 2nd Edition, Tata McGraw-Hill Education, 2008.
2. Hadi Saadat, “Power System Analysis”, 21st reprint, McGraw Hill Education Pvt. Ltd., New Delhi, 2010.
3.Kundur P., “Power System Stability and Control”, 10th reprint, McGraw Hill Education Pvt. Ltd.,New Delhi, 2010.
4. S.Sivanagaraju, “Power Generation, Operation and Control”, 1st Edition, Pearson Education India, 2009.

21EE402	POWER SYSTEM LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To demonstrate transmission line parameters
- To outline the characteristics of different relays
- To apply Gauss-Seidal (GS) method and Newton-Raphson (NR) method for power flow problems
- To solve fault analysis and stability analysis in power system
- To experiment with load frequency control and economic dispatch

LIST OF EXPERIMENTS

1. Computation of transmission efficiency and voltage regulation of Short, Medium and Long transmission lines.
2. ABCD parameters
3. Characteristics of Electromagnetic and Microprocessor Overcurrent relay
4. Characteristics of Overvoltage and Under Voltage relay.
5. Protection of transformer using over current and over voltage relays for external fault.
6. Identifying the location of Single phase to ground fault.
7. Power flow analysis using Gauss-Seidal and Newton Raphson method.
8. Stability based power flow analysis.
9. Economic load dispatch for a sample test system.
10. Load frequency control.
11. Study of Ferranti effect.

TOTAL: 60 PERIODS

COURES OUTCOMES: At the end of the course, learners will be able to:
CO1:Model transmission line parameters CO2: Make use of suitable relay for transformer protection CO3: Solve for power flow using GS and NR method CO4: Apply numerical integration methods for stability analysis CO5: Construct single area system for controlling Load frequency

21EE403	PROJECT WORK I	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To identify the problems in industries and social relevant applications.
- To make use of innovative methods for problem identification.
- To develop the prototype for the project.
- To apply the real time for successful working.
- To identify the platforms for the project explorations.

METHOD OF EVALUATION:

- The students in a group of 3 to 4 works on a topic approved by the head of the department and prepare a comprehensive project-I report after completing the work.
- The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester.
- The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 60PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Outline the problem identified in industries.
CO2: Experiment with the innovative techniques.
CO3: Make use of advanced tools for the solution.
CO4: Select a suitable method for implementation.
CO5: Analyse the developed prototype for future scope.

SEMESTER-VIII

<table>
<tr><td rowspan="2">21EE404</td><td rowspan="2">PROJECT WORK II</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>20</td><td>10</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:
To organize the works related to project.
To solve a specific problem right from its identification and literature review till the successful solution of the same.
To develop the students in preparing project reports.
To build the students to face reviews and viva voce examination.
To plan project contest and journal publication.</td></tr>
<tr><td colspan="6">METHOD OF EVALUATION:</td></tr>
<tr><td colspan="6">The students in a group of 3 to 4 works on a topic approved by the review committee under the guidance of the HoD and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor.
The progress of the project is evaluated based on minimum of three reviews.
A project report is required at the end of the semester.
The project work is evaluated based on oral presentation, hardware/software results and the project report jointly by external and internal examiners.</td></tr>
<tr><td colspan="2"></td><td colspan="4">TOTAL: 300 PERIODS</td></tr>
<tr><td colspan="6">COURSE OUTCOMES: At the end of the course, the students will be able to:
CO1: Solve engineering problem with social relevance.
CO2: Plan for writing report and viva voce examination.
CO3: Make use of the project reports for publications.
CO4: Choose a suitable methodology for a problem solving.
CO5: Organize the works related to project implementation.</td></tr>
</table>

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL I: POWER ENGINEERING

21PEE01	ENERGY UTILIZATION AND CONSERVATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the energy saving concept by different ways of illumination.
- To explain the basics of Refrigeration and Air conditioning
- To outline the concepts of heating & welding
- To explain the concepts of electric traction systems and their performance
- To summarize the various energy conservation Act and Policy

UNIT I	**ILLUMINATION**	**9**

Introduction - definition and meaning of terms used in illumination engineering - classification and comparison of light sources – (incandescent lamps, sodium vapour lamps, mercury vapour lamps, fluorescent lamps)– design of illumination systems - indoor lighting schemes - factory lighting halls - outdoor lighting schemes - flood lighting - street lighting - energy saving lamps, LED. Design of Illumination system - Case Studies

UNIT II	**REFRIGERATION AND AIR CONDITIONING**	**9**

Refrigeration-Domestic refrigerator and water coolers - Air-Conditioning-Various types of air-conditioning system and their applications, smart air conditioning units - Energy Efficient motors: Standard motor efficiency, need for efficient motors, Motor life cycle, Direct Savings and payback analysis, efficiency evaluation factor.

UNIT III	**HEATING AND WELDING**	**9**

Introduction - advantages of electric heating – modes of heat transfer - methods of electric heating - resistance heating - arc furnaces - induction heating - dielectric heating - electric welding – types - resistance welding - arc welding - power supply for arc welding - radiation welding.- Induction Welding

UNIT IV	**ELECTRIC DRIVES AND TRACTION**	**9**

Fundamentals of electric drive - choice of an electric motor - application of motors for particular services - traction motors - characteristic features of traction motor - systems of railway electrification - electric braking - train movement and energy consumption - traction motor control - track equipment and collection gear.

UNIT V	**ENERGY CONSERVATION ACT,2001 AND RELATED POLICIES**	**9**

Energy Conservation Act-2001 and its features –Notification under the Act Schemes of Bureau of Energy efficiency (BEE)-ECBC,S&L,DSM,BLY,SME'S, Designated Agencies-Electricity Act 2003-Integrated Energy Policy-National Action Plan change on climate change

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Compare different illumination schemes

CO2: Outline the concepts of Refrigeration and Air conditioning CO3: Summarize various modes of heating and Welding with its applications. CO4: Illustrate the choice of electric drives and the different characteristics of motor for traction CO5: Explain the various energy conservation methods
TEXT BOOKS: 1. Wadhwa, C.L. "Generation, Distribution and Utilization of Electrical Energy", 1st Edition, New Age International Pvt. Ltd, 2003. 2. Dr. Uppal S.L. and Prof. S. Rao, "Electrical Power Systems", 15th Edition, Khanna Publishers, New Delhi, 2014. 3. "General Aspects of Energy Management and Auditing", BEE Guide Book, 2010 4. Y P Abbi and Shashank Jain, "Handbook on Energy Audit and Environment Management " 1st Edition, The Energy and Resources Institute (TERI), 2006
REFERENCES: 1. Partab.H, "Art and Science of Utilisation of Electrical Energy", 1st Edition, DhanpatRai and Co, New Delhi, 2004. 2. Gupta.J.B, "Utilization of Electric Power and Electric Traction", 1st Edition, S.K.Kataria and Sons, 2002. 3. "Cleaner Production – Energy Efficiency Manual for GERIAP", UNEP, Bangkok prepared by National Productivity Council. 4. David H Phillips, "Welding Engineering An Introduction" , 1st Edition, John Wiley & Sons Ltd.,2016.

21PEE02	**SMART GRID**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the concepts of smart Grid in detail.
- To illustrate about the smart grid technologies.
- To outline about Smart Meters and Advanced Metering Infrastructure.
- To infer the power quality management issues in Smart Grid.
- To summarize the performance computing in Smart Grid applications.

UNIT I	**INTRODUCTION TO SMART GRID**	**9**
Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid - Smart grid drivers, functions, opportunities, challenges and benefits, Difference between conventional & Smart Grid - National and International Initiatives in Smart Grid.		
UNIT II	**SMART GRID TECHNOLOGIES**	**9**
Technology Drivers, Smart energy resources, Smart substations, Substation Automation, Feeder Automation, Transmission systems: EMS, FACTS and HVDC, Wide area monitoring, Protection and control, Distribution systems: DMS, Volt/VAR control, Fault Detection, Isolation and service		

restoration, Outage management, High-Efficiency Distribution Transformers, Phase Shifting Transformers, Plugin Hybrid Electric Vehicles(PHEV).		
UNIT III	**SMART METERS AND ADVANCED METERING INFRASTRUCTURE**	**9**
Introduction to Smart Meters- ,Advanced Metering infrastructure(AMI)drivers and benefits, AMI protocols,- - standards and initiatives,- AMI needs in the smart grid, - Phasor Measurement Unit(PMU), Intelligent Electronic Devices(IED)&their application for monitoring & protection.		
UNIT IV	**POWER QUALITY MANAGEMENT IN SMART GRID**	**9**
Power Quality & EMC in Smart Grid, Power Quality issues of Grid connected Renewable Energy Sources, Power Quality Conditioners for Smart Grid, Web based Power Quality monitoring, Power Quality Audit.		
UNIT V	**HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS**	**9**
Local Area Network(LAN),House Area Network(HAN), Wide Area Network(WAN), Broadband over Power line(BPL),IP based Protocols, Basics of Web Service and CLOUD Computing to make Smart Grids smarter, Cyber Security for Smart Grid.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Relate the concepts of Smart Grid and its present developments.

CO2: Outline different Smart Grid technologies.

CO3: Summarize different smart meters and advanced metering infrastructure.

CO4: Illustrate power quality management in Smart Grids

CO5: Explain LAN, WAN and Cloud Computing for Smart Grid application

TEXT BOOKS:

1. Stuart Borlase “Smart Grid: Infrastructure, Technology and Solutions”, 1st Edition, CRC Press 2012.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, JianzhongWu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, 1st Edition, Wiley 2012.
3. Salman K. Salman, “Introduction to the Smart Grid: Concepts, technologies and evolution”, 1st Edition, Institution of Engineering and Technology (IET), 2017.
4. Bernd M. Buchholz, Zbigniew A. Styczynski , “Smart Grids: Fundamentals and Technologies in Electric Power Systems of the Future”, 1st Edition, Springer, 2020.

REFERENCES:

1. Xi Fang, SatyajayantMisra, GuoliangXue, and Dejun Yang “SmartGrid –The New and Improved Power Grid: A Survey”, IEEE Transaction on Smart Grids, vol.14,2012
2. James Momohe “Smart Grid: Fundamentals of Design and Analysis,” 1st Edition, Wiley-IEEE Press, 2012.
3. Dr. A. Shunmugalatha,, Dr. S. Senthilrani,,Dr. T. Chandrasekar and Mrs. J. Rajeswari, “Smart Grid”, 1st Edition, Technical Publications, 2020.
4. Vehbi C. Güngör ,Dilan Sahin, Taskin Kocak, Salih Ergüt, Concettina Buccella, Carlo Cecati,

and Gerhard P. Hancke, "Smart Grid Technologies: Communication Technologies and Standards" IEEE Transactions On Industrial Informatics, Vol.7,No.4, November 2011.

21PEE03	POWER QUALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate various sources, causes and effects of power quality issues.
- To summarize the causes and mitigation techniques of voltage sag & swell.
- To outline the concepts of harmonics, voltage and current distortions.
- To interpret the knowledge on compensation techniques and design the passive filters.
- To explain the concepts of power quality monitoring and improvement using CPD.

UNIT I	INTRODUCTION TO POWER QUALITY	9

Terms and definitions– Overloading, under voltage, over voltage - Concepts of transients - Short duration variations such as interruption - Long duration variation such as sustained interruption - Sags and swells - Voltage sag - Voltage swell - Voltage imbalance – Voltage fluctuations - Power frequency variations - International standards of power quality. Computer Business Equipment Manufacturers Associations (CBEMA) curve.

UNIT II	VOLTAGE SAG AND SWELL	9

Estimating voltage sag performance - Thevenin's equivalent source - Analysis and calculation of various faulted condition - Estimation of the sag severity - Estimation of Motor Starting sags - Mitigation of voltage sag, Static transfer switches and fast transfer switches. - Capacitor switching – Lightning - Ferro resonance - Mitigation of voltage swell.

UNIT III	HARMONICS	9

Harmonic sources from commercial and industrial loads - Locating harmonic sources – Power system response characteristics - Harmonics Vs transients. Effect of harmonics – Harmonic distortion - Voltage and current distortions - Harmonic indices: THD, TDD and Related Problems - Inter harmonics – Resonance Harmonic distortion evaluation, IEEE and IEC standards.

UNIT IV	PASSIVE POWER COMPENSATORS	9

Principle of Operation of Passive Shunt and Series Compensators, Analysis and Design of Passive Shunt Compensators Simulation and Performance of Passive Power Filters- Limitations of Passive Filters Parallel Resonance of Passive Filters with the Supply System and its Mitigation. Fundamentals of load compensation – Voltage regulation & power factor correction.

UNIT V	POWER QUALITY MONITORING & IMPROVEMENT	9

Monitoring considerations – Monitoring and diagnostic techniques for various power quality problems– Power line disturbance analyzer – Quality measurement equipment – Harmonic spectrum analyzer – Flicker meters – Disturbance analyzer – Load compensation using DSTATCOM, Voltage regulation using DSTATCOM, protecting sensitive loads using DVR, UPQC.

	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the concepts of transients, sags and swells.

CO2: Illustrate the voltage sag performance and its mitigation techniques.

CO3: Summarize the effects of harmonics and distortions.

CO4: Demonstrate the passive shunt compensators design.

CO5: Outline the concepts of monitoring and diagnostic techniques of power quality problems.

TEXT BOOKS:

1. Roger. C. Dugan, Mark. F. Mc Granagham, Surya Santoso, H.Wayne Beaty, "Electrical Power Systems Quality", 1st Edition, McGraw Hill,2003
2. J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", 1st Edition, Wiley, 2000.
3. Bhim Singh, Ambrish Chandra, Kamal Al-Haddad, "Power Quality Problems & Mitigation Techniques" 1st Edition, Wiley, 2015.
4. Heydt, G.T., "Electric Power Quality", Stars in a Circle Publications, Indiana, 2nd Edition 1996.

REFERENCES:

1. Arindam Ghosh and Gerald Ledwich "Power Quality Enhancement Using Custom Power Devices", 1st Edition, Kluwer Academic Publishers, 2002.
2. Barry W.Kennedy "Power Quality Primer", 1st Edition, McGraw-Hill, New York, 2000.
3. R.C. Duggan, Mark.F.McGranaghan, Surya Santoas and H.WayneBeaty, "Electrical Power System Quality", 1st Edition, McGraw-Hill, 2004.
4. Derek A. Paice , " Power Electronics Converter Harmonics : Multi-pulse methods for clean power", 1st Edition, Wiley Publications, 1999.

21PEE04	RESTRUCTURED POWER SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the process of restructuring of power industry.
- To compare the fundamental concepts of different market models.
- To infer the concepts of economics of restructured power market.
- To outline the concepts of transmission pricing.
- To illustrate about the ancillary services and various power sectors in India.

UNIT I	**INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY**	**9**

Introduction - Reasons for restructuring - deregulation of power industry - Understanding the restructuring process - Entities involved - The levels of competition - The market place mechanisms - Sector-wise major changes required - Introduction to issues involved in deregulation - Reasons and objectives of deregulation of various power systems across the world.

UNIT II	**THE PHILOSOPHY OF MARKET MODELS**	**9**

Introduction - Market models based on contractual arrangements - Comparison of various market

models - Electricity vis-à-vis other commodities - Market architecture - Discriminatory or non-discriminatory pricing - . Simple bids or complex bids - . Day-ahead and real-time market Models for trading arrangements - Integrated or centralized model - ISO or TSO model.		
UNIT III	**FUNDAMENTALS OF ECONOMICS**	**9**
Introduction - Consumer behavior - Supplier behavior - Market equilibrium - Short-run and Long-run costs- Various costs of production - Relationship between short-run and long-run average costs - Perfectly competitive market -The firm's supply decision under perfect competition.		
UNIT IV	**PRICING OF TRANSMISSION NETWORK USAGE**	**9**
Introduction to transmission pricing - power wheeling - Issues involved - Principles of transmission pricing - Classification of transmission pricing methods - Rolled-in transmission pricing methods- Marginal transmission pricing paradigm - Composite pricing paradigm - Merits and de-merits of different paradigms - Debated issues in transmission Pricing.		
UNIT V	**ANCILLARY SERVICES AND REFORMS IN INDIAN POWER SECTOR**	**9**
Introduction to ancillary services - Types of ancillary services - Classification of ancillary services - Load-generation balancing related services- Voltage control and reactive power support services- Black start capability service - Markets for ancillary services - Framework of Indian power sector - Reform initiatives during 1990-1995 - The availability based tariff (ABT) - The Electricity Act 2003 - Open Access issues - Power exchange- Reforms in near future.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Illustrate the restructuring of power industry.

CO2: Outline the basics of various market models.

CO3: Illustrate about fundamentals of economics in Restructured Power System.

CO4: Explain the significance of pricing methods of transmission network.

CO5: Compare the various power sectors in India and Ancillary System.

TEXT BOOKS:

1. Daniel Kirschen and Goran Strbac, "Fundamentals of Power System economics", 1stEdition, John Wiley & Sons Ltd, 2004.
2. Mohammad Shahidehpour, Muwaffaq Alomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility" 1stEdition, CRC Press, 2001.
3. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", 1stEdition, Kluwer Academic Pub., 2001.
4. Daniel Kirschen and GoranStrbac, 'Fundamentals of Power System economics', 1st Edition, JohnWiley & Sons Ltd, 2004.

REFERENCES:

1. Sally Hunt, 'Making competition work in electricity', 1stEdition, John Wiley & Sons, Inc., 2002.
2. Steven Stoft, "Power system economics: designing markets for electricity", 1st Edition,

JohnWiley & Sons, 2002.
3. Loi Lei Lai, ‘Power system restructuring and deregulation’, 1st Edition, John Wiley & Sons Ltd., 2001.
4. Marijallic, Francisco Galiana and Lestor Fink, “Power System Restructuring Engineering and Economics’, 1st Edition, Kulwer Academic Publisher, USA, 1998.

21PEE05	POWER SYSTEMS TRANSIENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the importance of transients in power system.
- To summarize different over voltages due to switching transients
- To explain the behavior of lightning transients
- To illustrate the concept of travelling waves
- To interpret the effect of transients in the performance of integrated power system.

UNIT I	INTRODUCTION AND SURVEY	9

Review and importance of the study of transients - causes for transients. RL circuit transient with sine wave excitation - double frequency transients - basic transforms of the RLC circuit transients. Different types of power system transients - effect of transients on power systems – role of the study of transients in system planning.

UNIT II	SWITCHING TRANSIENTS	9

Over voltages due to switching transients - resistance switching and the equivalent circuit for interrupting the resistor current - load switching and equivalent circuit - waveforms for transient voltage across the load and the switch - normal and abnormal switching transients. Current suppression - current chopping - effective equivalent circuit. Capacitance switching - effect of source regulation - ferro resonance.

UNIT III	LIGHTNING TRANSIENTS	9

Review of the theories in the formation of clouds and charge formation - rate of charging of thunder clouds – mechanism of lightning discharges and characteristics of lightning strokes – model for lightning stroke - factors contributing to good line design - protection using ground wires - tower footing resistance - Interaction between lightning and power system.

UNIT IV	TRAVELING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS	9

Computation of transients - transient response of systems with series and shunt lumped parameters and distributed lines. Traveling wave concept - step response - Bewely’s lattice diagram - standing waves and natural frequencies - reflection and refraction of travelling waves.

UNIT V	TRANSIENTS IN INTEGRATED POWER SYSTEM	9

Short line and kilometric fault - distribution of voltages in a power system - Line dropping and load rejection - voltage transients on closing and reclosing lines - over voltage induced by faults - switching surges on integrated system Qualitative application of EMTP for transient computation.

	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Summarize the causes of transients in power system.
CO2: Outline the over voltages due to switching transients.
CO3: Explain the effect of lightning strokes in power system.
CO4: Interpret the concept of travelling waves in distributed lines.
CO5: Illustrate the transient performance of integrated power system with EMTP software.

TEXT BOOKS:

1. Allan Greenwood, 'Electrical Transients in Power Systems', 2nd Edition, Wiley Inter Science, New York, 1991.
2. Pritindra Chowdhari, "Electromagnetic transients in Power System", 2nd Edition, John Wiley and Sons Inc., 2009.
3. C.S. Indulkar, D.P.Kothari, K. Ramalingam, 'Power System Transients – A statistical approach', 2nd Edition, PHI Learning Private Limited, 2010.
4. Akihiro Ametani "Power System Transient theory and applications", 2nd Edition. CRC press, 2013.

REFERENCES:

1. M.S.Naidu and V.Kamaraju, 'High Voltage Engineering', 5th Edition, Tata McGraw Hill, 2013.
2. R.D. Begamudre, 'Extra High Voltage AC Transmission Engineering', 3rd Edition, Wiley Eastern Limited, 1986.
3. Y.Hase, Handbook of Power System Engineering," 2nd Edition, Wiley India, 2012.
4. J.L.Kirtley, "Electric Power Principles, Sources, Conversion, Distribution and use," 2nd Edition, Wiley India, 2012.

21PEE06	DISTRIBUTED GENERATION AND MICROGRID	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To summarize the conventional and NCE resources.
- To explain the concept of distributed generation.
- To illustrate the knowledge in impact of grid integration.
- To outline the concept of microgrid and its configuration.
- To demonstrate the various control operations of microgrid.

UNIT I	INTRODUCTION	9

Conventional power generation: advantages and disadvantages, Energy crises, Non- conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT II	DISTRIBUTED GENERATIONS (DG)	9

Concept of distributed generations, topologies, selection of sources, regulatory standards/framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG

installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants.		
UNIT III	**IMPACT OF GRID INTEGRATION**	**9**
Requirements for grid interconnection, limits on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues.		
UNIT IV	**BASICS OF MICROGRID**	**9**
Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids.		
UNIT V	**CONTROL AND OPERATION OF MICROGRID**	**9**
Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the various schemes of conventional and Non-conventional power generation.

CO2: Summarize different topologies and energy sources of distributed generation.

CO3: Interpret the requirements for grid interconnection and its impact with NCE sources.

CO4: Illustrate the basic operation of Micro grid.

CO5: Outline the various control operations of micro grid.

TEXT BOKS:

1. Math H. J. Bollen, FainanHussain,“ Integration of distributed generation power system” 2nd Edition ,Wiley IEEE press, 2011.
2. Qing - Chang Zhong, Tomas Hornlk, “Control of Power Inverters in Renewable Energy and Smart Grid Integration” 1st Edition Wiley IEEE Press, 2012.
3. D. Hall and R. P. Grover, “Biomass Regenerable Energy”, 2nd Edition John Wiley, New York, 1987.
4. John Twidell and Tony Weir, “Renewable Energy Resources” , 2nd Edition ,Taylor and Francis Publications, 2006.

REFERENCE BOOKS:

1. Amirnaser Yezdani, and Reza Iravani, “Voltage Source Converters in Power Systems: Modeling, Control and Applications”, 2nd Edition IEEE John Wiley Publications, 2010.
2. Dorin Neacsu, “Power Switching Converters: Medium and High Power”, 1st Edition, Taylor & Francis, 2006.
3. Chetan Singh Solanki, “Solar Photo Voltaics, Fundamentals, Technologies and Applications”, 1st Edition, PHI learning Pvt. Ltd., New Delhi, 2009.
4. J.F. Manwell, J.G. McGowan “Wind Energy Explained, Theory design and applications”, 1st Edition, Wiley publication, 2010.

21PEE07	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the various steps involved in an energy auditing process.
- To outline the concepts behind electricity billing and load management.
- To interpret the need for energy management on various electrical equipment.
- To illustrate the concept of lighting systems.
- To summarize the performance assessment made on various utilities and its need.

UNIT I	INTRODUCTION	9
Definition, Energy audit- Need for energy management - energy basics- energy accounting - energy monitoring, targeting and reporting- energy audit process- Types of energy audit, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments		
UNIT II	**ECONOMIC ANALYSIS AND LOAD MANAGEMENT**	**9**
Definition of load management- Demand control techniques- Utility monitoring and control system - Economic justification for load management systems -Economic analysis - Economic models-models- applications and limitations-Time value of money-Utility rate structures- Calculating the cost of electricity-Loss evaluation.		
UNIT III	**ELECTRICAL EQUIPMENTS AND METERING SYSTEM**	**9**
Electric motors-Transformers and reactors-Capacitors and synchronous machines. Relationships between parameters-Units of measure-Typical cost factors- Utility meters - Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements- Metering techniques and practical examples.		
UNIT IV	**LIGHTING SYSTEMS**	**9**
Concept of lighting systems - Task and working space -Light sources - Ballasts - Luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques-Lighting and energy standards.		
UNIT V	**ENERGY PERFORMANCE SYSTEMS**	**9**
Performance terms- definition- Purpose of performance test- Performance on Thermal power station- Steel industry- Cement industry- Paper and pulp industry- Textile industry- Fertilizer industry-Building & commercial establishments		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Demonstrate the need for energy management and auditing process

CO2: Explain the load management and economic analysis performed in a system.

CO3: Outline the energy management concepts for electrical equipment and metering system.

CO4: Classify various lighting systems and energy standards.

CO5: Interpret the performance assessment made on various utility systems.

TEXT BOOKS:
1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", 7th Edition, The Fairmont Press, Inc., 2011. 2. Amit K. Tyagi, "Handbook on Energy Audits and Management", TERI, 2003. 3. Ian M . Shapiro , "Energy audits and improvements for commercial buildings: a guide for energy managers and energy auditors", 1st Edition, John Wiley & Sons, 2016. 4. Moncef Krarti, "Energy Audit of Building Systems: An Engineering Approach", 2nd Edition, CRC Press, 2010.
REFERENCES
1. Frank Kreith, D. Yogi Goswami, "Energy management and conservation handbook", 1st Edition, CRC Press, 2008. 2. Patrik Thollander, Jenny Palm "Improving Energy Efficiency in Industrial Energy Systems: An Interdisciplinary Perspective on Barriers, Energy Audits, Energy Management, Policies, and Programs", 1stEdition, Springer-Verlag London, 2013. 3. General Aspects of Energy Management and Energy Audit, 4th Edition, Bureau of Energy Efficiency India, 2015. 4. Anil Kumar, Om Prakash, Prashant Singh Chauhan, Samsher Gautam, "Energy Management-Conservation and Audits", 1st Edition, CRC Press, 2020.

21PEE08	POWER SYSTEM DYNAMICS	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES: • To illustrate dynamic modeling of a synchronous machine. • To explain the modeling concepts of excitation systems. • To outline transient, steady state and dynamic stability. • To interpret numerical integration methods for power system stability analysis • To summarize the effects of stability in single machine infinite bus system.					
UNIT I	**MODELLING OF SYNCHRONOUS MACHINES**				**9**
Simplest model of the synchronous machine – circuit equations – equation in physical quantities - Inductance of Synchronous Machine - Park's transformation - dq0 components – assumptions of balanced currents and voltages in the armature – phasor diagram – equivalent circuit – reactance – final machine dynamic equations – inclusion of damper winding.					
UNIT II	**MODELLING OF EXCITATION SYSTEMS**				**9**
Excitation system requirements - elements of an excitation system – types of excitation system – dynamic performance measure – control and protective functions – modelling of excitation system.					
UNIT III	**POWER SYSTEM STABILITY**				**9**
Power system stability considerations – definitions - classification of stability - rotor angle and voltage stability - stability of interconnected systems – bad effects of instability –					

Importance of stability to system operation and design.		
UNIT IV	**TRANSIENT STABILITY**	**9**
Inertia constant and equivalent inertia constant – power angle curve – swing equation – point by point solution- transient stability - swing equation - equal area criterion - solution of swing equation - Euler method - Runge-Kutta method - critical clearing time and angle.		
UNIT V	**SMALL SIGNAL STABILITY**	**9**
State space representation - small signal stability of single machine infinite bus system (SMIB) – synchronous machine classical model representation - effect of field circuit dynamics- effect of excitation system – Power system stabilizer for small signal stability improvement.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Explain the dynamic modelling of synchronous machine.
CO2: Illustrate the modeling of excitation system for stability analysis.
CO3: Classify the power system stability with its effects on interconnected systems.
CO4: Experiment with Modified Euler's and Runge – Kutta method for stability analysis
CO5: Show the effects of small signal stability analysis in power system.

TEXT BOOKS:

1. P. W. Sauer and M. A. Pai, "Power System Dynamics and Stability", 1st Edition, Prentice Hall, 1998.
2. P. Kundur, "Power System Stability and Control", 1st Edition, McGraw-Hill, 1993.
3. P.M Anderson and A.A Fouad, "Power System Control and Stability", 1st Edition, Iowa State University Press, Ames, Iowa, 1978.
4. R.Ramanujam,"Power System Dynamics Analysis and Simulation", 1st Edition, PHI Learning Private Limited, New Delhi, 2009.

REFERENCES:

1. E.W.Kimbark, "Power System Stability" vol.1, 1st Edition, John Wiley,1995.
2. James A.Momoh, Mohamed. E. EI-Hawary. "Electric Systems, Dynamics and Stability with Artificial Intelligence applications", 1st Edition, Marcel Dekker, USA, 2000.
3. MirceaEremia and Mohammad Shahidehpour, "Handbook of Electrical Power System Dynamics: Modeling, Stability and Control", 1st Edition, IEEE Press Series on Power Engineering, 2013.
4. L.P.Singh, "Advanced Power system Analysis and Dynamics", 6th Edition, New Age International Publishers, 2012.

VERTICAL II - POWER CONVERTERS AND DRIVES

<table>
<tr><td rowspan="2">21PEE09</td><td rowspan="2">MODERN POWER CONVERTERS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:
• To explain the switched mode regulator for various industrial applications.
• To interpret the characteristics of Switched mode AC-DC converters
• To illustrate the characteristics and performance of multilevel inverters.
• To outline the performance of AC-AC Converters with and without DC Link
• To compare hard switched and soft switched converters and explain the soft switching techniques.</td></tr>
<tr><td>UNIT I</td><td colspan="4">SWITCHED MODE POWER SUPPLY (SMPS)</td><td>9</td></tr>
<tr><td colspan="6">DC Power supply and Classification; Switched mode dc power supply - with and without isolation, single and multiple outputs; Closed loop control and regulation; Design examples on converter and closed loop performance.</td></tr>
<tr><td>UNIT II</td><td colspan="4">AC-DC CONVERTERS</td><td>9</td></tr>
<tr><td colspan="6">Switched mode AC-DC converters, synchronous rectification - single and three phase topologies - switching techniques-with and without input-output isolation. performance indices design examples -Difference Between diode rectifiers and phase controlled rectifiers-Applications.</td></tr>
<tr><td>UNIT III</td><td colspan="4">DC-AC CONVERTERS</td><td>9</td></tr>
<tr><td colspan="6">Multi-level Inversion - concept, classification of multilevel inverters, Principle of operation, features and analysis of Diode clamped, Flying capacitor and cascaded multilevel inverters; Modulation schemes. Application of Multilevel Inverters.</td></tr>
<tr><td>UNIT IV</td><td colspan="4">AC-AC CONVERTERS WITH AND WITHOUT DC LINK</td><td>9</td></tr>
<tr><td colspan="6">Matrix converters. Basic topology of matrix converter; Commutation – current path; Modulation techniques - scalar modulation, indirect modulation; Matrix converter as only AC-DC converter; AC-AC converter with DC link - topologies and operation - with and without resonance link - converter with dc link converter-Applications.</td></tr>
<tr><td>UNIT V</td><td colspan="4">SOFT-SWITCHING POWER CONVERTERS</td><td>9</td></tr>
<tr><td colspan="6">Soft switching techniques. ZVS, ZCS, quasi resonance operation; Performance comparison hard switched and soft switched converters.AC-DC converter, DC-DC converter, DC-AC converter.; Resonant DC power supplies.</td></tr>
<tr><td colspan="3"></td><td colspan="3">TOTAL: 45 PERIODS</td></tr>
<tr><td colspan="6">COURSE OUTCOMES: At the end of the course, learners will be able to:
CO1: Interpret switched mode DC power supply for various industrial applications.
CO2: Explain the characteristics of Switched mode AC-DC converters with and without isolation.
CO3: Summarize the different types of multilevel inverters.
CO4: Outline the bidirectional switch with and without DC link.
CO5: Illustrate the soft switching power converters with resonant DC link.</td></tr>
</table>

TEXT BOOKS:
1. Mohammed H. Rashid, "Power Electronics", 4thEdition ,Pearson Education ,2018. 2. Ned Mohan, Tore M. Undeland and William P. Robbins, "Power Electronics", 2nd Edition,Pearson Education,2014. 3. Daniel W. Hart, "Power Electronics ", 1st Edition , McGraw Hill Publications, 2011. 4. V. R. Moorthi , "Power Electronics Devices, Circuits and Industrial applications", 1st Edition ,Oxford University Press, 2005. 5. Dr. P. S. Bimbhra ," Power Electronics" , 6th Edition , Khanna Publishers, 2019.
REFERENCES
1. Philip T. Krein , "Elements of Power Electronics", 2nd Edition, Oxford University Press, 2015. **2.** Robert W. Erickson, Dragan and Maksimobic, "Fundamentals of Power Electronics", 2nd Edition, Springer, 2015. 3. Joseph Vithayathil , "Power Electronics, Principles and Applications", 6th Reprint, McGraw Hill Series, 2013. 4. Ashfaq Ahmed, "Power Electronics for Technology",1st Edition, Pearson Education, , Indian reprint, 2003.

21PEE10	SWITCHED MODE POWER CONVERTERS	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES: • To explain the modern power electronic converters and its applications in electric power utility. • To show the operation of switched mode power converters • To outline the operation of resonant converters and UPS • To illustrate the operation of the DC-AC converters. • To interpret the operation and performance of power conditioners and filters.					
UNIT I	**DC-DC CONVERTERS**				**9**
Principles of step down and step up converters – Analysis and state space modeling of Buck, Boost, Buck- Boost and Cuk converters.					
UNIT II	**POWER CONVERTERS**				**9**
Analysis and state space modeling of fly back,- Forward, - Push pull, - Luo, - Half bridge and full bridge converters- control circuits and PWM techniques.					
UNIT III	**RESONANT CONVERTERS**				**9**
Introduction- classification- basic concepts- Resonant switch- Load Resonant converters ZVS ,Clamped voltage topologies- DC link inverters with Zero Voltage Switching- Series and parallel Resonant inverters- Voltage control.					
UNIT IV	**DC-AC CONVERTERS**				**9**
Single phase and three phase inverters, control using various (sine PWM, SVPWM and PSPWM) techniques, various harmonic elimination techniques- Multilevel inverters					

Concepts – Types: Diode clamped- Flying capacitor- Cascaded types- Applications.		
UNIT V	**POWER CONDITIONERS, UPS & FILTERS**	**9**
Introduction- Power line disturbances- Power conditioners –UPS: offline UPS, Online UPS, Applications – Filters: Voltage filters, Series-parallel resonant filters, filter without series capacitors, filter for PWM VSI, current filter, DC filters – Design of inductor and transformer for PE applications – Selection of capacitors		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Outline the state space model for DC – DC converters

CO2: Illustrate the operation of switched mode power converters.

CO3: Explain the importance of Resonant Converters.

CO4: Summarize the PWM techniques for DC-AC converters

CO5: Relate the operation of filters and UPS

TEXT BOOKS:

1. Simon Ang, Alejandro Oliva," Power-Switching Converters", 3rd Edition, CRC Press, 2010.
2. KjeldThorborg, "Power Electronics – In theory and Practice", 1st Edition, Overseas Press, 2005.
3. M.H. Rashid – "Power Electronics handbook", 4th Edition, Elsevier Publication, 2017.
4. GopalK.Dubey, "Power semiconductor controlled Drives", 1st Edition, Prentice Hall Inc., NewJersey,1989.

REFERENCES

1. Philip T Krein, "Elements of Power Electronics", 2ndEdition, Oxford University Press, 2017.
2. Ned Mohan, Tore.M.Undeland, William.P.Robbins, "Power Electronics converters, Applications and design",3rd Edition, John Wiley and Sons, 2006
3. M.H. Rashid "Power Electronics circuits, devices and applications"- 3rdEdition, Prentice Hall of India New Delhi, 2007.
4. Erickson, Robert W, "Fundamentals of Power Electronics",2nd Edition, Springer, 2010.

21PEE11	POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain about Renewable Energy System and its environmental impacts.
- To illustrate various electrical machines for Wind Energy Conversion System.
- To summarize different power converters namely AC to DC, DC to DC and AC to AC converters for renewable energy systems.
- To demonstrate the concept of wind and PV systems.
- To outline the maximum power point tracking algorithms and hybrid energy system.

UNIT I	**INTRODUCTION**	**9**

Environmental aspects of electric energy conversion: impacts of renewable energy generation on environment (cost-GHG Emission) – Global warming and climate change impacts - Qualitative study of different renewable energy resources: Solar, Wind, Ocean, Biomass, Fuel cell, Hydrogen energy systems and Hybrid renewable energy systems.		
UNIT II	**ELECTRICAL MACHINES FOR RENEWABLE ENERGY CONVERSION**	**9**
Review of 3 Phase Induction Motor – Construction & Principle, Review of reference theory fundamentals – Principle of operation and analysis: IG, PMSG, SCIG and DFIG.		
UNIT III	**POWER CONVERTERS**	**9**
Solar: Block diagram of solar photo voltaic system -Principle of operation: line commutated converters (inversion-mode) - Boost and buck-boost converters- selection of inverter, battery sizing, array sizing Wind: Three phase AC voltage controllers- AC-DC-AC converters: uncontrolled rectifiers, PWM Inverters, Grid Interactive Inverters-matrix converters.		
UNIT IV	**ANALYSIS OF WIND AND PV SYSTEMS**	**9**
Solar radiation and measurement – Solar cells and their characteristics – PV arrays – Introduction to flexible solar cells –Basic Principle of wind Energy conversion – Components and classification of Wind Energy Conversion System (WECS) – Smart grid.		
UNIT V	**HYBRID RENEWABLE ENERGY SYSTEMS**	**9**
Need for Hybrid Systems- Range and type of Hybrid systems- Case studies of Wind-PV Maximum Power Point Tracking (MPPT). - Converters for hybrid renewable energy system - Recent Developments in Multilevel converters – Smart meters.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES: At the end of the course, learners will be able to: CO1: Demonstrate the working principle of various renewable energy resources with its environmental impacts. CO2: Illustrate the principle, operation & characteristics of various machines for renewable energy systems. CO3: Outline the performance characteristics of various power converters. CO4: Explain the principle of energy conversion and grid integration schemes for wind & solar systems. CO5: Summarize various types of hybrid renewable energy systems for MPPT.		
TEXT BOOKS: 1.S. N. Bhadra, D.Kastha, S.Banerjee,"Wind Electrical Systems", 1st Edition,Oxford University Press,2005. 2.Ion Boldea, "Variable speed generators", 1st Edition, Taylor& Francis group, 2006. 3.Chetan Singh Solanki ,"Solar Photovoltaics: Fundamentals, Technologies And Applications", 3rd Edition, 2015. 4.Haitham Abu-Rub; Mariusz Malinowski; Kamal Al-Haddad, " Power Electronics for Renewable Energy Systems, Transportation and Industrial Applications", 3rd Edition, Wiley-IEEE Press,2014.		

REFERENCES
1. Rashid .M. H "power electronics Hand book", 2nd Edition, Academic press, 2001.
2. B.H.Khan "Non-conventional Energy sources ", 3rd Edition, Tata McGraw-hill Publishing Company, New Delhi, 2009.
3. Rai. G.D, "Non conventional energy sources", 3rd Edition, Khanna publishes, 1993.
4. Gray, L. Johnson, "Wind energy system", 2nd Edition, Prentice Hall linc, 1995.

21PEE12	SPECIAL ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To interpret the construction, principle of operation, control and performance of stepper motors.
- To explain the construction, principle of operation and performance of synchronous reluctance motors.
- To infer the construction, principle of operation, control and performance of switched reluctance motors.
- To outline the construction, principle of operation, control and performance of permanent magnet brushless DC motors.
- To illustrate the construction, principle of operation and performance of permanent magnet synchronous motors

UNIT I	STEPPER MOTORS	9

Constructional features – Principle of operation – Variable reluctance motor – Hybrid motor – Single and multi stack configurations – Torque equations – Modes of excitation – Characteristics – Drive circuits – Microprocessor control of stepper motors – Closed loop control-Concept of lead angle– Applications.

UNIT II	SYNCHRONOUS RELUCTANCE MOTORS	9

Constructional features – Types – Axial and Radial flux motors – Principle of operation – Variable Reluctance Motors – Voltage and Torque Equations - Phasor diagram - performance characteristics – Applications.

UNIT III	SWITCHED RELUCTANCE MOTORS	9

Constructional features – Rotary and Linear SRM - Principle of operation – Torque equation – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Characteristics and Closed loop control – Applications.

UNIT IV	PERMANENT MAGNET BRUSHLESS DC MOTORS	9

Permanent Magnet materials – Minor hysteresis loop and recoil line-Magnetic Characteristics – Permeance coefficient -Principle of operation – Types – Magnetic circuit analysis – EMF and torque equations –Commutation - Power Converter Circuits and their controllers – Motor characteristics and control– Applications.

UNIT V	PERMANENT MAGNET SYNCHRONOUS MOTORS	9

Principle of operation – Ideal PMSM – EMF and Torque equations – Armature MMF – Synchronous Reactance – Sine wave motor with practical windings - Phasor diagram – Torque/speed characteristics - Power controllers - Converter Volt-ampere requirements– Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the performance of stepper motors.

CO2: Illustrate characteristics and performance of synchronous reluctance motors.

CO3: Demonstrate the controllers for switched reluctance motors.

CO4: Summarize the performance and applications of permanent magnet brushless DC motors.

CO5: Outline the performance and characteristics of permanent magnet synchronous motors.

TEXT BOOKS:

1. K.Venkataratnam, "Special Electrical Machines", 1st Edition, Universities Press (India) Private Limited, 2008.
2. T.J.E. Miller, "Brushless Permanent Magnet and Reluctance Motor Drives", 1st Edition, Clarendon Press, Oxford, 1989.
3. T. Kenjo, "Stepping Motors and Their Microprocessor Controls", 1st Edition, Clarendon Press London, 1984.
4. E.G. Janardanan, "Special electrical machines", 1st Edition, PHI learning Private Limited, Delhi, 2014.

REFERENCES

1. R.Krishnan, "Switched Reluctance Motor Drives – Modeling, Simulation, Analysis, Design and Application",1st Edition, CRC Press, New York, 2001.
2. P.P. Aearnley, "Stepping Motors – A Guide to Motor Theory and Practice", 1st Edition, Peter Perengrinus London, 2002.
3. T. Kenjo and S. Nagamori, "Permanent Magnet and Brushless DC Motors", 1st Edition, Clarendon Press, London, 1989.
4. R.Srinivasan, "Special Electrical Machines", 1st Edition, Lakshmi Publications, 2013.

21PEE13	SOLID STATE DRIVES AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the steady state characteristics of electrical drive
- To relate the operation of the converter / chopper fed DC drive.
- To illustrate the characteristics and performance of induction motor drives.
- To summarize the application of synchronous motor drives.
- To outline the controllers for DC drives.

UNIT I	DRIVE CHARACTERISTICS	9

Electrical drive-Equations governing motor load dynamics – steady state stability – multi

quadrant Dynamics: acceleration, deceleration, starting & stopping – four quadrant load torque characteristics- Selection of motor.		
UNIT II	**CONVERTER / CHOPPER FED DC MOTOR DRIVE**	**9**
Steady state analysis of the single and three phase converter fed separately excited DC motor drive – continuous and discontinuous conduction – Time ratio and current limit control – four quadrant operation of converter / chopper fed drive-Applications.		
UNIT III	**INDUCTION MOTOR DRIVES**	**9**
Stator voltage control – Rotor resistance control, qualitative treatment of slip power recovery drives-V/f control –voltage / current fed inverter – closed loop control-Vector control application.		
UNIT IV	**SYNCHRONOUS MOTOR DRIVES**	**9**
V/f control and self-control of synchronous motor: Margin angle control and power factor control –Three phase voltage / current source fed synchronous motor –Applications**.**		
UNIT V	**SPECIAL MACHINES DRIVES**	**9**
Transfer function for DC motor / load and converter – closed loop control with current and speed feedback – armature voltage control and field weakening mode .design of controllers-current controller and speed controller.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Show the steady state operation of various drives with its torque characteristics

CO2: Illustrate the operation of the converter / chopper fed DC drive.

CO3: Explain the operation of both classical and modern induction motor drives

CO4: Demonstrate the design of synchronous motor drives

CO5: Outline the concept of current and speed controller for drives

TEXT BOOKS:

1. Gopal K.Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosa Publishing House, 2010.
2. Bimal K.Bose. "Modern Power Electronics and AC Drives", 1st Edition, Pearson Education, 2002.
3. Gopal K .Dubey, "Power semiconductor controlled Drives”, 1st Edition, Prentice Hall Inc., New Jersey, 1989.
4. R.Krishnan, "Electric Motor & Drives: Modeling, Analysis and Control", 1st Edition, Prentice hall of India, 2001.

REFERENCES

1. S.K.Pillai, "A First course on Electrical Drives", 1st Edition, Wiley Eastern Limited,1993.
2. Murphy J.M.D and Turnbull, "Thyristor Control of AC Motor", 1st Edition, Pergamon Press, Oxford, 1988.
3. J.Gnanavadivel,”Solid State Drives”, 1st Edition, Anuradha Publications, Chennai. 2017.
4. Philip T.Krein, "Elements of Power Electronics" 1st Edition, Oxford University Press, 2004.

21PEE14	DIGITAL CONTROL OF ELECTRICAL DRIVES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the concepts of power electronic converters.
- To explain modeling of DC motor, drives and control techniques
- To demonstrate the modelling and analysis of Induction motor drive.
- To interpret V/f and vector control for Induction motor drive.
- To illustrate the control of embedded drives.

UNIT I	POWER ELECTRONIC CONVERTERS FOR DRIVES	9

Power electronic switches-state space representation of switching converters - Fixed frequency PWM-variable frequency PWM- space vector PWM- Hysteresis current control-dynamic analysis of switching converters-PWM modulator model.

UNIT II	CONTROL OF DC DRIVES	9

Modelling of DC machines-block diagram/transfer function-phase control – 1-phase/ 3-phase converter fed DC drives- Chopper fed DC drives-four quadrant chopper circuit - closed loop control - speed control - current control - cascade control – constant torque/power operation-comparison of chopper/converter fed drives techniques-merits/demits.

UNIT III	ANALYSIS AND MODELLING OF INDUCTION MOTOR DRIVE	9

Basics of induction motor drive-classification – equivalent circuit- torque Vs slip characteristics-steady state performance- Dynamic modeling of induction motor, 3-phase to two phase transformation-stator, rotor, and synchronously rotating reference frame model.

UNIT IV	CONTROL OF INDUCTION MOTOR DRIVE	9

VSI fed induction motor drives- waveforms for 1-phase, 3-phase Non-PWM and PWM VSI fed induction motor drives -principles of V/F control- principle of vector control-direct vector control- space vector modulation- indirect vector control.

UNIT V	EMBEDDED CONTROL OF DRIVES	9

Generation of firing pulses- generation of PWM pulses using embedded processors - IC control of DC drives- fixed frequency/variable frequency/current control- V/F control using PIC microcontroller- vector control using embedded processors.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Outline the concept of PWM converters.
CO2: Illustrate the controlling methods of DC drives.
CO3: Interpret the dynamic modeling for Induction motor drive.
CO4: Summarize the controlling methods of Induction motor drive.
CO5: Explain the vector control of drives using embedded processors.

TEXT BOOKS:

1. R. Krishnan, “Electric Motor Drives, Modeling, Analysis and Control”, 1st Edition, Prentice Hall of India, 2002.

2. Raj Kamal, “Embedded Systems- Architecture, Programming and Design”, 1st Edition, Tata McGraw Hill Publications, 2006.
3. Vedam Subrahmanyam, “Thyristor control of Electric drives”, 2nd Edition, Tata McGraw Hill Publications, 1988.
4. D.M. Dhamdhere,” Operating Systems, A Concept-Based Approach”, 2nd Edition, Tata McGraw Hill Publications, 2008.

REFERENCES

1. Ion Boldea & S.A. Nasar, “Electric Drives”, 1st Edition, CRC Press, 2006.
2. Simon Ang, Alejandro Oliva “Power Switching Converters”, 1st Edition, CRC Press,2005.
3. B.R. Gupta, V. Singhal, “Fundamentals of Electric Drives and Control”, 1st Edition, S.K. Kataria & Sons Publishers, 2013.
4. Duco W. J. Pulle, “Applied Control of Electrical Drives: Real Time Embedded and Sensorless Control using VisSim and PLECS”, 1st Edition, Springer, 2015.

21PEE15	WIND ENERGY CONVERSION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basic concepts of Wind energy conversion system
- To illustrate the mathematical modeling and control of the Wind turbine.
- To outline the concepts of fixed speed wind energy conversion systems.
- To summarize the concepts of variable speed wind energy conversion systems.
- To interpret the grid integration issues with wind energy conversion systems.

UNIT I INTRODUCTION 9

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Power coefficient-Sabinin’s theory-Aerodynamics of Wind turbine.

UNIT II WIND TURBINES 9

HAWT-VAWT (Horizontal and Vertical Axis Wind Turbine) -Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations- Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control and stall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED SYSTEMS 9

Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model Wind speed - Model wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS 9

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG (doubly-fed induction generator) - PMSG (Permanent Magnet synchronous Generator) -Variable speed generators modeling - Variable speed variable frequency schemes.

UNIT V	GRID CONNECTED SYSTEMS	9

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Summarize the concepts of Wind energy conversion system.
CO2: Interpret the control and modeling of Wind turbine.
CO3: Explain the Fixed speed system types.
CO4: Illustrate the characteristics of variable speed systems.
CO5: Outline the issues of Grid connected wind energy conversion system.

TEXT BOOKS:

1. L.L.Freris “Wind Energy conversion Systems”, 1st Edition, Prentice Hall, 1990
2. S.N.Bhadra, D.Kastha, S.Banerjee, “Wind Electrical Systems”, 1st Edition, Oxford University Press, 2010.
3. Ion Boldea, “Variable speed generators”, 1st Edition, Taylor & Francis group, 2006.
4. S.M.Muyeen, “Wind Energy conversion Systems Technology and Trends”, 1st Edition, Springer, 2012.

REFERENCES:

1. E.W.Golding “The generation of Electricity by wind power”, 2nd Edition, Redwood burn Ltd., Trowbridge, 1976.
2. N. Jenkins,” Wind Energy Technology”, 1st Edition, John Wiley & Sons,1997.
3. S.Heir “Grid Integration of WECS”, 1st Edition, Wiley 1998.
4. N. Jenkins,” Wind Energy Technology”, 2nd Edition, John Wiley & Sons, 1997.

21PEE16	FLEXIBLE AC TRANSMISSION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basic concepts of Flexible AC Transmission System (FACTS) controllers in power transmission.
- To illustrate the characteristics and applications of Static Var Compensator (SVC) & Static Compensator (STATCOM) in power transmission
- To summarize the applications of Thyristor Controlled Series Capacitor (TCSC) and Static Synchronous Series Compensator (SSSC)
- To outline the operational characteristics of Unified Power Flow Controller and Interline Power Flow Controllers
- To demonstrate the concepts of special purpose FACTS controllers.

UNIT I	INTRODUCTION TO FACTS	9

Reactive power control in electrical power transmission lines –Uncompensated transmission line

– Fixed series and shunt compensation – Basic types of FACTS controllers – Brief description and definitions of FACTS controllers.		
UNIT II	**STATIC SHUNT COMPENSATION**	**9**
Basic operating principle of Static Var Compensators and STATicCOMpensator (STATCOM) – Regulation slope - transfer function and dynamic performance- Comparison between SVC and STATCOM - V-I & V-Q characteristics – Applications: Enhancement of transient stability and power oscillation damping.		
UNIT III	**STATIC SERIES COMPENSATORS**	**9**
Concepts of Controlled Series Compensation - Operation of Thyristor Controlled Series Capacitor (TCSC) - Modelling of TCSC for load flow studies - Modelling of Thyristor Switched Series Capacitor (TSSC) for power flow - Applications: Improvement of the system stability limit - Enhancement of power system damping – Sub Synchronous Resonance (SSR) Mitigation.		
UNIT IV	**COMBINED SERIES AND SHUNT CONTROLLERS**	**9**
Unified Power Flow Controller (UPFC) – Operating principle – Independent real and reactive power flow control – Dynamic performance – Interline Power Flow Controllers (IPFC) – operating principle – control structure – practical application considerations.		
UNIT V	**SPECIAL PURPOSE FACTS CONTROLLERS**	**9**
N G Hingorani (NGH) – SSR damping scheme – Thyristor Controlled Braking Resistor(TCBR) – Design and operating aspects – Application examples – Western Area Power Administration's (WAPA) substation with Advanced Series Capacitor (ASC), Bonneville Power Administration (BPA) system with TCSC.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Outline the need for Flexible AC Transmission System (FACTS) controllers.
CO2: Summarize the applications of Static VAR Compensator (SVC) & Static Compensator (STATCOM).
CO3:Illustrate the applications of Thyristor Controlled Series Capacitor (TCSC) and Thyristor Switched Series Capacitor (TSSC).
CO4: Interpret the operational characteristics of UPFC and Interline Power Flow Controllers.
CO5: Explain the special purpose FACTS controllers in power system

TEXT BOOKS:

1. N.G. Hingorani and L. Gyugyi, "Understanding FACTS: Concepts and Technology Flexible AC Transmission Systems", 2nd Edition, Wiley India publishers, 2011.
2. Mohan Mathur, R., Rajiv. K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", 1st Edition, IEEE press and John Wiley & Sons, 2002
3. K.R.Padiyar, "FACTS Controllers in Power Transmission and Distribution", 2nd Edition, New Age International Publishers, Reprint 2016.
4. V.K. Sood, "HVDC and FACTS controllers- Applications of Static Converters in Power System", 1st Edition, Springer Publishers, 2014.

REFERENCES:

1. K.R.Padiyar, "HVDC Power Transmission Systems", 2nd Edition, New Age International publishers, 2016.
2. A.T.John,"Flexible A.C. Transmission Systems", 1st Edition, Institution of Electrical and Electronic Engineers publishers, 1999.

3. Xiao-Ping Zhang, "Flexible AC transmission systems, Modelling & Control", 2nd Edition, Springer Publications, 2012.
4. Suman Bhowmick, "Flexible AC Transmission Systems (FACTS): Newton Power-Flow Modeling of Voltage-Sourced Converter-Based Controllers", 1st Edition, CRC Press, 2016.

VERTICAL III: EMBEDDED SYSTEM ENGINEERING

21PEE17	MICROCONTROLLER BASED SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the architecture of PIC microcontroller and timers
- To outline the peripheral devices for data communication
- To illustrate the embedded system development process.
- To interpret the functional blocks and assembly language programming of ARM processor.
- To demonstrate the organization of ARM processors and its applications

UNIT I	INTRODUCTION TO PIC MICROCONTROLLER	9

Introduction to PIC Microcontroller–PIC 16C6x and PIC16C7x Architecture– Program Memory considerations – Register File Structure - Instruction Set - Addressing modes –Interrupts-Interrupt Programming–PIC microcontroller Interrupts- Timers.

UNIT II	PERIPHERALS AND INTERFACING	9

I^2C Bus for Peripherals Chip Access– Bus operation-Bus subroutines– Serial EEPROM—Analog to Digital Converter–UART-Baud rate selection–Data handling circuit–Initialization - LCD and keyboard Interfacing -ADC, DAC, and Sensor Interfacing.

UNIT III	EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT	9

Embedded Product Development Life Cycle- different phases of EDLC, Modelling of EDLC; issues in Hardware-software Co-design, Data Flow Graph, state machine model, Sequential Program Model, concurrent Model, object oriented Model.

UNIT IV	INTRODUCTION TO ARM PROCESSOR	9

ARM Architecture –ARM programmer's model –ARM Development tools- Memory Hierarchy –ARM Assembly Language Programming–Simple Examples–Architectural Support for Operating systems.

UNIT V	ARM ORGANIZATION	9

3-Stage Pipeline ARM Organization–5-Stage Pipeline ARM Organization–ARM Instruction Execution- ARM Implementation– ARM Instruction Set– ARM coprocessor interface– Architectural support for High Level Languages – Embedded ARM Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Outline the architecture and programming in PIC microcontrollers.
CO2: Summarize the embedded peripheral devices for data communication.
CO3: Interpret the recent trends in embedded firmware environment.
CO4: Explain the basic circuits for ARM microcontroller.
CO5: Illustrate the assembly and software program of ARM microcontrollers.

TEXT BOOKS:

1. Peatman,J.B., "Design with PIC Micro Controllers" 3rd Edition, Pearson Education, 2004.
2. Rajkamal, "Embedded System-Architecture, Programming Design", 1st Edition, McGraw Hill, 2013.
3. Furber,S., "ARM System on Chip Architecture" , 1st Edition, Addison Wesley trade Computer Publishers, 2000.
4. Santul Bisht , "ARM processor" , 1st Edition, LAP LAMBERT Academic Publishing , 2012.

REFERENCES

1. Mazidi M.A."PIC Microcontroller", Rollin McKinley, Danny causey, 1st Edition, Prentice Hall

of India, 2007.
2. Douglas V. Hall, "Microprocessors & Interfacing", 3rd Edition, McGraw Hill Higher Education, 2017.
3. Nicolas K. Haddad, "Microcontroller System Design Using PIC18F Processors", 1st Edition, IGI Global Publications, 2017.
4. Joseph Yiu, "The Definitive Guide to ARM, Cortex,M3 and Cortex, M4 Processors", 2nd Edition, Newnes, imprint of Elsevier, 2010.

21PEE18	**REAL TIME OPERATING SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the fundamentals of interaction of OS with a computer and user computation.
- To illustrate the fundamental concepts of real time operating systems (RTOS).
- To summarize the programming logic of modeling process based on range of OS features
- To compare the types and functionalities in commercial OS application development using RTOS
- To outline the embedded operating systems.

UNIT I	**REVIEW OF OPERATING SYSTEMS**	**9**

Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – issues in distributed system: states, events, clocks.

UNIT II	**OVERVIEW OF RTOS**	**9**

RTOS Task and Task state –Multithreaded Preemptive scheduler- Process Synchronization-Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronization problem – Deadlocks.

UNIT III	**REAL TIME MODELS AND LANGUAGES**	**9**

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks –RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

UNIT IV	**REAL TIME KERNEL**	**9**

Principles – Design issues – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

UNIT V	**INTRODUCTION TO EMBEDDED OS**	**9**

Discussions on Basics of Linux supportive RTOS – uCOS-C Executive for development of RTOS Application –introduction to Android Environment - Stack – Android User Interface.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Summarize the real-time scheduling and schedulable analysis.
CO2: Compare theoretical and practical knowledge of RTOS.
CO3: Explain the multitasking techniques in real time systems.
CO4: Interpret the fundamental concepts of real-time operating systems.
CO5: Illustrate the employable and entrepreneurship capacity in embedded systems design.

TEXT BOOKS:

1. Silberschatz, Galvin, Gagne "Operating System Concepts",6th Edition, John Wiley,2003.
2. Charles Crowley, "Operating Systems-A Design Oriented approach", 1st Edition, McGraw Hill,1997
3. Karim Yaghmour, "Building Embedded Linux System", 1st Edition, O'Reilly Publication, 2003.

4. C.M. Krishna, Kang, G.Shin, “Real Time Systems”, 3rd Edition, McGraw Hill, 1997.

REFERENCES

1. Marko Gargenta, “Learning Android”, 1st Edition, O’Reilly Publications, 2011.
2. Herma K., “Real Time Systems – Design for distributed Embedded Applications”, 2nd Edition, Kluwer Academic Publishers, 1997.
3. Corbet Rubini, Kroah-Hartman, “Linux Device Drivers”, 1st Edition, O’Reilly Publications, 2016.
4. Mukesh Sighal and N G Shi “Advanced Concepts in Operating System”, 2nd Edition, McGraw Hill, 2000.

21PEE19	**PERVASIVE DEVICES AND TECHNOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To explain the fundamentals of wireless sensor devices.
- To summarize the WSN processor and its functions in networking
- To outline the concept of wireless network communication
- To illustrate the concept of sensor network protocols.
- To interpret the wireless networking devices for various protocols

UNIT I	**WIRELESS SENSOR DEVICES AND NETWORKING**	**9**

Challenges for Wireless Sensor Networks- Characteristic requirements for WSN ,WSN vs Adhoc Networks - introduction to Sensor node networking with any Commercially available sensor nodes – Physical layer and transceiver design considerations in WSNs, -Applications of sensor networks.

UNIT II	**BUILDING PERVASIVE SENSOR NETWORK**	**9**

Single-Node Architecture - Hardware Components, constraints & challenges in resources- Energy Consumption of Sensor Nodes, Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Network Architecture -Sensor Network Scenarios.

UNIT III	**WIRELESS TECHNOLOGY**	**9**

Constructional features – Rotary and Linear SRM - Principle of operation – Torque production – Steady state performance prediction- Analytical method -Power Converters and their controllers – Methods of Rotor position sensing – Sensor less operation – Characteristics and Closed loop control – Applications.

UNIT IV	**OVERVIEW OF SENSOR NETWORK PROTOCOLS**	**9**

Introduction to fundamentals of Wireless sensor network MAC Protocols - Low duty cycle protocols
and wakeup concepts - Contention-based protocols - Schedule-based protocols - IEEE 802.15.4MAC protocol- Energy usage profile.

UNIT V	**WIRELESS NETWORKING OF DEVICES**	**9**

Classification of Wireless Networking of Devices, introduction to RF WPAN 802.15.1 & Bluetooth -
protocol stack, frame, link manager layer –Bluetooth piconet–application.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Outline the fundamentals of wireless sensor devices and network. CO2: Explain the concept of building pervasive sensor network. CO3: Interpret the basics of wireless technology for various protocols. CO4: Compare various sensor network protocols CO5: Summarize the wireless networking devices
TEXT BOOKS: 1. HolgerKarl, AndreasWillig, "Protocols & Architectures for WSN", 1st Edition, John Wiley, 2012. 2. Mark Ciampa, Jorge Olenewa, "Wireless Communications", 2nd Edition, Cengage Learning, 2009. 3. Frank Adelstein, Sandeep K.S Gupta Etal, "Fundamentals of Mobile & Pervasive Computing", 1st Edition, Tata McGraw Hill Publications,2010. 4. Jaganathan Sarangapani, "Wireless AdHoc & Sensor N/Ws-Protocols and Control", 2nd Edition, CRC press, 2007.
REFERENCES 1. Natalia Olifer and Victor Olifer, "Computer Networks principles, technologies and protocols for network design", 1st Edition, Wiley, 2015. 2. William Stallings, "Wireless communications and Networks", 2nd Edition PHI/Pearson Education, 2002. 3. Mullet, "Introduction to wireless telecommunications systems and networks", 1st Edition, Cengage learning, 2010. 4. Feng Zhao & Leonidas J. Guibas, "Wireless Sensor Networks- An Information Processing Approach", 2nd Edition, John Wiley,2012.

21PEE20	**EMBEDDED LINUX FOR IoT**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES: • To illustrate the fundamentals of Linux Operating system, its basic commands and shell programming • To outline the history of embedded Linux and basics of GNU Cross Platform Tool Chain. • To summarize different types of architecture for Embedded Linux • To explain the concept of configuring kernel using the cross-platform tool chain. • To interpret drivers for LINUX platforms familiarizing the concepts					
UNIT I	**FUNDAMENTALS OF LINUX**				**9**
Basic Linux System Concepts: Working with Files and Directories - Introduction to Linux File system -Working with Partitions and File systems - Understanding Linux Permissions; Using Command LineTools: Executing Commands from the Command Line - Getting to a Shell - Popular Command-Line Commands - Working with the Bash Shell.					
UNIT II	**VARIOUS DISTRIBUTIONS AND CROSS PLATFORM TOOL CHAIN**				**9**
Introduction - History of Embedded Linux - Embedded Linux versus Desktop Linux -					

Commercial Embedded Linux Distribution - Choosing a distribution - Embedded Linux Distributions – Architecture of Embedded Linux - Linux Kernel Architecture - Porting Roadmap - GNU Cross Platform Toolchain.		
UNIT III	**HOST/ TARGET SETUP AND OVERALL ARCHITECTURE**	**9**
Real Life Embedded Linux Systems - Design and Implementation Methodology - Types of Host/Target Development Setups - Types of Host/Target Debug Setups - Generic Architecture of an Embedded Linux System - System Startup - Types of Boot Configurations - System Memory Layout – Processor Architectures - Buses and Interfaces - I/O – Storage.		
UNIT IV	**KERNEL CONFIGURATION**	**9**
A Practical Project Workspace - GNU Cross-Platform Development Tool chain - C Library Alternatives - Other Programming Languages - Eclipse: An Integrated Development Environment – Terminal Emulators - Selecting a Kernel - Configuring the Kernel - Compiling the Kernel - Installing the Kernel -Basic Root File system Structure - Libraries - Kernel Modules.		
UNIT V	**LINUX DRIVERS**	**9**
Introduction in to basics on Linux drivers, introduction to GNU cross platform Tool chain- Case study on programming one serial driver for developing application using Linux Driver.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Outline the Linux desktop and GNU tool chain with Eclipse IDE
CO2: Interpret the cross compiler Linux kernel in distribution platform.
CO3: Summarize the applications of the Linux kernel in RTOS.
CO4: Illustrate about distributions and cross platform tool chain.
CO5: Explain the application of Linux Drivers.

TEXT BOOKS:

1. Karim Yaghmour, Jon Masters, Gilad Ben-Yossef and Philippe Gerum, “Building Embedded Linux Systems”, 2nd Edition, SPD -O’Reilly Publications, 2008.
2. P.Raghavan, Amol Lad, Sriram Neelakandan, “Embedded Linux System Design & Development”, 3rd Edition, Auerbach Publications, 2012.
3. Karim Yaghmour, “Building Embedded Linux System” , 2nd Edition, O’Reilly Publication, 2003.
4. Raj Kamal, “Embedded Systems- Architecture, Programming and Design” 1st Edition, Tata McGraw Hill, 2006.

REFERENCES

1. William Von Hagen, “Ubuntu Linux Bible”, 3rd Edition, Wiley Publishing Inc., 2010.
2. Jonathan Corbet, Alessandro Rubini and Greg Kroah-Hartman, “Linux Device Drivers”, 3rd Edition, SPD -O’Reilly Publications, 2011.
3. Robert Love, “Linux System Programming”, 1st Edition, SPD -O’Reilly Publications, 2010.
4. Corbet Rubini, Kroah-Hartman, “Linux Device Drivers”, 1st Edition, O’Reilly Publications, 2016.

21PEE21	EMBEDDED AUTOMOTIVE SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the fundamentals of embedded communication process.
- To explain the fundamentals of wireless embedded networking
- To demonstrate the automation in instrumentation
- To illustrate the measurement and control of electrical apparatus
- To interpret the communication for large electrical system automation

UNIT I — EMBEDDED PROCESS COMMUNICATION WITH INSTRUMENT BUS — 9

Embedded Networking: Introduction – Cluster of Instruments in System: introduction to bus protocols, connectors, Bus Architecture & Interfacing of external instruments to – RS 232C,RS – 422, RS 485 and USB standards – embedded ethernet – MOD bus and CAN bus.

UNIT II — WIRELESS EMBEDDED NETWORKING — 9

Wireless sensor networks – Introduction – Sensor node architecture – Commercially available sensor nodes -Network Topology –Localization –Time Synchronization - Energy efficient MAC protocols – SMAC –Energy efficient and robust routing – Data Centric routing Applications of sensor networks; Applications.

UNIT III — BUILDING SYSTEM AUTOMATION — 9

Concept of Microcontroller based & PC based data acquisition – Concept of Virtual Instrumentation - Programming Environment to build a Virtual Instrumentation, Building system automation with graphical user interface programming-Programmable Logic Controllers- Introduction-Ladder &Functional Block programming.

UNIT IV — EMBEDDED MEASUREMENT AND CONTROL — 9

Sensor Types & Characteristics: Sensing Voltage, Current, flux, Torque, Position, Proximity, Force, Data acquisition & Display system- Signal conditioning circuit design- computers/ embedded processor interfacing circuit -design automation and protection of electrical appliances.

UNIT V — ELECTRICAL SYSTEM AUTOMATION — 9

Data Acquisition, Monitoring, Communication, Event Processing, and Polling Principles, SCADA system principles – outage management– Decision support application for substation automation, extended control feeder automation, Performance measure and response time.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the fundamentals of embedded communication protocols.
CO2: Outline the wireless embedded networking concepts.
CO3: Illustrate the concepts of building system automation.
CO4: Summarize the various measurement and control methods of electrical apparatus.
CO5: Compare the various communication system automation.

TEXT BOOKS:

1. James Northcote-Green, Robert Wilson,"Control and automation of electrical power distribution systems", 1st Edition, Taylor and Francis, 2006.
2. Krzysztof Iniewski, "Smart Grid, Infrastructure & Networking", 2nd Edition, Tata McGraw Hill Publications, 2012.

3. Robert Faludi, "Building Wireless Sensor Networks", 1st Edition, O'Reilly Publications, 2011.
4. Shih-LinWu, Yu-CheeTseng, "Wireless Ad-Hoc Networking, PAN, LAN, SAN", 2nd Edition, Aurebach Publications, 2012.

REFERENCES

1. Jan Axelson, "Embedded Ethernet and Internet Complete", 2nd Edition, Penram publications, 2003.
2. Bhaskar Krishnamachari, "Networking wireless sensors", 1st Edition, Cambridge press 2005.
3. Robert H. Bishop, "Learning with Lab-View", 1st Edition, Prentice Hall, 2009.
4. Ernest O.Doeblin and Dhanesh N Manik, "Measurements Systems – Application and Design", 5th Edition, Tata McGraw Hill Publications, 2007.

21PEE22	INTERNET OF THINGS IN MEDICINE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To explain the fundamentals of IoT functional blocks of healthcare systems.
- To summarize various protocols for IoT.
- To illustrate the IoT system using Rasperry Pi/Arduino.
- To outline data analytics for cloud offerings related to IoT in medicine.
- To interpret the real time applications of IoT in health care systems.

UNIT I	FUNDAMENTALS OF IoT	9

Evolution of Internet of Things - Enabling Technologies – IoT Architectures, IoT World Forum (IoTWF) and Alternative IoT models – Simplified IoT Architecture and Core IoT Functional Stack -– Fog, Edge and Cloud in IoT – Functional blocks of an IoT ecosystem in health care systems.

UNIT II	IoT PROTOCOLS	9

IoT Access Technologies: Physical and MAC layers, topology and Security of IEEE Protocols and WAN – Network Layer: IP versions, Constrained Nodes and Constrained Networks – Optimizing IP for IoT: From 6LoWPAN to 6Lo– Application Layer Protocols: CoAP and MQTT.

UNIT III	DESIGN AND DEVELOPMENT OF PROCESSORS	9

Design Methodology - Embedded computing logic - Microcontroller, System on Chips - IoT system building blocks - Arduino - Board details, IDE programming - Raspberry Pi - Interfaces and Raspberry Pi with Python Programming.

UNIT IV	DATA ANALYTICS AND SUPPORTING SERVICES	9

Structured Vs Unstructured Data and Data in Motion Vs Data in Rest –Hadoop Ecosystem for medical emergency management– Apache Kafka, Apache Spark – Edge Streaming Analytics and Network Analytics in Internet of medical things.

UNIT V	APPLICATIONS OF IOT IN MEDICINE	9

NSUM Technique for Diabetes Patients, Healthcare Monitoring system, An IoT Model for Neuro sensors, A Fuzzy-Based expert System to diagnose Alzheimer's Disease, Secured architecture for IoT enabled Personalized Healthcare Systems, Healthcare Application.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Outline the concepts of IoT and its applications in health care systems.

CO2: Compare various protocols for IoT.

CO3: Summarize the computing methods for the development of processors.
CO4: Explain the data analytics methods in emergency management system.
CO5: Outline the applications of IoT in medicine.

TEXT BOOKS:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things", 1st Edition, Cisco Press, 2017.
2. Robert Faludi,"Building Wireless Sensor Networks", 1st Edition, O'Reilly Publications, 2011.
3. Raj Kamal, "Embedded Systems- Architecture, Programming and Design", 2nd Edition, Tata McGraw Hill Publications, 2006.
4. Karim Yaghmour, "Building Embedded Linux System", 2nd Edition, O'Reilly Publications,2003.

REFERENCES

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", 1st Edition, Universities Press, 2015.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key Applications and Protocols", 1st Edition, Wiley, 2012.
3. Shih-LinWu,Yu-CheeTseng,"WirelessAd-HocNetworking,PAN,LAN,SAN",2nd Edition, Aurebach Publications,2012.
4. William Stallings, "Wireless communications and Networks", 2nd Edition PHI/Pearson Education, 2002.

21PEE23	SENSORS AND TRANSDUCERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the concepts of measurement technology.
- To classify the various sensors used to measure displacement and range.
- To summarize the working principle of force and magnetic sensors
- To demonstrate the operation of pressure, temperature sensors
- To outline the fundamentals of signal conditioning, data acquisition and communication systems used in mechatronics system development.

UNIT I	**INTRODUCTION**	**9**

Basics of Measurement – Classification of errors – Error analysis – Static and dynamic characteristics of transducers – Performance measures of sensors – Classification of sensors – Sensor calibration techniques – Sensor Output Signal Types-Sensor Modeling.

UNIT II	**MOTION, PROXIMITY AND RANGING SENSORS**	**9**

Motion Sensors – Potentiometers, Encoders –Inductive, Capacitive, Linear variable displacement transducer (LVDT) – Rotary variable displacement transducer (RVDT) –Accelerometer – Global positioning system (GPS), Bluetooth, Range Sensors –Laser Range Sensor (LIDAR).

UNIT III	**FORCE AND MAGNETIC SENSORS**	**9**

Strain Gauge, Load Cell, Magnetic Sensors –types, principle, requirement and advantages: Magnetoresistive – Hall Effect – Compass, Gyroscope, Inclinometers.

UNIT IV	OPTICAL, PRESSURE AND TEMPERATURE SENSORS	9
Photo conductive cell, photo voltaic, Photo resistive, Light dependent resistor (LDR) – Fiber optic sensors – Pressure – Diaphragm, Bellows, Piezoelectric – Tactile sensors, Temperature – IC, Thermistor, Resistance temperature detector (RTD), Thermocouple. Acoustic Sensors – flow and level measurement.		
UNIT V	**SIGNAL CONDITIONING AND DATA ACQUISITION SYSTEMS**	**9**
Amplification – Filtering – Sample and Hold circuits – Data Acquisition: Single channel and multi-channel data acquisition – Data logging - applications - Automobile, Aerospace, Home appliances, Manufacturing, Environmental monitoring.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Summarize the types, characteristics and errors associated with sensors.

CO2: Demonstrate the operating principles of motion, proximity and ranging sensors.

CO3: Outline the operating principle of force and magnetic sensors.

CO4: Illustrate the working principles of optical, pressure and temperature sensors.

CO5: Interpret the role of data acquisition systems in real time applications.

TEXT BOOKS:

1. Ernest O Doebelin, "Measurement Systems – Applications and Design", 2nd Edition, Tata McGraw-Hill Publications, 2009.

2. Sawney A K and Puneet Sawney, "A Course in Mechanical Measurements and Instrumentation and Control", 12th Edition, Dhanpat Rai& Co, New Delhi, 2013.

3. Patranabis D, "Sensors and Transducers", 2nd Edition, PHI, New Delhi, 2010.

4. Jacob Fraden , "Handbook of Modern SensorsPhysics, Designs, and Applications", 1st Edition, Springer, New York, 2004.

REFERENCES

1.William C. Dunn ,"Introduction to Instrumentation, Sensors, and Process Control", 1st Edition, Artech House, Inc, 2006.

2. Randy Frank, "Understanding Smart Sensors", 2nd Edition, Artech House, Inc, 2000.

3. Richard Zurawski, "Industrial Communication Technology Handbook", 2nd Edition, CRC Press, 2015.

4. Waldemar Nawrocki, "Measurement Systems and Sensors", 1st Edition, Artech House Inc, 2005.

VERTICAL IV: ELECTRIC VEHICLE TECHNOLOGY

21PEE24	ELECTRIC VEHICLE ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the concept of electric vehicles.
- To demonstrate the operation of electric vehicle motors
- To explain the architecture of electric vehicle
- To illustrate the management of architecture parameters.
- To summarize acceleration performance parameters.

UNIT I	INTRODUCTION TO ELECTRIC VEHICLES	9

Electric Vehicle – Need - Types – Cost and Emissions – End of life. Electric Vehicle Technology – layouts, cables, components, Controls. Batteries – overview and its types. Battery plug-in and life. Ultra-capacitor, Charging – Methods and Standards. Alternate charging sources – Wireless & Solar

UNIT II	ELECTRIC VEHICLE MOTORS	9

Motors (DC, Induction, BLDC) – Types, Principle, Construction, Control. Electric Drive Trains (EDT) – Series HEDT (Electrical Coupling) – Power Rating Design, Peak Power Source (PPS); Parallel HEDT (Mechanical Coupling) – Torque Coupling and Speed Coupling. Switched Reluctance Motors (SRM) Drives – Basic structure, Drive Convertor, Design.

UNIT III	ARCHITECTURE OF ELECTRIC VEHICLE	9

Introduction-Electric Vehicle Architecture Power Trains – Electric Motor – Battery Pack – Inverters – DC-DC converter – On-board charger – Battery Management System Components

UNIT IV	MANAGEMENT OF VEHICLE ARCHITECTURE PARAMETERS	9

Introduction - Terms and definitions - Development of a vehicle architecture - Current approaches in systems engineering - Approach of parameter management - Application

UNIT V	MODELLING IN PERFORMANCE PARAMETER	9

Modelling Vehicle Acceleration - Acceleration performance parameters, modelling the acceleration of an electric scooter, modelling the acceleration of a small car.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Summarize the layouts, components and charging methods of electric vehicle.
CO2: Illustrate the operation of DC, induction and BLDC motors.
CO3: Outline the electric vehicle architecture.
CO4: Demonstrate the vehicle architecture parameters.
CO5: Interpret the modelling of acceleration for electric vehicle.

TEXT BOOKS:

1. Jack Erjavec and Jeff Arias, "Hybrid, Electric and Fuel Cell Vehicles", 1st Edition, Cengage Learning, 2012.
2. Mehrdad Ehsani, YiminGao, Sebastien E. Gay and Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", 1st Edition, CRC Press, 2009.
3. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 1stEdition, John Wiley & Sons Ltd, 2003.
4. Beate Muller, Gereon Meyer, "Electric Vehicle Systems Architecture and Standardization Need", 1st Edition, Springer International Publishing Switzerland, 2015.

REFERENCES:

1. Wei Liu, "Hybrid Electric Vehicle System Modeling and Control - General Motors", 1st Edition, John Wiley & Sons, Inc., 2017.
2. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles_ Fundamentals, Theory, and Design, Second Edition", 1st Edition, CRC Press, 2010.
3. Iqbal Husain, "Electric and Hybrid Vehicles- Design Fundamentals", 1st Edition, CRC Press, 2021.
4. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 1st Edition,Wiley, 2012.

21PEE25	ELECTRIC VEHICLE DESIGN, MECHANICS AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the concepts of electric vehicle
- To explain the architecture design of electric vehicle
- To demonstrate the operation of electric vehicle
- To summarize the controlling mechanism in electric vehicles.
- To illustrate the maintenance and replacement in electric vehicle

UNIT I	INTRODUCTION: ELECTRIC VEHICLE	9

History, Components of Electric Vehicle, Comparison with Internal combustion Engine : Technology, Comparison with Internal combustion Engine: Benefits and Challenges
EV classification and their electrification levels. EV Terminology

UNIT II	ELECTRIC VEHICLE ARCHITECTURE DESIGN	9

Types of Electric Vehicle and components. Electrical protection and system requirement, Photovoltaic solar based EV design, Battery Electric vehicle (BEV).Hybrid electric vehicle (HEV).Plug-in hybrid vehicle (PHEV),Fuel cell electric vehicle (FCEV),Electrification Level

of EV, Comparison of fuel vs Electric and solar power, Solar Power operated Electric vehicles		
UNIT III	**ELECTRIC VEHICLE DYNAMICS**	**9**
Electric components used in electric vehicles. Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives. Configuration and control of Switch Reluctance Motor drives, drive system efficiency.		
UNIT IV	**VEHICLE CONTROLLERS**	**9**
Power electronics circuits used for control and distribution of electric power in DC-DC, AC-DC, DC-AC converters used for HEV. Fundamental of Drives and Control of EV Using DC motor, Induction Motor, Permanent Magnet Motor, Switched Reluctance Motor, BLDC motor, Design and Sizing of Traction Motors.		
UNIT V	**MAINTENANCE, REPAIRS AND REPLACEMENT**	**9**
Introduction, Technical information, De-energizing. During work- Maintenance intervals, Repairs affecting other vehicle systems, Inspect high voltage components. Remove and replace-High Voltage Components, Battery back, Low Voltage Components. Re-energizing-results, records and recommendations,		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the concepts of Internal combustion Engine.

CO2: Summarize the components used in Electric Vehicle.

CO3: Illustrate control of Induction Motor drives in Electric Vehicle.

CO4: Demonstrate the Sizing of Traction Motors

CO5: Outline Re-energizing-results in a vehicle system

TEXT BOOKS:

1. Amir Khajepour, Saber Fallah and Avesta Goodarzi, "Electric and Hybrid Vehicles Technologies, Modelling and Control: A Mechatronic Approach", 1st Edition, John Wiley & Sons Ltd, 2014.
2. Antoni Szumanowski, "Hybrid Electric Power Train Engineering and Technology: Modelling, Control, and Simulation", Book chapter, 1st Edition, IGI Global, 2013.
3. Mehrdad Ehsani, Yimin Gao, Ali Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles Fundamentals, Theory, and Design" 2nd Edition, CRC Press, 2010.
4. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 2nd Edition, John Wiley & Sons Ltd, 2003

REFERENCES:

1. Chris Mi, Abul Masrur & David Wenzhong Gao, "Hybrid electric Vehicle- Principles & Applications with Practical Properties", 1st Edition, Wiley, 2011.
2. James Larminie, John Lowry, "Electric Vehicle Technology", Wiley, 2nd Edition, 2012.
3. Sandeep Dhameja, "Electric Vehicle Battery Systems", 1st Edition, Newnes Publications,

2001.
4. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, 2nd Edition, CRC Press, 2003.

21PEE26	ELECTRIC HYBRID VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the basic concepts of electric hybrid vehicles.
- To interpret suitable drive scheme for developing an electric hybrid vehicle.
- To outline the basic schemes of electric vehicles and hybrid electric vehicles.
- To explain the energy storage systems and sizing for electric vehicle applications
- To summarize the various communication protocols and technologies used in vehicle networks

UNIT I	INTRODUCTION TO HYBRID ELECTRIC VEHICLES	9

History of hybrid electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies. Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics, and mathematical models to describe vehicle performance.

UNIT II	HYBRID ELECTRICDRIVE-TRAINS	9

Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.Electric Drive-trains: Basic concept of electric traction, introduction to various electric drive-train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT III	ELECTRIC PROPULSION UNIT	9

Introduction to electric components used in hybrid electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT IV	DRIVE AND ENERGY STORAGE SYSTEM	9

Introduction to Energy Storage Requirements in Hybrid Electric Vehicles, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices-Sizing the drive system- Matching the electric machine and the internal combustion engine (ICE), Sizing the propulsion motor, sizing the power electronics, selecting the energy storage technology, Communications, supporting subsystems

UNIT V	ENERGY MANAGEMENT STRATEGIES	9

Introduction to energy management strategies used in hybrid electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies. Case Studies: Design of a Hybrid Electric Vehicle (HEV), Design of a Battery Electric Vehicle (BEV).

	TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the basics of electric and hybrid electric vehicles.

CO2: Illustrate the use of different power electronics devices and electrical machines in hybrid electric vehicles.

CO3: Summarize the various control strategies of special machines used in hybrid electric vehicles.

CO4: Demonstrate different energy storage devices used for hybrid electric vehicles.

CO5: Interpret working of different configurations of electric vehicles and Energy Management strategies in HEVs.

TEXT BOOKS:

1. Tom Denton, "Electric and Hybrid Vehicle", 1st Edition, Newyork, NY, Routledge, Taylor & Francis Group, 2016.
2. Ali Emadi, Mehrdad Ehsani, John M.Miller, "Vehicular Electric Power Systems", Special Indian Edition, Marcel dekker, Inc 2010.
3. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals", 2nd Edition, CRC Press, Taylor & Francis Group, 2011.
4. Amir Khajepour, M. Saber Fallah, AvestaGoodarzi, "Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach",1st Edition, Wiley, 2014.

REFERENCE BOOKS:

1. Mehrdad Ehsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, 3rd Edition, CRC Press, 2018.
2. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 1stEdition, Wiley, 2003.
3. A.K.Babu, 'Electric& Hybrid Vehicles', 1st Edition, Khanna Publishing, 2019.
4. Ronald K. Jurgen, "Electric and Hybrid-Electric Vehicles: Batteries", 1st Edition, SAE International, 2011.

21PEE27	MOTOR AND POWER CONVERTERS FOR ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the characteristics of electric vehicle motors
- To illustrate the controllers with different mode of operation

- To explain the modeling of Induction motor
- To compare the speed control methods used in Induction motor
- To summarize the concepts of EV control with PWM and inverter

UNIT I	**EV MOTORS CHARACTERISTICS AND DC MOTOR**	**9**
Requirement of EV motors, Comparison of EV motors, Basics of DC Motor, Torque speed characteristics, DC Motor dynamics, Field Weakening Control, Four quadrant operation		
UNIT II	**DC MOTOR DYNAMICS & CONTROL**	**9**
Current Loop Control, Speed Control Loop Dynamical System Control: Gain & Phase Margins, PDController, PI Controller, Selecting PI Gain for Speed Controller, PI Controller Design, PI Controllerwith Reference model, Comparison of conventional PI Controller with PI controller with ReferenceModel, 2 DOF Controller with Internal Model Control, Load Torque Observer, Feedback Linearization,Simplified Modeling of Practical Current Loop		
UNIT III	**INDUCTION MOTOR**	**9**
Rotating Magnetic Field, Basics of Induction motor, Speed-Torque Curve Leakage inductance, circlediagram, current displacement (double cage rotor), line starting, Dynamic modelling of Induction motor		
UNIT IV	**INDUCTION MOTOR SPEED CONTROL**	**9**
Rotating Magnetic Field, Basics of Induction motor, Speed-Torque Curve Leakage inductance, circlediagram, current displacement (double cage rotor), line starting, Dynamic modelling of Induction motor, Rotor Field oriented control, Stator Field Oriented Control, Field Weakening Control, Variable VoltageVariable Frequency Control		
UNIT V	**PWM AND INVERTER**	**9**
Sinusoidal PWM, Injection of third order harmonics, Space Vector Modulation, Dead time & compensation, Encoders, Resolvers, R/D Converters, Hall current sensors and current sampling, VoltageModel Estimator, Current Model Estimator, Closed-loop MRAS observer, Sliding Mode Observer.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Interpret the Torque speed Characteristics of DC motor.

CO2: Illustrate the Practical Current Loop Model.

CO3: Show Dynamic modelling of Induction motor.

CO4: Outline frequency control methods in Induction motor.

CO5: Explain Space Vector Modulation.

TEXT BOOKS:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals", 1St Edition, CRC Press, 2003.
2. AmirKhajepour, Saber Fallah and AvestaGoodarzi, "Electric and Hybrid VehiclesTechnologies, Modelling and Control: A Mechatronic Approach", 1st Edition,

John Wiley & Sons Ltd, 2014.
3. L. Ashok Kumar, S. Albert Alexander, "Power Converters for Electric Vehicles" 1st Edition,CRC Press 2021
4. Monzer Al Sakka, Joeri Van Mierlo and Hamid Gualous, "DC/DC Converters for Electric Vehicles" Kindle Edition, Intech Open, 2011

REFERENCES:

1. Mehrdad Ehsani, YimiGao, Sebastian Longo, Kambiz Ebrahimi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design", 3rd Edition, CRC Press, 2018.
2. Seref Soylu, "Electric Vehicles: Modelling and Simulations", Edited Volume, kindle Edition, Intech Open,2011
3. Kwang Hee Nam, " AC Motor Control and Electrical Vehicle Applications", 1st Edition, CRC Press, 2017
4. Surajit Das Barman , Abrar Hussain , Toufiq Ahmed, "Speed Control of DC Motor Using PWM Technique", Kindle Edition, Lambert Publications, 2012

21PEE28	ELECTRIC VEHICLE CHARGING SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To summarize the battery parameters used in EV charging
- To explain Lead acid and Nickel based batteries
- To illustrate sodium, lithium and metal air batteries
- To demonstrate charging infrastructure of batteries
- To outline battery charges for EV charging

UNIT I	BATTERY PARAMETERS	9

Cell and battery voltages, Charge (or Amphour) capacity, Energy stored, Energy density, Specific power, Amphour (or charge) efficiency, Energy efficiency, Self-discharge rates, Battery geometry, Batterytemperature, heating and cooling needs, Battery life and number of deep cycles

UNIT II	EV BATTERIES	9

Lead Acid Batteries: Lead acid battery basics, Special characteristics of lead acid batteries, Battery life and maintenance, Battery charging, Summary Nickel-based Batteries: Introduction, Nickel cadmium, Nickel metal hydride batteries

UNIT III	SODIUM, LITHIUM AND METAL AIR BATTERIES	9

Sodium-based Batteries: Introduction, Sodium sulphur batteries, Sodium metal chloride (Zebra) batteriesLithium Batteries: Introduction, The lithium polymer battery, The lithium ion battery

Metal Air Batteries: Introduction, The aluminum air battery, The zinc air battery		
UNIT IV	**CHARGING INFRASTRUCTURE**	**9**
Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.		
UNIT V	**EV CHARGING**	**9**
Battery Chargers: Charge equalisation, Conductive (Basic charger circuits, Microprocessor based chargercircuit. Arrangement of an off-board conductive charger, Standard power levels of conductive chargersInductive (Principle of inductive charging, Soft-switching power converter for inductive charging),Battery indication methods		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the heating and cooling need in battery.

CO2: Illustrate the Battery charging methods.

CO3: Compare the different types of batteries.

CO4: Model the Battery Swapping Station.

CO5: Summarize the Standard power levels of conductive chargers.

TEXT BOOKS:

1.Husain, I. "Electric and Hybrid Vehicles" Boca Raton, 2nd Edition, CRC Press, 2010.
2. James Larminie, John Lowry, "Electric Vehicle Technology Explained", 2nd Edition, John Wiley & Sons Ltd, 2003.
3. C.C Chan, K.T Chau, "Modern Electric Vehicle Technology", 1st Edition, Oxford University Press Inc., New York 2001.
4. Guangjin Zhao, "Reuse and Recycling of Lithium-Ion Power Batteries", 1st Edition, John Wiley & Sons. 2017.

REFERENCES:

1. Arno Kwade, Jan Diekmann, "Recycling of Lithium-Ion Batteries: The LithoRec Way", 1st Edition, Springer, 2018.
2. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, "Thermal Management of Electric Vehicle Battery Systems", 1stEdition, JohnWiley& Sons Ltd., 2016.
3. G. Pistoia, J.P. Wiaux, S.P. Wolsky, "Used Battery Collection and Recycling", 1st Edition, Elsevier, 2001.
4. T R Crompton, "Battery Reference Book",3rd Edition, Newnes- Reed Educational and Professional Publishing Ltd., 2000.

21PEE29	TESTING OF ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain about the testing of electric vehicle.

- To summarize the static testing of vehicle
- To illustrate the dynamics testing of vehicle
- To interpret the vehicle component testing.
- To demonstrate the retro fitment and charging station.

UNIT I	**INTRODUCTION**	**9**
Specification & Classification of Vehicles (including M, N and O layout), Homologation & its Types, Regulations overview (EEC, ECE, FMVSS, AIS, CMVR), Type approval Scheme, Homologation for export, Conformity of Production, various Parameters, Instruments and Types of test tracks, Hardware in The Loop (HIL) concepts for EV/HEVs.		
UNIT II	**STATIC TESTING OF VEHICLE**	**9**
Photographs, CMVR physical verification, Tyre Tread Depth Test, Vehicle Weightment, Horn installation, Rear view mirror installation, Tell Tales, External Projection, Wheel Guard, Arrangement of Foot Controls for M1 Vehicle, Angle & Dimensions Measurement of Vehicle, The Requirement of Temporary Cabin For Drive– Away – Chassis, Electric vehicle – Safety Norms, Energy consumption and Power test.		
UNIT III	**DYNAMICS TESTING OF VEHICLE**	**9**
Hood Latch, Gradeability, Pass-by Noise, Interior Noise, Turning Circle Diameter & Turning Clearance Circle Diameter, Steering Effort, Constant Speed Fuel Consumption, Cooling Performance, Speedo-meter Calibration, Range Test, Maximum Speed, Acceleration Test, Coast-down test, Brakes Performance ABS Test, Broad band / Narrow band EMI Test, Electric vehicle – Range Test.		
UNIT IV	**VEHICLE COMPONENT TESTING**	**9**
Horn Testing, Safety Glasses Test: Windscreen laminated and toughened safety glass, Rear View Mirror Test, Hydraulic Brakes Hoses Fuel Tank Test: Metallic & Plastic, Hinges and Latches Test, Tyre & Wheel Rim Test, Bumper Impact Test, Side Door Intrusion, Crash test with dummies, Demist test, Defrost Test, Interior Fittings, Steering Impact test (GVW<1500 kg), Body block test, Head form test, Driver Field OfVision, Safety belt assemblies, Safety belt anchorages, Seat anchorages & head restraints test, AirbagTest, Accelerator Control System, Motor power, Safety Requirements of Traction Batteries, EMI-EMC(CI, BCI, RE,RI and CTE).		
UNIT V	**TESTS FOR HYBRID ELECTRIC VEHICLES, RETROFITMENT AND CHARGING STATION**	**9**
Hybrid Electric Vehicles Tests (M and N category), Tests for Hybrid Electric System Intended for Retrofitment on Vehicles of M and N Category (GVW < 3500 kg), Test for Electric Propulsion kit intended for Conversion, Test for Electric Vehicle Conductive AC Charging System, and Test for Electric vehicle conductive DC charging system.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES: At the end of the course, learners will be able to:		

CO1: Illustrate specification and classification of vehicles.
CO2: Interpret the various testing of EV.
CO3: Demonstrate the various dynamic tests of EV
CO4: Summarize the various component testing of EV.
CO5: Explain the various hybrid electric vehicle testing.

TEXT BOOKS:

1. Michael Plint& Anthony Martyr, "Engine Testing & Practice", 3rd Edition, Butterworth Heinmenn, 2007
2. Richard W. Carlson, "Testing and Analysis of Three Plug-in Hybrid Electric Vehicles", 1st Edition, SAE International,2007
3. M. Pozzi, "Testing of Electric Vehicles", 1st Edition, The University of Michigan,2016
4. Ronald K. Jurgen, "Electric and Hybrid-electric Vehicles", 1st Edition, SAE International,2011.

REFERENCES:

1. Bosch Automotive Handbook, 7thEdition,Robert Bosch, 2007.
2. Li Zhai, "Electromagnetic Compatibility of Electric Vehicle", 1st Edition, Springer Singapore,2021
3. Bruno Scrosati, JurgenGarche, Werner Tillmetz, "Advances in Battery Technologies for Electric Vehicles", 1st Edition, Elsevier Science,2015.
4. RuiXiong, "Battery Management Algorithm for Electric Vehicles", 1st Edition, Springer Singapore,2019.

21PEE30	RENEWABLE ENERGY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To summarize renewable energy sources.
- To illustrate the components and working principle of wind power plants.
- To explain the various types of solar thermal and solar PV systems.
- To interpret the biomass conversion and mini/micro hydro power plant.
- To outline the other types of renewable energy sources.

UNIT I	RENEWABLE ENERGY SOURCES	9

Environmental consequences of fossil fuel use, Importance of renewable sources of energy, Sustainable Design and development, Types of RE sources, Limitations of RE sources, Present Indian and international energy scenario of conventional and RE sources.

UNIT II	WIND ENERGY	9

Power in the Wind – Types of Wind Power Plants(WPPs)–Components of WPPs-Working of WPPs- Siting of WPPs-Grid integration issues of WPPs.

UNIT III	SOLAR PV AND THERMAL SYSTEMS	9

Solar Radiation, Radiation Measurement, Solar Thermal Power Plant, Central Receiver

Power Plants, Solar Ponds.- Thermal Energy storage system with PCM- Solar Photovoltaic systems : Basic Principle of SPV conversion – Types of PV Systems- Types of Solar Cells, Photovoltaic cell concepts: Cell, module, array ,PV Module I-V Characteristics, Efficiency & Quality of the Cell, series and parallel connections, maximum power point tracking, Applications.		
UNIT IV	**BIOMASS ENERGY**	**9**
Introduction-Bio mass resources –Energy from Bio mass: conversion processes-Biomass Cogeneration-Environmental Benefits. Geothermal Energy: Basics, Direct Use, Geothermal Electricity. Mini/micro hydro power: Classification of hydropower schemes, Classification of water turbine, Turbine theory, Essential components of hydroelectric system.		
UNIT V	**OTHER ENERGY SOURCES**	**9**
Tidal Energy: Energy from the tides, Barrage and Non Barrage Tidal power systems. Wave Energy: Energy from waves, wave power devices. Ocean Thermal Energy Conversion (OTEC)- Hydrogen Production and Storage- Fuel cell: Principle of working- various types - construction and applications. Energy Storage System- Hybrid Energy Systems.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Classify the various conventional energy sources

CO2: Illustrate the construction and working of wind power plants

CO3: Explain the knowledge of solar energy systems.

CO4: Interpret the basics of biomass conversion energy.

CO5: Outline the various renewable energy sources and their applications.

TEXT BOOKS:

1. Joshua Earnest, Tore Wizeliu, "Wind Power Plants and Project Development", 1st Edition PHI Learning Pvt.Ltd, New Delhi, 2011.
2. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2013.
3. Scott Grinnell, "Renewable Energy & Sustainable Design", 1st Edition, CENGAGE Learning, USA, 2016.
4. A.K. Mukerjee and Nivedita Thakur, "Photovoltaic Systems: Analysis and Design", 2nd Edition PHI Learning Private Limited, New Delhi, 2011.

REFERENCES

1. Richard A. Dunlap, "Sustainable Energy", 1st Edition, Cengage Learning India Private Limited, Delhi, 2015.
2. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", 2nd Edition, PHI Learning Private Limited, New Delhi, 2011
3. Godfrey Boyle, "Renewable Energy", Open University, 2nd Edition, Oxford University Press in association with the Open University, 2004.
4. A. Shunmugalatha, M. Devaki and R. Saranya, "Renewable Energy Systems", 1st Edition Technical Publication, 2020.

VERTICAL V: MODERN CONTROL TECHNOLOGIES

21PEE31	NON LINEAR CONTROL SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain state feedback control and state observer
- To illustrate phase plane analysis
- To summarize various function analysis
- To demonstrate the design and function of optimal controller.
- To outline the function of optimal estimator including Kalman Filter

UNIT I	STATE VARIABLE ANALYSIS	9

Introduction to state Model- effect of state Feedback- Necessary and Sufficient Condition for Arbitrary Pole-placement- pole placement Design- design of state Observers- separation principle- servo design: -State Feedback with integral control.

UNIT II	PHASE PLANE ANALYSIS	9

Features of linear and non-linear systems - Common physical non-linearities – Methods of linearization Concept of phase portraits – Singular points – Limit cycles – Construction of phase portraits – Phase plane analysis of linear and non-linear systems – Isocline method.

UNIT III	DESCRIBING FUNCTION ANALYSIS	9

Basic concepts, derivation of describing functions for common non-linearities – Describing function analysis of non-linear systems – limit cycles – Stability of oscillations.

UNIT IV	ANALYSIS OF NONLINEAR SYSTEMS	9

Periodic orbits - limit cycles-Poincare-Bendixson criterion-Bendixson criterion. Existence and uniqueness of solutions, Lipschitz condition.

UNIT V	STABILITY OF NONLINEAR SYSTEMS	9

Stability of Nonlinear Systems - Lyapunov stability - local stability - local linearization and stability in the small- Direct method of Lyapunov - generation of Lyapunov function for linear and nonlinear systems – variable gradient method.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Illustrate concepts of state variables and state model.

CO2: Explain linear and non-linear systems.

CO3: Summarize the concepts of phase plane method.

CO4: Outline the stability analysis by describing function method.

CO5: Demonstrate the function of Optimal state regulator.
TEXT BOOKS: 1. M.Gopal, "Digital Control and State Variable Methods", 4th Edition, McGraw Hill India, 2012 2. K. Ogata, "Modern Control Engineering", 5thEdition, Pearson publication, 2012 3. K. P. Mohandas, "Modern Control Engineering", 2nd Edition, Sanguine Technical Publishers, 2006 4. D.S.Naidu, "Optimal Control Systems" 1st Edition, CRC Press, 2009.
REFERENCES 1. M.Gopal, "Modern Control System Theory", 3rdEdition, New Age International Publishers, 2014. 2. William S Levine, "Control System Fundamentals", 1st Edition, The Control Handbook, CRC Press, 2011. 3. H. Marquez, 'Nonlinear Control Systems", Analysis and Design, 1st Edition Wiley, 2003. 4. A. Isidori, "Nonlinear Control Systems", 3rd Edition, Springer, 1995.

21PEE32	LOGIC AND DISTRIBUTED CONTROL SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the overview of automation technologies such as PLCs, SCADA and DCS used in industries.
- To summarize the basics of PLC Programming with ladder logic.
- To apply PLC controlled sequential process in PLC programming languages.
- To illustrate hardware architecture and types of distributed control system.
- To explain some of the advanced principles those are evolving for present and future automation.

UNIT I	**PLC & SCADA**	**9**
PLC: Evolutions of PLCs – Programmable Controllers – Architecture, I/O modules – Comparative study of Industrial PLCs. SCADA: Remote terminal units- Master station - Communication architectures.		
UNIT II	**BASICS OF PLC PROGRAMMING(LADDER)**	**9**
Basics of PLC programming – Ladder Logic – Relay type instructions – Timer/Counter instructions – Program control instructions – Data manipulation and math instructions – Programming Examples.		

UNIT III	PLC PROGRAMMING (OTHER LANGUAGES)	9
Functional block programming - Sequential function chart – Instruction list – Structured text programming – PLC controlled sequential Process Examples.		
UNIT IV	**DISTRIBUTED CONTROL SYSTEM**	**9**
DCS: Evolution & types – Hardware architecture – Field control station – Interfacing of conventional and smart field devices (HART and FF enabled) with DCS Controller – Communication modules – Operator and Engineering Human interface stations – Study of any one DCS available in market.		
UNIT V	**ADVANCED TOPICS IN AUTOMATION**	**9**
Introduction to Networked Control systems – Plant wide control – Internet of things – Cloud based Automation – OLE for Process Control – Safety PLC – Case studies: PLC - SCADA - DCS.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the important components such as PLC, SCADA, DCS, I/O modules and field devices of an industrial automation system.

CO2: Outline the various instructions in PLC programming with ladder logic

CO3: Develop PLC program in different languages for industrial sequential applications.

CO4: Show the most appropriate automation technologies for a given application.

CO5: Infer to gain knowledge on the recent developments in industrial automation.

TEXT BOOKS:

1. F.D. Petruzella, "Programmable Logic Controllers", 3rd Edition, Tata Mc-Graw Hill, 2010
2. Michael P. Lukas, "Distributed Control Systems: Their Evaluation and Design" , 1st Edition Van Nostrand Reinhold Co., 1986
3. D. Popovic and V.P.Bhatkar,' Distributed computer control for industrial Automation', 1st Edition, Marcel Dekker, Inc., Newyork, 1990.

REFERENCES

1. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3,4. 60870.5 and Related Systems", 1st Edition, Newnes, 2004.
2. Hughes, T.A., "Programmable Logic Controllers: Resources for Measurements and Control Series", 3rd Edition, ISA Press, 2004.
3. McMillan, G.K., "Process/Industrial Instrument and Controls Handbook", 5th Edition, McGraw- Hill handbook, New York, 1999.
4. NPTEL Notes on, "Programmable Logic Control System" by Department of Electrical Engg., IIT Kharagpur.

21PEE33	PROCESS MODELING AND SIMULATION	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To classify the mathematical models of simulation
- To interpret the linear and non-linear algebraic equations of Steady State Lumped systems.
- To explain the simulation of closed loop systems.
- To outline the concepts of Steady State Distributed System.
- To illustrate Unsteady State Distributed System & Other Modeling Approaches.

UNIT I	INTRODUCTIONTO MODELING AND SIMULATION	9
Introduction to modeling and simulation, classification of mathematical models, conservation equations and auxiliary relations.		
UNIT II	**STEADY STATE LUMPED SYSTEMS**	**9**
Degree of freedom analysis, single and network of process units, systems yielding linear and nonlinear algebraic equations, flow sheeting – sequential modular and equation oriented approach, tearing, partitioning and precedence ordering, solution of linear and non-linear algebraic equations.		
UNIT III	**UNSTEADY STATE LUMPED SYSTEMS**	**9**
Analysis of liquid level tank, gravity flow tank, jacketed stirred tank heater, reactors, flash and distillation column, solution of ODE initial value problems, matrix differential equations, simulation of closed loop systems.		
UNIT IV	**STEADY STATE DISTRIBUTED SYSTEM**	**9**
Analysis of compressible flow, heat exchanger, packed columns, plug flow reactor, solution of ODE boundary value problems.		
UNIT V	**UNSTEADY STATE DISTRIBUTED SYSTEM & OTHER MODELING APPROACHES**	**9**
Analysis laminar flow in pipe, sedimentation, boundary layer flow, conduction, heat exchanger, heat transfer in packed bed, diffusion, packed bed adsorption, plug flow reactor. Empirical modeling, parameter estimation, population balance and stochastic modeling.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the process models based on conservation principles.
CO2: Summarize the numerical methods for the solution of linear and non-linear algebraic equations of Steady State Lumped systems.
CO3: Outline the process data and computational technique.
CO4: Interpret the Steady State Distributed System.
CO5: Illustrate the steady State Distributed System & Other Modeling Approaches.

TEXT BOOKS:

1. Ramirez. W,“ Computational Methods in Process Simulation”, 2nd Edition, Butterworths Publishers, New York, 2000.
2. Luyben, W.L., “Process Modeling Simulation and Control”, 2nd Edition, McGraw-Hill Book Co., 1990.

3. C ´esar de Prada Constantinos Pantelides Jos ´e Luis Pitarch , ”Process Modeling and Simulation”, 1stEdition, MDPI Publication, 2019.
4. Bharat A. Bhanvase, Rajendra P. Ugwekar, “Process Modeling, Simulation, and environmental Applications in Chemical Engineering”, 1stEdition,Apple Academic Press, 2021.

REFERENCES:

1. Felder, R. M. and Rousseau, R. W., “Elementary Principles of Chemical Processes”, 1st Edition, John Wiley, 2000.
2. Franks, R. G. E., “Mathematical Modeling in Chemical Engineering “, 1st Edition, John Wiley, 1967.
3. Amiya K. Jana, “Process Simulation and Control Using ASPEN”, 2nd Edition, PHI Learning Ltd, 2012.
4. Amiya K. Jana, “Chemical Process Modeling and Computer Simulation” 2nd Edition, PHI Learning Ltd, 2012.

21PEE34	COMPUTER CONTROL OF PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the linear time invariant system in discrete State Space form.
- To explain about Digital controllers.
- To summarize the techniques of DAS, DDC, AI and SCADA.
- To Illustrate the System identification techniques.
- To outline about Multi-loop and multivariable controller for multivariable system.

UNIT I	ANALYSIS OF DISCRETE DATA SYSTEM	9

State-space representation of discrete data systems: Selection of sampling process – Selection of sampling period – Review of z-transform – Pulse transfer function – Modified z-transform - Stability of discrete data system – Jury’s stability test.

UNIT II	DESIGN OF DIGITAL CONTROLLER	9

Digital PID – Position and velocity form – Deadbeat’s algorithm – Dahlin’s algorithm – Kalman’s algorithm - Pole placement controller – Predictive controller.

UNIT III	COMPUTER AS A CONTROLLER	9

Basic building blocks of computer control system – Data acquisition systems – SCADA – Direct digital control – Introduction to AI and expert control system – Case study - Design of computerized multi loop controller.

UNIT IV	SYSTEM IDENTIFICATION	9

Non Parametric methods: Transient Analysis, Frequency analysis, Correlation analysis, Spectral analysis. Parametric methods: Least Square method, Recursive least square method.

UNIT V	MULTI LOOP REGULATORY CONTROL	9
Multi-Loop Control: Introduction, Process Interaction, Pairing of Input and Outputs, Relative Gain Array (RGA) - Properties and Application of RGA, Multi-loop PID Controller – Decoupler.		
	TOTAL: 45 PERIODS	

COURSEOUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the analysis of discrete data system.

CO2: Summarize various digital control algorithms.

CO3: Classify the techniques of DAS, DDC, AI and SCADA.

CO4: Outline the models from Input-Output data.

CO5: Illustrate Multi-loop and multivariable controller for multivariable system.

TEXT BOOKS

1. P.B. Deshpande, and R.H.Ash, “Computer Process Control”, 1st Edition, ISA Publication, USA, 1995.
2. SigurdSkogestad, Ian Postlethwaite, “Multivariable Feedback Control: Analysis and Design”, 1st Edition, John Wiley and Sons, 2005.

3.Nagaraj B, “Computer Control of Process”, Anuradha Agencies, 1st Edition, Technical Publishers, 2018.

3. John Peschon, Lucas Pun, Sanjay K.Mitter , “Computer Process Control” , 1st Edition, MIT Publications,2007.

REFERENCES

1.C.M.Houpis, G.B.Lamount, “Digital Control Systems Theory, Hardware and Software”, International Student Edition, McGraw Hill Book Co., 1985.

2. G. Stephanoupoulis, “Chemical Process Control”, 1st Edition, Prentice Hall of India, New Delhi, 1990.

3. Singh, “Computer Aided Process Control”, 1st Edition, Prentice Hall of India, 2004.

4.M. Chidambaram, “Computer Control of Processes”, 1st Edition, Narosa Publication, 2006.

21PEE35	SYSTEM MODELLING AND IDENTIFICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the mathematical modeling of systems.
- To explain systems by their behavior using parametric identification methods using online and offline data.
- To demonstrate systems by their behavior using nonparametric identification methods using online and offline data.

- To outline the data using parametric and recursive estimation methods.
- To summarize the case studies on electromechanical and process control systems.

UNIT I	**NONPARAMETRIC IDENTIFICATION**	**9**
Transient and frequency analysis methods, impulse and step response methods, correlation method, spectral analysis.		
UNIT II	**PARAMETRIC INDENTIFICATION**	**9**
Steps in identification process, determining model structure and dimension, Linear and nonlinear model structures (ARX, ARMAX, Box-Jenkins, FIR, Output Error models), Input signals: commonly used signals, spectral properties, and persistent excitation, Residual analysis for determining adequacy of the estimated models.		
UNIT III	**MODEL REFERENCE ADAPTIVE CONTROLLER**	**9**
The MIT rule – Lyapunov theory – Design of model reference adaptive controller using MIT rule and Lyapunov theory – Relation between model reference adaptive controller and self-tuning regulator.		
UNIT IV	**PARAMETRIC ESTIMATION**	**9**
Linear regression, least square estimation, statistical analysis of LS methods, Minimizing prediction error- identifiability, bias, Least squares, relation between minimizing the prediction error and the MLE, MAP, Convergence and consistency, asymptotic distribution of parameter estimates, Instrumental Variable Method.		
UNIT V	**CASE STUDIES**	**9**
Electro Mechanical Systems, Process Control Systems using Matlab/Equivalent System Identification Toolbox		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1:Summarize different model structures, parameterization, identifiability, structure determination and order estimation.

CO2: Explain parameter estimation using different identification techniques.

CO3: Interpret the asymptotic distribution of parameter estimates, Instrumental Variable Method.

CO4: Illustrate the accuracy and precision of Recursive Estimation model.

CO5: Compare design choices to arrive at a validated model.

TEXT BOOKS:

1. Jung, L.,"System Identification: Theory for the User", 2nd Edition, Prentice-Hall, 1999.
2. TorstenSoderstrom, PetreStoica, "System Identification", 1st Edition, Prentice Hall International, 1989.
3. Karel J. Keesman, "System Identification, An introduction", 1st Edition, Springer, 2011.

4. Johan Schoukens, "Mastering System Identification in 100 Exercises", 1st Edition, Wiley-IEEE Press, 2012.
REFERENCES 1. Zhu, Y., "Multivariable System Identification for Process Control", 1st Edition, Pergamon publishing, 2001. 2. Landan ID, "System Identification and Control Design," 1st Edition, Prentice Hall, 1990. 3. ArunK.Tangirala, "Principles of System Identification: Theory and Practice", 1st Edition, CRC Press,2014. 4. Rik Pintelon Johan Schoukens, "System Identification", 2nd Edition, Wiley-IEEE Press, 2012.

21PEE36	**PROCESS CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES: • To illustrate technical terms and nomenclature associated with Process control domain • To explain sizing of control valves with their characteristics and selection • To demonstrate an overview of the features associated with Industrial type PID controller • To compare various PID tuning methods • To show various types of control schemes such as cascade control, feed forward control and Model Based control schemes					
UNIT I	**PROCESS MODELLING AND DYNAMICS**				**9**
Need for process control – Mathematical Modeling of Processes: Level, Flow, Pressure and Thermal processes – Continuous and batch processes – Self regulation – Servo and regulatory operations – Lumped and Distributed parameter models – Heat exchanger – CSTR –Linearization of nonlinear systems.					
UNIT II	**FINAL CONTROL ELEMENTS**				**9**
Actuators: Pneumatic and electric actuators – Control Valve Terminology - Characteristic of Control Valves: Inherent and Installed characteristics - Valve Positioner – Modeling of a Pneumatically Actuated Control Valve – Control Valve Sizing: ISA S 75.01 standard flow equations for sizing Control Valves – Cavitation and flashing – Control Valve selection					
UNIT III	**CONTROL ACTIONS**				**9**
Characteristic of ON-OFF, Proportional, Single speed floating, Integral and Derivative controllers–P+I, P+D and P+I+D control modes – Practical forms of PID Controller – PID Implementation					

Issues: Bumpless, Auto/manual Mode transfer, Anti-reset windup Techniques – Direct/reverse action.		
UNIT IV	**PID CONTROLLER TUNING**	**9**
PID Controller Design Specifications: Criteria based on Time Response and Criteria based Frequency Response - PID Controller Tuning: Z-N and Cohen-Coon methods, Continuous cycling method and Damped oscillation method, optimization methods, Auto tuning – Cascade control – Feed-forward control		
UNIT V	**MODEL BASED CONTROL SCHEMES**	**9**
Smith Predictor Control Scheme - Internal Model Controller – IMC PID controller – Three element Boiler drum level control - Introduction to Multi-loop Control Schemes – Control Schemes for CSTR, and Heat Exchanger - P&ID diagram		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1:Explain about Process Modelling And Dynamics

CO2:Summarize the operation of final control elements

CO3:Demonstrate the Characteristic of PID controller

CO4:Illustrate the Specifications of PID tuning methods

CO5:Explain Model Based control schemes

TEXT BOOKS:

1. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, 2nd Edition, Wiley publication, 2003.
2. Bequette, B.W., “Process Control Modeling, Design and Simulation”, 2nd Edition, Prentice Hall of India, 2004.
3. Stephanopoulos, G., “Chemical Process Control An Introduction to Theory and Practice”, 1st Edition, Prentice Hall of India, 2005.
4. Johan Schoukens, “Mastering System Identification in 100 Exercises”, 1st Edition, Wiley-IEEE Press

REFERENCES

1. Ramesh C. Panda., T.Thyagarajan., “An Introduction to Process Modelling Identification and Control for Engineers”, 1st Edition, Narosa Publishing, 2017.
2. Coughanowr D.R., “Process Systems Analysis and Control”, 1st Edition, McGraw Hill International, 2004.
3. Curtis D. Johnson, “Process Control Instrumentation Technology”, 8th Edition, Pearson, 2006.
4. Considine, D.M., “Process Instruments and Controls Handbook”, 2nd Edition, McGraw Hill, 1999.

21PEE37	ROBOTICS AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basics of robotics
- To illustrate homogeneous transformation in robots
- To outline kinematic analysis of robots
- To demonstrate the robot machine vision system in robotic motion control.
- To relate independent joint control of robot dynamics

UNIT I	INTRODUCTION TO ROBOTS	9
Types of robots, Degrees of freedom of robots, Robot configurations and concept of workspace, End effectors and Different types of grippers, vacuum and other methods of gripping. Pneumatic, hydraulic and electrical actuators, applications of robots, specifications of different industrial robots.		
UNIT II	**RIGID MOTION AND HOMOGENEOUS TRANSFORMATION**	**9**
Coordinate frames. Different orientation descriptions. Free vectors. Translations rotations and relative motion, Composition of rotation, rotation with respect to fixed frame and current frame, parameterisation of rotation, Euler Angele, roll, pitch, yaw, axis/angle representation, Homogeneous transformation		
UNIT III	**FORWARD KINEMATICS**	**9**
Link coordinate frames. Denavit-Hartenberg convention. Assignment, of coordinate frame, Joint and end effector Cartesian space. Calculation of DH parameters and forward kinematic equation of different configuration of manipulator, Planner elbow manipulator, Cylindrical three link, SCARA, Spherical Wrist and other configuration..		
UNIT IV	**ROBOT MACHINE VISION AND SENSOR**	**9**
Sensors and sensor based system in robotics: Machine vision system, Description, Sensing, Digitizing, Image processing, Analysis and application, Robotic assembly sensors, Intelligent sensors		
UNIT V	**INDEPENDENT JOINT CONTROL**	**9**
Actuator dynamics, Set point tracking Feed forward control, Drive Train dynamics. Introduction to force control and multivariable control.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Illustrate basic concepts of robot configuration and different methods of gripping.
CO2: Explain Translations rotations and relative motion of robots.
CO3: Relate the forward kinematic equation of different manipulators.
CO4: Show the sensing and image processing by means of robots.

CO5: Summarize the drive train dynamics.

TEXT BOOKS:

1. M.W. Spong, S. Hutchinson, and M. Vidyasagar, “Robot Modeling and Control”, 2^{nd}Edition, Wiley publication, 2020.
2. J.J. Craig, “Introduction to Robotics: Mechanics and Control”, 4^{th}Edition, Pearson Education, 2017.
3. M.P. Groover, “Industrial Robots: Technology, Programming and applications”, 2^{nd} Indian Edition, McGraw Hill, 2012.
4. Kevin M. Lynch, Frank C. Park, “Modern Robotics: Mechanics, Planning, and Control”, 1^{st}Edition, Cambridge University Press, 2017.

REFERENCES

1. Etienne Dombre; Wisama Khalil, Somerset, “Robot Manipulators : Modeling, Performance Analysis and Control”, 1^{st}Edition, Wiley publications, 2013
2. M.O. Tokhi, A.K.M. Azad, “Flexible robot manipulator: modelling, simulation and control” 2^{nd}Edition, The Institution of Engineering and Technology, 2017.
3. Ashitava Ghosal, “Robotic fundamental Concept and Analysis”, 11^{th} impression, Oxford University Press, 2015.
4. Saeed B. Niku, “Introduction to Robotics: Analysis, Control, Applications”, 3^{rd} Edition, Wiley publication, 2020

VERTICAL – VI: INDUSTRIAL SYSTEMS

21PEE38	NANOMATERIALS FOR ENERGY HARVESTING APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the various types of energy harvesting and storage applications
- To outline the methods of hydrogen energy generation
- To summarize the key challenges in choosing nanogenerators
- To explain the conventional energy generation techniques
- To show the various nanomaterials used for energy storage

UNIT I	**INTRODUCTION**	**9**

Criteria for choosing the nanomaterials for energy harvesting and storage applications, Brief discussion about all types of energy harvesting and storage systems, Solar energy, Nanomaterials used for solar energy, Types of solar energy, Solar thermal and heat transfer fluids with example.

UNIT II	**HYDROGEN ENERGY**	**9**

Introduction, Nanomaterials used for hydrogen energy generation, Methods to produce hydrogen energy, Hydrogen production from fossil fuels and biomass, thermo-chemical process, electrolysis, solar and biological, Key Challenges for hydrogen energy generation.

UNIT III	**NANOGENERATORS**	**9**

Introduction, Types of Nanogenerators: Piezoelectric, Thermoelectric, Pyro-electric, Electromagnetic, and Triboelectric, Key challenges for choosing nanomaterials for nanogenerators.

UNIT IV	**CONVENTIONAL ENERGY GENERATION TECHNIQUES**	**9**

Wind energy, Tidal, Thermal, hydro power generation, Nuclear and geothermal energy production.

UNIT V	**ENERGY STORAGE**	**9**

Nanomaterials used for energy storage, key challenges for energy storage, Solution of key challenges, Type of energy storages: Electrochemical (Batteries), Supercapacitor, Hydrogen storage, Thermal energy storage.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the need for energy harvesting and storage applications

CO2: Outline the various techniques used in hydrogen energy generation

CO3: Summarize the nanogenerators types used for energy generation.

CO4: Interpret the challenges in conventional energy generation techniques

CO5: Classify the various types nanomaterials used for energy storage

TEXT BOOKS:

1. Losito, Onofrio, Mescia, Luciano, Prudenzano, Franceso, "Innovative materials and systems for energy harvesting applications",1st Edition, Engineering Science Reference,

IGI Global, 2015.

2. Hyunuk Kim, Yonas Tadesse, Shashank Priya, “Energy Harvesting Technologies”, 1st Edition, Springer, 2009.
3. Alireza Khaligh, Omer C. Onar, “Energy Harvesting: Solar, Wind, and Ocean Energy Conversion Systems (Energy, Power Electronics, and Machines)”, 1st Edition, CRC Press, 2009.
4. Alper Erturk, Daniel J. Inman, “Piezoelectric Energy Harvesting”, 1st Edition, Wiely, 2011.

REFERENCES

1. Niell Elvin, Alper Erturk, “Advances in Energy Harvesting Methods”, 1st Edition, Springer-Verlag New York, 2013.
2. Dibin Zhu, Steve Beeby, “Energy Harvesting Systems: Principles, Modeling and Applications”, 1st Edition, Springer-Verlag New York, 2011.
3. Zekai Şen, “Solar Energy Fundamentals and Modeling Techniques: Atmosphere, Environment, Climate Change and Renewable Energy”, 1st Edition, Springer-Verlag London, 2008.
4. Weidong Xiao, “Photovoltaic Power System: Modeling, Design, and Control”, 1st Edition, Wiley, 2017.

21PEE39	ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the need for energy storage systems
- To explain the structure of thermal storage systems
- To summarize the various concepts of chemical storage system
- To classify the various electromagnetic storage system
- To interpret the working of electrochemical storage system

UNIT I	ENERGY STORAGE SYSTEMS OVERVIEW	9

Scope of energy storage, needs and opportunities in energy storage, Technology overview and key disciplines, comparison of time scale of storages and applications, Energy storage in the power and transportation sectors. Importance of energy storage systems in electric vehicles, Current electric vehicle market.

UNIT II	THERMAL STORAGE SYSTEM	9

Heat pumps, hot water storage tank, solar thermal collector, application of phase change materials for heat storage-organic and inorganic materials, efficiencies, and economic evaluation of thermal energy storage systems.

UNIT III	CHEMICAL STORAGE SYSTEM	9

Hydrogen, methane , concept of chemical storage of solar energy, application of chemical energy

storage system, advantages and limitations of chemical energy storage, challenges, and future prospects of chemical storage systems.		
UNIT IV	**ELECTROMAGNETIC STORAGE SYSTEMS**	**9**
Double layer capacitors with electrostatically charge storage, superconducting magnetic energy storage (SMES), concepts, advantages and limitations of electromagnetic energy storage systems, and future prospects of electrochemical storage systems.		
UNIT V	**ELECTROCHEMICAL STORAGE SYSTEM**	**9**
Batteries-Working principle of battery, primary and secondary (flow) batteries, battery performance evaluation methods, major battery chemistries and their voltages- Li-ion battery &Metal hydride battery vs lead-acid battery. Supercapacitors: Working principle of supercapacitor, types of supercapacitors, cycling and performance characteristics, difference between battery and supercapacitors, Introduction to Hybrid electrochemical super capacitors. Fuel cell: Operational principle of a fuel cell, types of fuel cells, hybrid fuel cell-battery systems and hybrid fuel cell-supercapacitor systems.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the opportunities for energy storage systems

CO2: Interpret the efficiency of thermal storage systems

CO3: Outline the various applications of chemical storage system

CO4: Summarize the merits and demerits of electromagnetic storage system

CO5: Classify the various electrochemical storage system

TEXT BOOKS:

1. Dr. Satyender Singh, “Energy Storage Systems: An Introduction” Nova Publisher, 1st Edition, 2020.
2. Luisa Cabeza, “Advances in Thermal Energy Storage Systems-Methods and Applications”, 2nd Edition, Woodhead Publishing Series in Energy, 2020.
3. Klaus Brun , Timothy C. Allison, “Thermal, Mechanical, and Hybrid Chemical Energy Storage Systems”, 1st Edition, Academic Press Inc, November 2020.
4. Slobodan Petrovic , “Battery Technology Crash Course: A Concise Introduction”, 1st Edition, Springer, 2021.

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1. Slobodan Petrovic, “Electrochemistry Crash Course for Engineers “1st Edition, Springer, 2021
2. V. K. Mathew, Tapano Kumar Hotta, Hafiz Muhammad Ali, Senthilarasu Sundaram, “Energy Storage Systems: Optimization and Applications”, 1st Edition, Springer, 2022.
3. Igor V. Barsukov, Christopher S. Johnson , “New Carbon Based Materials for Electrochemical Energy Storage Systems”, 1st Edition, NATO Science Series, 2006.
4. B. K. Middleton, M. M. Aziz, “Magnetic Storage Systems Beyond 2000”, 1st Edition, Springer Netherlands, 2001.

21PEE40	INDUSTRIAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain different methods used for measuring force, torque and speed
- To classify the vibration, acceleration and density measurement instruments
- To summarize the types of viscosity and humidity measurement system
- To outline the temperature sensor selection criteria
- To show techniques used for pressure and vacuum measurement

UNIT I	MEASUREMENT OF FORCE, TORQUE AND SPEED	9

Different types of load cells: Hydraulic, Pneumatic, Strain gauge, Magneto-elastic and Piezoelectric load cells – Different methods of torque measurement: Strain gauge, Relative angular twist. Sped measurement: Capacitive tacho, Drag cup type tacho, D.C and A.C tacho generators – Stroboscope.

UNIT II	MEASUREMENT OF ACCELERATION, VIBRATION AND DENSITY	9

Accelerometers: LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers – Mechanical type vibration instruments – Seismic instruments as accelerometer – Vibration sensor – Calibration of vibration pickups – Units of density and specific gravity – Baume scale and API scale – Densitometers: Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer.

UNIT III	MEASUREMENT OF VISCOSITY, HUMIDITY AND MOISTURE	9

Viscosity: Saybolt viscometer – Rotameter type and Torque type viscometers – Consistency Meters – Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Commercial type dew meter. Moisture: Different methods of moisture measurements –Thermal, Conductivity and Capacitive sensors, Microwave, IR and NMR sensors, Application of moisture measurement – Moisture measurement in solids.

UNIT IV	TEMPERATURE MEASUREMENT	9

Definitions and standards – Primary and secondary fixed points – Different types of filed in system thermometers – Sources of errors in filed in systems and their compensation – Bimetallic thermometers – IC sensors – Thermocouples: Laws of thermocouple, Fabrication of industrial thermocouples, Reference junctions compensation, Signal conditioning for thermocouple, Commercial circuits for cold junction compensation.

UNIT V	PRESSURE MEASUREMENT	9

Units of pressure – Manometers: Different types, Elastic type pressure gauges: Bourdon tube, Bellows, Diaphragms and Capsules – Electrical methods: Elastic elements with LVDT and strain gauges – Capacitive type pressure gauge – Piezo resistive pressure sensor-Resonator pressure sensor – Pressure gauge selection, installation and calibration using dead weight ester.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to: CO1: Show the various methods used for measurement of force, torque and speed CO2: Summarize the operating principle of vibration, acceleration and density measurement CO3: Outline working of viscosity, moisture and humidity measurement instrument CO4: Classify the devices used for temperature sensing CO5: Explain the various methods used for pressure and vacuum measurement
TEXT BOOKS: 1. Doebelin, E.O. and Manik, D.N., "Measurement systems Application and Design", 6th Edition, McGraw-Hill Education Pvt. Ltd, 2011. 2. Jones, B.E., "Instrument Technology", Vol.2, International Edition, 1st Edition, Butterworth-Heinemann, 2003 3. Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", 1st Edition, CRC Press, 2005. 4. Patranabis, D., "Principles of Industrial Instrumentation", 3rd Edition, McGraw-Hill Education, 2017.
REFERENCES 1. Eckman D.P., "Industrial Instrumentation", 1st Edition, Wiley Eastern Limited, 1990. 2. Singh,S.K., "Industrial Instrumentation and Control", 1st Edition, Tata Mc-Graw-Hill Education Pvt. Ltd., New Delhi,2009. 3. A.K. Sawhney, "A Course in Electronic Measurements and Instrumentation", 1st Edition, Dhanpat Rai& Co. (P) Limited, 2015. 4. Jain, R.K., Mechanical and Industrial Measurements, 1st Edition, Khanna Publishers, Delhi, 1999.

21PEE41	**INDUSTRIAL ELECTRICAL AND ELECTRONICS ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES: • To outline the performance of manufacturing engineering systems • To illustrate the basic subsystems and sequence of SPM and GPM machines • To explain the architecture of Industrial machine controllers • To interpret efficient industrial design for all modern requirements • To summarize PLC module configuring					
UNIT I	**MANUFACTURING ENGINEERING SYSTEM**				**9**
Batch, Cell concept, Individual part flow, Takt time, Process Time, Lead time, Cycle time, Overall Equipment Effectiveness (OEE), Process Flow diagram, Lean manufacturing technique and Six sigma overview					
UNIT II	**SUBSYSTEMS OF SPECIAL PURPOSE MACHINE (SPM)/GENERAL PURPOSE MACHINE (GPM)**				**9**

Basic Subsystems of a machine - Base & Columns, Fixture, Tooling's, Spindle, Slide ways, Hydraulics, Pneumatics, Lubrication, Cladding & Auto door, Coolant & Chip tray. Electrical - Control Cabinet, Servo drives, Operator console, Human machine interface (HMI)/Man Machine Interface (MMI).		
UNIT III	**OPERATING MODES OF SPM/GPM**	**9**
Auto cycle sequence - Auto Door movement, component clamp/de-clamp, Slide feed, Axes interpolation in a computer numerical control(CNC) machine, Automatic Tool Change, Metal cutting at regulated rpm, Cutting coolant and bed coolant. Safety interlocks- Levels of safety, redundancy levels and poka yoke used in machining process & power saving techniques.		
UNIT IV	**ARCHITECTURE OF MACHINE CONTROLLERS**	**9**
Sensors & transducers, Actuators, Relays, contactor, power supply, fuse, Isolator, Miniature Circuit Breaker. MCCB – Molded Case Circuit Breaker. ELCB – Earth Leakage Circuit Breaker, Controlling Induction motor from VFD, Servomotor& Servo drives, Encoders, Operator panel elements (Push button, Selector switch, lamp, HMI etc), PLC & CNC controllers. I/O assignment - Addressing Digital I/O, Analogue I/O & counter inputs for a machine based on application. Selection of elements for application control - PLC/CNC controller, HMI/MMI, sensors, transducers, actuators, motors, drives, Circuit breakers, power supply, relays, cables, Earthing/shielding of measuring equipment		
UNIT V	**PROGRAMMABLE LOGIC CONTROLLER / COMPUTERIZED NUMERICAL CONTROL**	**9**
Configuring PLC modules using ladder, Bit, Byte & words, addressing digital I/O signals, Concept of NO/NC elements, coils, flags, Boolean operation, AND/OR/NOT, Pulse triggered execution, serial, parallel and latch execution sequence, Relays, Counter, Timers, Registers, Mathematical and logical instructions, building tags. Addressing analogue I/Os in Ladder, Programming an analogue I/O block, Read/Write functions, Programming an encoder using counter block, Compare functions Examples of very commonly used safety logics/techniques, building poka yoke in ladder using peripheral sensors, power saving techniques.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Summarize the process flow diagram, Lean manufacturing technique and Six sigma.

CO2: Interpret the various subsystems of SPM and GPM machines.

CO3: Outline the need for control of safety devices in industrial machine controllers.

CO4: Explain the selection of elements for application control.

CO5: Illustrate the process of controlling machine using PLC.

TEXT BOOKS:

1. Black, J. T., Hunter, Steve L., "Lean Manufacturing Systems and Cell Design", 1st Edition, Society of Manufacturing Engineers (SME), 2003.
2. Frank Voehl, H. James Harrington, Chuck Mignosa, Rich Charron, "The Lean Six Sigma Black Belt Handbook: Tools and Methods for Process Acceleration", 1st Edition, Productivity Press, 2013.
3. W. Bolton, "Programmable Logic Controllers", 1st Edition, Newnes imprint of Elsevier,

2006. 4. Frank D. Petruzella, "Programmable Logic Controllers", 4th Edition McGraw-Hill, 2011.
REFERENCES 1. Alan Overby, "CNC Machining Handbook: Building, Programming, and Implementation", 1st Edition, McGraw-Hill TAB Electronics, 2010. 2. Edward Ford, "Getting Started with CNC: Personal Digital Fabrication with Shapeoko and Other Computer-Controlled Routers", 1st Edition, Maker Media, Inc, 2016. 3. Suk-Hwan Suh, Seong Kyoon Kang, Dae-Hyuk Chung, Ian Stroud, "Theory and Design of CNC Systems", 1st Edition, Springer-Verlag London, 2008. 4. Kandray, Daniel E., "Programmable Automation Technologies - An Introduction to CNC, Robotics and PLCs", 1st Edition, Industrial Press, 2010.

21PEE42	ANALYTICAL INSTRUMENTATION	L	T	P	C
		3	0	0	3
COURSE OBJECTIVES: • To explain the construction of spectrometry • To classify chromatography and its applications • To summarize the instruments used as gas analyzer and pollution detector • To interpret the method for pH and conductivity measurement • To outline the types of mass spectrometry.					
UNIT I	**SPECTROPHOTOMETRY**				**9**
Spectral methods of analysis – Beer-Lambert law – UV-Visible spectroscopy – IR Spectrophotometry - FTIR spectrophotometry – Atomic absorption spectrophotometry - Flame emission and atomic emission photometry – Construction, working principle, sources detectors and applications.					
UNIT II	**CHROMATOGRAPHY**				**9**
General principles – classification – chromatographic behavior of solutes – quantitative determination – Gas chromatography – Liquid chromatography – High-pressure liquid chromatography – Applications.					
UNIT III	**INDUSTRIAL GAS ANALYZERS AND POLLUTION MONITORING INSTRUMENTS**				**9**
Gas analyzers – Oxygen, NO2 and H2S types, IR analyzers, thermal conductivity detectors, analysis based on ionization of gases. Air pollution due to carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide estimation - Dust and smoke measurements					
UNIT IV	**pH METERS AND DISSOLVED COMPONENT ANALYZERS**				**9**
Selective ion electrodes - Principle of pH and conductivity measurements - dissolved oxygen analyzer – Sodium analyzer – Silicon analyzer – Water quality Analyzer.					
UNIT V	**NUCLEAR MAGNETIC RESONANCE AND MASS**				**9**

	SPECTROMETRY	

NMR – Basic principles – Continuous and Pulsed Fourier Transform NMR spectrometer – Mass Spectrometry – Sample system – Ionization methods – Mass analyzers – Types of mass spectrometry.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Outline the various spectral method of analysis

CO2: Summarize the working of chromatography

CO3: Interpret the dust and smoke detection using gas analyzer

CO4: Classify different methods for pH and conductivity measurement

CO5: Explain the basic principle of mass spectrometry.

TEXT BOOKS:

1. Willard, H.H., Merritt, L.L., Dean, J.A., Settle, F.A., "Instrumental Methods of Analysis", 7thEdition, CBS publishing & distribution, 2012.
2. Braun, R.D., "Introduction to Instrumental Analysis", 1stEdition, Pharma Book Syndicate, 2006.
3. Robert E. Sherman., "Analytical Instrumentation", 1st Edition, Instruments Society of America, 1996.
4. A.K. Sawhney, "A Course in Electronic Measurements and Instrumentation", 1st edition, Dhanpat Rai& Co. (P) Limited, 2015.

REFERENCES

1. Khandpur, R.S., "Handbook of Analytical Instruments", 2nd Edition, Tata McGraw-Hill publishing Co. Ltd., 2007.
2. Ewing, G.W., "Instrumental Methods of Chemical Analysis", 5th Edition, McGraw-Hill, reprint 1985. (Digitized in 2007).
3. Liptak, B.G., "Process Measurement and Analysis", CRC Press, 5th Edition, 2015.
4. Doebelin, E.O. and Manik, D.N., "Measurement systems Application and Design", 6th Edition, McGraw-Hill Education Pvt. Ltd, 2011.

21PEE43	SOFT COMPUTING TECHNIQUES AND APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To show the architecture of biological and artificial neuron model
- To explain the role of neural networks for control
- To outline the process of fuzzification and defuzzification system

- To summarize the various applications of fuzzy logic systems
- To interpret the steps in genetic algorithm

UNIT I	**ARCHITECTURES –ARTIFICIAL NEURAL NETWORKS**	**9**
Introduction – Biological neuron – Artificial neuron – Neuron model – Supervised and unsupervised learning- Single layer – Multi layer feed forward network – Learning algorithm-Back propagation network.		
UNIT II	**NEURAL NETWORKS FOR CONTROL**	**9**
Feedback networks – Discrete time Hopfield networks – Transient response of continuous time system – Applications of artificial neural network - Process identification – Neuro controller for inverted pendulum.		
UNIT III	**FUZZY SYSTEMS**	**9**
Classical sets – Fuzzy sets – Fuzzy relations – Fuzzification – Defuzzification – Fuzzy rules - Membership function – Knowledge base – Decision-making logic – Introduction to neuro fuzzy system- Adaptive fuzzy system		
UNIT IV	**APPLICATION OF FUZZY LOGIC SYSTEMS**	**9**
Fuzzy logic control: Home heating system - liquid level control - aircraft landing- inverted pendulum– fuzzy PID control, Fuzzy based motor control.		
UNIT V	**GENETIC ALGORITHMS**	**9**
Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters-Solution of typical control problems using genetic algorithm- Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Interpret the difference between supervised and unsupervised learning network.

CO2: Outline the applications of artificial neural network

CO3: Explain fuzzy rule and membership functions

CO4: Summarize the fuzzy logic control made in various applications

CO5: Show the various applications of genetic algorithm

TEXT BOOKS:

1. Laurance Fausett, Englewood Cliffs, N.J., “Fundamentals of Neural Networks”, 1st Edition, Pearson Education, 1992.
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, 3rd Edition, Tata McGraw Hill, 2010.
3. S.N.Sivanandam and S.N.Deepa, “Principles of soft computing”, 2nd Edition, Wiley India Edition, 2013.
4. M.Gen and R,Cheng, “Genetic algorithms and optimization”, 1st Edition, Wiley Series in Engineering Design and Automation, 2000.

REFERENCES

1. N.P. Padhy and S.P. Simon, “Soft computing with MATLAB programming”, 1st Edition,

Oxford publishers, 2015.

2. John Yen & Reza Langari, "Fuzzy Logic – Intelligence Control & Information", 1st Edition, Pearson Education, 2003.
3. Hagan, Demuth, Beale, "Neural Network Design", 1st Edition, Cengage Learning, 2012.
4. William S.Levine, "Control System Advanced Methods," 2nd Edition, The Control Handbook CRC Press, 2010.

21PEE44	DESIGN OF ELECTRICAL INSTALLATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the purpose of cost estimation in electrical installation
- To classify wiring system for domestic and industrial applications
- To explain the procedure for electrical layout in domestic application
- To outline the steps involved in preparing electrical layout for industrial application
- To show the procedure for electrical motor installation

UNIT I	INTRODUCTION	9

Purpose of estimating and costing, proforma for making estimates, preparation of materials schedule, costing, price list, tender document, net price list, market survey, overhead charges, labor charges, electrical point method and fixed percentage method, contingency, profit, purchase system, enquiries, comparative statements, orders for supply, payment of bills. Tenders – its constituents, finalization, specimen tender.

UNIT II	TYPES OF WIRING	9

Cleat, batten, casing capping and conduit wiring, comparison of different wiring systems, selection and design of wiring schemes for particular situation (domestic and Industrial).Selection of wires and cables, wiring accessories and use of protective devices i.e. MCB, ELCB etc. Use of wire-gauge and tables (to be prepared/arranged)

UNIT III	ESTIMATING AND COSTING DOMESTIC INSTALLATIONS	9

Standard practice as per IS and IE rules. Planning of circuits, sub-circuits and position of different accessories, electrical layout, preparing estimates including cost as per schedule rate pattern and actual market rate

UNIT IV	ESTIMATING AND COSTING INDUSTRIAL INSTALLATIONS	9

Relevant IE rules and IS standard practices, planning, designing and estimation of installation for single phase motors of different ratings, electrical circuit diagram, starters, preparation of list of materials, estimating and costing exercises on workshop with single phase, 3-phase motor load and the light load (3-phase supply system), Service line connections estimate for domestic and Industrial loads (over-head and Under- ground connections) from pole to energy meter.

UNIT V	INSTALLATION PLAN	9

Installation plan, single line diagram and prepare the estimate of cost and list of material for the following 2HP 3-phase Induction Motor for screw milling machine, 3HP 3-phase Induction Motor for small lathe, 5HP 3-phase Induction Motor for milling machine, One 1HP 3-phase Induction Motor for grinder Installation plan, single line diagram and prepare the estimate of cost and list of material for the following machinery.5, 3, 1, 1/2 HP 3-Phase 400v Induction Motor.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Show the various types of estimation methods in electrical installation.

CO2: Outline the selection process of wires and cables.

CO3: Explain the estimate preparation of domestic installations.

CO4: Classify the IE rules and IS standard in industrial installations.

CO5: Interpret the procedure for electrical motor installation.

TEXT BOOKS:

1. B Gupta, "A Course in Electrical Installation, Estimating and Costing", 2nd Edition, S.K. Kataria & Sons, 2013.
2. Raina, Battacharya, "Electrical Design: Estimation & Costing", 2nd Edition, Wiley Eastern, 2009.
3. S.K Bhattacharya," Estimating and Costing", 3rd Edition, Tata McGraw Hill, 2006.
4. V.K. Jain, Amitabh Bajaj , "Design of Electrical Installations", 1st Edition, Laxmi Publications, 2016.

REFERENCES

1. Surjeet Singh, "Estimating and Costing", 2nd Edition, Dhanpat Rai& Co., 2003.
2. S.L Uppal, "Estimating and Costing", 2nd Edition, Khanna Publishers, 2004.
3. N Alagappan and B Ekambaram, "Electrical Estimating and Costing", 2nd Edition, TMH, 2006.
4. ISI, National Electric Code, Bureau of Indian Standard Publications, 2011.

MANDATORY COURSES

21MCC01	CONSTITUTION OF INDIA	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- To explain the basic features and fundamental principles of Constitution of India.
- To explain the salient features and characteristics of the Constitution of India
- To explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers
- To explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India
- To explain the Local Self Government – Constitutional Scheme in India

SYLLABUS

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States.
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India.
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

TOTAL : 15 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the meaning of the constitution law and constitutionalism and Historical perspective of the Constitution of India.

CO2: Explain the salient features and characteristics of the Constitution of India, scheme of the fundamental rights and the scheme of the Fundamental Duties and its legal status.

CO3: Explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers between the Union and the States, and Parliamentary Form of Government in India.

CO4: Explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India, and Emergency Provisions. CO5: Explain the Local Self Government – Constitutional Scheme in India, Scheme of the Fundamental Right to Equality.
TEXT BOOKS: 1. Durga Das Basu,"Introduction to the Constitution of India", LexisNexis Butterworths Wadhwa, 20th Edition, Reprint 2011. 2. Web link: https://www.india.gov.in/my-government/ constitution-india.

21MCC02	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- To explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge.
- To explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.
- To explain about the use of Traditional Knowledge to meet the basic needs of human being.
- To explain the rich biodiversity materials and knowledge preserved for practicing traditional lifestyle.
- To explain the use of Traditional Knowledge in Manufacturing and Industry.

UNIT-I	TRADITIONAL AND MODERN KNOWLEDGE	3

Two Worlds of Knowledge - Phase of Explorers, Sir Arthur Cotton and Irrigation, Smallpox Vaccination, Late Nineteenth Century, Voelcker, Howard and Agriculture, Havell and Indian Art; Indians at the Encounter - Gaekwad of Baroda and Technical Education, Science Education and Modern Industries, Hakim Ajmal Khan and Ayurveda, R. N. Chopra and Indigenous Drugs, Gauhar Jaan and Indian Classical Music; Linking Science and the Rural - Tagore's Sriniketan Experiment, Marthandam, the YMCA Model, Gandhi's Thoughts on Development, Nehru's View of Growth; Post- Independence Era - Modernization and Traditional Knowledge, Social Roots of Traditional Knowledge Activism, Global Recognition for Traditional Knowledge.

UNIT-II	PROTECTION AND SHARING	3

For Recognition and Protection - United Nations Educational, Scientific and Cultural Organization (UNESCO), World Health Organization (WHO), International Labour Organization (ILO), UN Working Group on Indigenous Populations, Evolution of Other Organizations; Norms of Sharing - United Nations Environment Programme (UNEP), World Intellectual Property Organization (WIPO), World Trade Organization (WTO); IPR and Traditional Knowledge - Theoretical Background, Positive Protections of TK, Defensive Strategies, IPR Facilitation for TK.

UNIT-III	TRADITIONAL KNOWLEDGE FOR BASIC NEEDS	3
Indian Midwifery Tradition—The Dai System, Surface Flow Irrigation Tanks, Housing - A Human Right, Changing Priorities—Niyamgiri. **Biodiversity and Genetic Resources:** Jeevani - The Wonder Herb of Kanis, A Holistic Approach - FRLHT, Basmati - In the New Millennium, AYUSH-Based Cosmetics.		
UNIT-IV	**TRADITIONAL KNOWLEDGE IN MANUFACTURING**	**3**
Drug Discovery, A Sweetener of Bengal, The Sacred Ring of Payyanur, Channapatna Toys.		
UNIT-V	**TRADITIONAL CULTURAL EXPRESSIONS**	**3**
Banarasi Saree, Music, Built and Tangible Heritage, Modern Yoga, Sanskrit and Artificial Intelligence, Climate Change and Traditional Knowledge.		
	TOTAL :15 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge.

CO2: Explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.

CO3: Explain about the use of Traditional Knowledge to meet the basic needs of human being.

CO4: Explain the rich biodiversity materials and knowledge preserved for practicing traditional life style.

CO5: Explain the use of Traditional Knowledge in Manufacturing and Industry.

TEXT BOOKS:

1. Nirmal Sengupta “Traditional Knowledge in Modern India Preservation, Promotion, Ethical Access and Benefit Sharing Mechanisms” Springer, 2019.

2. Amit Jha,”Traditional Knowledge System in India”, Atlantic Publishers and Distributors Pvt Ltd, 2009.

3. Basanta Kumar Mohanta, Vipin Kumar Singh “Traditional Knowledge System and Technology in India”, Pratibha Prakashan, 2012.

4. Kapil Kapoor, Michel Danino "Knowledge Traditions and Practices of India", Central Board of Secondary Education, 2012.

WEB REFERENCES :

1. NPTEL video lecture on “Ayurvedic Inheritance of India”, Video link: https://nptel.ac.in/courses/121/106/121106003/#.

2. Youtube video on “Introduction to Indian Knowledge Systems”, Video link: https://www.youtube.com/watch?v=LZP1StpYEPM.

3. Youtube video on “12 Great achievements of Indian Civilization”, Video link: https://www.youtube.com/watch?v=xmogKGCmclE.

ONE CREDIT COURSES

21OCEE01	SOFTWARES FOR ELECTRICAL ENGINEERS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To Apply numerical methods for engineering problems
- To Make use of MATLAB to solve computational problems

LIST OF EXPERIMENTS

1. Study of Introduction to MATLAB.
2. Study of basic matrix operations.
3. Simulation of DC Circuits.
4. Determination of time response of an R-L-C circuit.
5. Study of Three Phase Inverter With 180^0 Conduction Mode By Using Matlab Programming.
6. Performance Evaluation of short Transmission Line.
7. Performance operation on signals and sequences.

TOTAL: 15 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Make use of MATLAB for Electrical Engineering.

CO2: Construct plots and export this for use in reports and presentations.

TEXT BOOKS:

1. Stephen J. Chapman- Thomson, "MATLAB Programming for Engineers Book", 1st Edition, Ware companion series, 2004
2. Stormy Attaway, "A Practical Introduction to Programming and Problem Solving", 3rd Edition, Butterworth-Heinemann, 2013

REFERENCES

1. Mathew & Fink "Numerical Methods Using MATLAB", 1st Edition, Pearson, 1998.
2. Rudra Pratap "Getting started with Matlab: A quick introduction for scientist & engineers", 1st Edition, Oxford, 2010.

21OCEE02	ANN APPLICATIONS TO ELECTRICAL ENGINEERING	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To illustrate applications of artificial neural networks for real time operations
- To Explain the Neural Networks and its application in electrical Engineering

LIST OF EXPERIMENTS

1. Estimate the power system restoration using Artificial Neural Network
2. Conduct a test for the pattern classification for floral identification using ANN
3. Estimate the PID parameters for controller using ANN
4. Conduct Neuro-Fuzzy Wavelet based Adaptive MPPT Algorithm for Photovoltaic Systems Using MATLAB.
5. Evaluate maintenance scheduling for a power system using ANN

6. Conduct economic load dispatch for a given power system using ANN
7. Perform a load flow analysis using ANN

TOTAL: 15 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Outline the concept of biological neuron and types of neural network

CO2: Summarize the applications of neural networks in electrical engineering

TEXTBOOKS:

1. Laurene V. Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms, and Applications", 1st Edition, Pearson Education, 1993.
2. W. T. Miller, R. S. Sutton, P. J. Webros, "Neural Networks for Control", 1st Edition, MIT Press, 1996.

REFERENCES :

1. B. Yegnanarayana, "Artificial Neural Networks", 12th Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2006.
2.S.Rajasekaran, G. A. Vijayalakshami, "Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis & Applications", 2nd Edition, PHI Learning2017

21OCEE03	SOLAR POWER ENGINEERING	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To explain the basic concepts in solar PV Energy System.
- To demonstrate the performance assessment of grid connected and standalone solar Power System

LIST OF EXPERIMENTS

1. Simulation study on Solar PV Energy System.
2. Study the performance characteristics of solar PV system.
3. Study the P-V and V-I characteristics of single PV module.
4. Study the P-V and V-I characteristics of PV module during shadowing.
5. Study performance assessment of standalone solar PV system.
6. Simulation study on Solar PV Energy System (1kW) for Off-Grid Inverter
7. Simulation study on Solar PV Energy System (1kW) for On-Grid Inverter.

TOTAL: 15 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Apply the controllers for hybrid systems.

CO2: Experiment with the characteristics of solar PV system.

TEXT BOOKS:

1.Chetan Singh Solanki., Solar Photovoltaic: "Fundamentals, Technologies and Application", 1st Edition, PHI Learning Pvt., Ltd., 2009.
2. Jha .A.R, "Solar Cell Technology and Applications", 1st Edition, CRC Press, 2010.

REFERENCES

1. Partain .L.D, Fraas L.M., "Solar Cells and Their Applications", 2nd Edition, Wiley, 2010.

2. Sukhatme .S.P, Nayak .J.K, “Solar Energy”, 1st Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2010.

21OCEE04	TESTING AND CALIBRATION SYSTEM	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To explain the basic concepts and terminologies of testing systems
- To demonstrate the performance of various measuring instruments at different loading conditions

LIST OF EXPERIMENTS

1. Analyze a comparative experimental study on calibration of a Pressure gauge using a dead weight pressure gauge calibrator and the digital pressure calibrator.
2. Evaluate the estimation of uncertainties during flow measurement using rotameter.
3. Validate the calibrator calculations of the voltmeter and ammeter for a given electrical circuit.
4. Conduct a test for the verification and validation of a three phase wattmeter and a single phase wattmeter.
5. Conduct a test for measuring humidity using a hygrometer.
6. Perform the experiment on RTD and thermocouple for probe calibration.
7. Conduct an experiment on torque transducer calibration and check the error.

TOTAL: 15 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Analyze and estimate the errors present in measuring system

CO2: Interpret the measured data with calculated values

REFERENCES :

1. Alessandro Brunelli ,“Calibration Handbook of Measuring Instruments”, 1st Edition,ISA,2014
2. Halit Eren, “ Electronic Portable Instruments-Design and Applications”, 1st Edition, CRC Press, 2004

TEXTBOOKS:

1. Ramon Pallas-Areny/John.G.Webster “Sensors and Signal Conditioning”, 2nd Edition, Wiley India, 2011.
2. Paul.D.Q, “An Introduction to Measuration and Calibration”, 1st Edition, Campbell Industrial Press, 2019.

21OCEE05	HYBRID ENERGY SYSTEMS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To explain the basic concepts and terminologies of hybrid power systems.
- To interpret the intelligent controllers for hybrid systems.

LIST OF EXPERIMENTS

1. Study performance assessment of standalone solar PV system.
2. Study the performance characteristics of wind power plant.

3. Performance analysis of Hybrid (Solar and Wind) power plant.
4. Experiment on Performance assessment of micro Wind Energy Generator.
5. Simulation on Hybrid Power.
6. Experiments on Performance Assessment of Fuel Cell.
7. Simulation on Intelligent Controllers for Hybrid Systems.

TOTAL: 15 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1: Analyze Performance assessment of hybrid systems

CO2: Demonstrate the intelligent controllers for hybrid systems.

REFERENCES :

1. D.P.Kothari, K.C Singal, Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2013.
2. Scott Grinnell, "Renewable Energy & Sustainable Design", 1st Edition, CENGAGE Learning, USA, 2016.

TEXTBOOKS:

1. Richard A. Dunlap," Sustainable Energy" 1st Edition, Cengage Learning India Private Limited, Delhi, 2015.
2. A.Shunmugalatha, M.Devaki and R.Saranya, Renewable Energy Systems, 1st Edition, Technical publication, 2020.

21OCEE06	DESIGN THINKING	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To explain the concept of design thinking for product and service development.
- To summarize the fundamental concept of innovation and design thinking.

Unit-I	PROCESS OF DESIGN	7

Understanding Design thinking - Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping

Unit-II	TOOLS FOR DESIGN THINKING	8

Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Interpret the various design process procedure.

CO2: Outline the design ideas through different technique.

TEXT BOOKS:

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", 2nd edition, Cengage learning (International edition), 2013.

2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", 2nd edition, Harvard Business Press, 2009.

REFERENCE BOOKS:

1. Yousef Haik and Tamer M.Shahin, “Engineering Design Process”, 2^{nd} edition, Cengage Learning, 2011.

2. Jeanne Liedtka, Andrew King and Kevin Bennett, “Solving Problems with Design Thinking - Ten Stories of What Works” 2^{nd} edition, Columbia Business School Publisher, 2013.

SEMESTER – I

21IP101	**INDUCTION PROGRAMME** *(Common to all B.E./ B.Tech. programmes)*	L	T	P	C
		0	0	0	0

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, as a citizen and as a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. "

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and **therefore there shall be no tests / assessments** during this programme.

REFERENCE: Guide to Induction program from AICTE

<table>
<tr><td rowspan="2">21EN101</td><td rowspan="2">PROFESSIONAL ENGLISH-1
(Common to all B.E./B.TECH. Programmes)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>2</td><td>0</td><td>4</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:
• To develop learners skills in listening and responding effectively
• To apply basic grammar for better communication
• To employ reading passages for understanding vocabulary
• To construct logical sentences and participate in pair presentation, extempore
• To organize ideas for various compositions in writing</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION</td><td>12</td></tr>
<tr><td colspan="6">Listening – Listening for general information - Specific details - Conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form; Speaking - Self Introduction; Introducing a friend; Conversation - Politeness strategies; Telephone conversation; Leave a voicemail; Leave a message with another person; asking for information to fill details in a form; Reading - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails; Writing - Writing emails / letters introducing oneself; Grammar - Present Tense (simple, continuous); Question types: Wh/ Yes or No/ and Tags Vocabulary - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).</td></tr>
<tr><td>UNIT II</td><td colspan="4">NARRATION AND SUMMATION</td><td>12</td></tr>
<tr><td colspan="6">Listening - Listening to podcast, anecdotes / stories / event narration; documentaries and interviews with celebrities; Speaking - Narrating personal experiences / events; Interviewing a celebrity; Reporting / and summarizing of documentaries / podcasts/ interviews; Reading - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs; Writing - Guided writing - Paragraph writing Short Report on an event (field trip etc.); Grammar - Past tense (Simple, continuous); Subject-Verb Agreement; and Prepositions; Vocabulary - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.</td></tr>
<tr><td>UNIT III</td><td colspan="4">DESCRIPTION OF A PROCESS / PRODUCT</td><td>12</td></tr>
<tr><td colspan="6">Listening - Listen to a product and process descriptions; a classroom lecture; and advertisements about a products; Speaking - Picture description; Giving instruction to use the product; Presenting a product; and Summarizing a lecture; Reading - Reading advertisements, gadget reviews; user manuals; Writing - Writing definitions; instructions; and Product /Process description; Grammar - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect, Present and past perfect continuous tenses; Vocabulary - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words)</td></tr>
<tr><td>UNIT IV</td><td colspan="4">CLASSIFICATION AND RECOMMENDATIONS</td><td>12</td></tr>
</table>

Listening - Listening to TED Talks; Scientific lectures; and educational videos; **Speaking** – Small Talk; Mini presentations and making recommendations; **Reading** - Newspaper articles; Journal reports - Non Verbal Communication (tables, pie charts etc,) **Writing** - Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode) **Grammar** - Articles; Pronouns - Possessive & Relative pronouns; **Vocabulary** - Collocations; Fixed / Semi fixed expressions		
UNIT V	**EXPRESSIONS**	**12**
Listening - Listening to debates/ discussions; different viewpoints on an issue; and panel discussions; **Speaking** - Group discussions, Debates, and Expressing opinions through Simulations & Role-play; **Reading** - Reading editorials; and Opinion Blogs; **Writing** - Essay Writing (Descriptive or narrative); **Grammar** - Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences; **Vocabulary** - Cause & Effect Expressions - Content vs. Function words.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Listen and comprehend complex academic texts

CO2: Read and infer the denotative and connotative meanings of technical texts

CO3: Write definitions, descriptions, narrations and essays on various topics

CO4: Speak fluently and accurately in formal and informal communicative contexts

CO5: Express their opinions effectively in both oral and written medium of communication

TEXT BOOKS:

1. Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University. English for Science & Technology. Cambridge University Press, 2021
2. Board of Editors, Department of English, Anna University. English for Engineers & Technologists. Orient Blackswan Private Ltd, 2020.
3. Board of Editors, Department of English, Anna University. Using English Orient Blackswan Private Ltd, 2017

REFERENCES:

1. Meenakshi Raman & Sangeeta Sharma. Technical Communication – Principles And Practices Oxford University Press, New Delhi, 2016
2. Lakshminarayanan K.R. A Course Book on Technical English. SciTech Publications (India) Pvt. Ltd., 2012
3. Ayesha Viswamohan. English For Technical Communication (With CD). McGraw Hill Education, ISBN: 0070264244. 2008.
4. Kulbhusan Kumar, RS Salaria, Effective Communication Skill. Khanna Publishing House. 1st Edition, 2018.
5. Dr. V. Chellammal. Learning to Communicate. Allied Publishing House, New Delhi, 2003.

21MA101	MATRICES AND CALCULUS (*Common to all B.E. / B.Tech. Programmes*)	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To explain the students about differential calculus.
- To demonstrate the functions of several variables technique to solve problems in many engineering branches.
- To demonstrate the various techniques of integration.
- To prepare the student to use mathematical tools in evaluating multiple integrals and their applications.

UNIT I	MATRICES	12

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II	DIFFERENTIAL CALCULUS	12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.

UNIT III	FUNCTIONS OF SEVERAL VARIABLES	12

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV	INTEGRAL CALCULUS	12

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centre of mass.

UNIT V	MULTIPLE INTEGRALS	12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use the matrix algebra methods for solving engineering problems.

CO2: Apply differential calculus tools in solving various application problems.
CO3: Make use of differential calculus ideas on several variable functions.
CO4: Identify suitable methods of integration in solving practical problems.
CO5**:** Solve practical problems of areas, volumes using multiple integrals.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", 10^{th} Edition, John Wiley and Sons, New Delhi, 2016.
2. Grewal.B.S. “Higher Engineering Mathematics”, 44^{th} Edition, Khanna Publishers, New Delhi, 2018.
3. James Stewart, "Calculus: Early Transcendentals", 8^{th} Edition, Cengage Learning, New Delhi, 2015.

REFERENCES:

1. Bali. N., Goyal. M. and Watkins. C., “Advanced Engineering Mathematics”, 7^{th} Edition, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 2009.
2. Jain. R.K. and Iyengar. S.R.K., “Advanced Engineering Mathematics”, 5^{th} Edition, Narosa Publications, New Delhi, 2016.
3. Ramana. B.V., "Higher Engineering Mathematics", 6^{th} Edition, McGraw Hill Education Pvt. Ltd, New Delhi, 2010.
4. Thomas. G. B., Hass. J and Weir. M.D, “Thomas Calculus”, 14^{th} Edition, Pearson India, 2018.

21PH101	ENGINEERING PHYSICS *(Common to I Year B.E. / B.Tech. Students)*	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To illustrate the students effectively to achieve an understanding of mechanics.
- To infer the students to gain knowledge of electromagnetic waves and its applications.
- To explain the basics of oscillations, optics and lasers.
- To outline the importance of quantum physics.
- To relate the students towards the applications of quantum mechanics.

UNIT I	**MECHANICS**	**9**

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum– double pendulum –Introduction to nonlinear oscillations.

UNIT II	**ELECTROMAGNETIC WAVES**	**9**

The Maxwell’s equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.

UNIT III	**OSCILLATIONS, OPTICS AND LASERS**	**9**

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave – sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference– Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein’s coefficients - population inversion - Nd-YAG laser, CO_2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV	**BASIC QUANTUM MECHANICS**	**9**

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in an infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V	APPLIED QUANTUM MECHANICS	9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the importance of mechanics.

CO2: Extend their knowledge in electromagnetic waves.

CO3: Illustrate a strong foundational knowledge in oscillations, optics and lasers.

CO4: Interpret the importance of quantum physics.

CO5: Summarize quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow, "An Introduction to Mechanics", 1st Edition, McGraw Hill Education, 2017.
2. E.M.Purcell and D.J.Morin, "Electricity and Magnetism", 3rd Edition, Cambridge University Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", 7th Edition, McGraw-Hill, 2017.

REFERENCES

1. R.Wolfson. "Essential University Physics", Volume 1 & 2. , 1st Edition (Indian Edition) Pearson Education, 2009.
2. Paul A. Tipler, "Physics" - Volume 1 & 2, 1st Edition (Indian Edition), CBS Publishers & Distributors, 2004.
3. K.Thyagarajan and A.Ghatak. "Lasers: Fundamentals and Applications", 2nd Edition, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R. Resnick and J. Walker, "Principles of Physics", 10th Edition (Indian Edition), Wiley, 2015.
5. N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students", 1st Edition, Springer Verlag, 2012.

21CH101	**ENGINEERING CHEMISTRY** ***(Common to all B.E / B.Tech. Programmes)***	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To describe water quality parameters and water treatment techniques.
- To discuss basic principles and preparatory methods of nanomaterials.
- To demonstrate the basic concepts and applications of phase rule and composites.
- To identify different types of fuels, their preparation, properties and combustion characteristics.
- To illustrate the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I	**WATER AND ITS TREATMENT**	**9**

Water: Sources and impurities, **Water quality parameters:** Definition and significance of-colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination).**Desalination of brackish water**: Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. **Treatment of boiler feed water**: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II	**NANOCHEMISTRY**	**9**

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials**: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. **Applications** of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III	**PHASE RULE AND COMPOSITES**	**9**

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). **Properties and applications of**: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. **Hybrid composites** - definition and examples.

UNIT IV	**FUELS AND COMBUSTION**	**9**

Fuels: Introduction: Classification of fuels; **Coal and coke**: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:**

Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Power alcohol and biodiesel.**

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; **Ignition temperature**: spontaneous ignition temperature, Explosive range; **Flue gas analysis** - ORSAT Method. **CO_2 emission and carbon foot print.**

UNIT V	ENERGY SOURCES AND STORAGE DEVICES	9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. **Solar energy conversion:** Principle, working and applications of solar cells**; Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H_2-O_2 fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO 1: Infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO 2: Describe the basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO 3: Apply the knowledge of phase rule and composites for material selection requirements.

CO 4: Identify suitable fuels for engineering processes and applications.

CO 5: Demonstrate different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", 1st Edition, Tata McGraw-Hill Publishing Company Ltd, NewDelhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", 12th Edition, S. Chand Publishing, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B.B. Rath and James Murday, "Text book of nanoscience and nanotechnology", 1st Edition,Universities Press-II M Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" 2nd Edition, McGraw Hill Education (India) Private Limited, 2017.
3. Friedrich Emich, "Engineering Chemistry", 1st Edition,Scientific International PVT, LTD, New Delhi, 2014.
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", 2nd Edition,

Cambridge University Press, Delhi, 2019

5. O.V. Roussak and H.D. Gesser, “Applied Chemistry-A Text Book for Engineers and Technologists”, 2nd Edition, Springer Science Business Media, New York, 2013.

21CS101	PROBLEM SOLVING AND PYTHON PROGRAMMING (Common to all B.E./B.Tech Programmes)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

UNIT-I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.

UNIT-II	DATA TYPES, EXPRESSIONS, STATEMENTS	9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT-III	CONTROL FLOW, FUNCTIONS, STRINGS	9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-else-if-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT-IV	LISTS, TUPLES, DICTIONARIES	9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT-V	FILES, MODULES, PACKAGES	9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter’s age validation, Marks range validation (0-100).

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of design approaches to solve computational problems.

CO2: Develop and execute basic Python programs using expressions and input/output statements.

CO3: Utilize strings, functions and control statements to develop real world problems.

CO4: Construct programs using Python data types like lists, tuples and dictionaries.

CO5: Prepare a Python application by incorporating files and exceptions.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher,"Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
3. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc- Graw Hill, 2018.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", 1st Edition, Pearson Education, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", 3rd Edition, MIT Press, 2021
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019

21CS102	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY *(Common to all B.E./B.Tech Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.,)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.,- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error,voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.,

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1:Develop algorithmic solutions to simple computational Problems
CO2: Illustrate and execute basic Python programs using simple statements.
CO3: Build program for scientific problems using strings, functions and control statements.
CO4: Utilize compound data types lists, tuples and dictionaries for real-time applications.
CO5: Experiment the python packages, files and exceptions for developing software applications

21PC101	PHYSICS AND CHEMISTRY LABORATORY *(Common to all B.E / B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

CHEMISTRY LABORATORY

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters such as acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electro analytical techniques such as pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles.
- To analyze the quality of coal sample using proximate analysis.

List of Experiments (Any 7 experiments)

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.
2. Determination of types and amount of alkalinity in water sample.
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate. (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel.
15. Proximate analysis of Coal.

COURSE OUTCOMES : At the end of the course, learners will be able to

CO1: To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.

CO2: To determine the amount of metal ions through volumetric and spectroscopic techniques.

CO3: To analyse and determine the composition of alloys.

CO4: To learn simple method of synthesis of nanoparticles.

CO5: To quantitatively analyse the impurities in solution by electro analytical techniques.

Text Book:

J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, "Vogel's Textbook of Quantitative Chemical Analysis" 2009.

<table>
<tr><td rowspan="2">21EN102</td><td rowspan="2">ENGLISH-II
(Common to all B.E./B.TECH. Programmes)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:
• To develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
• To prepare and write convincing job applications and effective reports.
• To demonstrate their speaking skills to make technical presentations and participate in group discussions.
• To apply their Listening skill which will help them comprehend lectures and talks in their areas of specialization
• To choose appropriate soft skills to suit the situation.</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION TO TECHNICAL ENGLISH</td><td>9</td></tr>
<tr><td colspan="6">Listening - Factual and Academic speeches; Speaking - Asking for and giving directions - Reading - Technical texts from - Newspapers /websites; Writing - Statements - Definitions - issue based writing instructions - Checklists - Recommendations; Vocabulary Development- technical vocabulary; Grammar - Error spotting - Compound words; Soft skills - Leadership Skills.</td></tr>
<tr><td>UNIT II</td><td colspan="4">READING AND STUDY SKILLS</td><td>9</td></tr>
<tr><td colspan="6">Listening - Listening to longer technical talks and completing exercises based on them; Speaking - Describing a general process; Reading - Reading longer technical texts - Identifying the various transitions in a text - Paragraphing; Writing - Interpreting charts, graphs; Vocabulary Development - Vocabulary used in formal letters/emails and reports Grammar - Impersonal passive voice, numerical adjectives - Soft skills - Teamwork</td></tr>
<tr><td>UNIT III</td><td colspan="4">TECHNICAL WRITING AND GRAMMAR</td><td>9</td></tr>
<tr><td colspan="6">Listening - Listening to classroom lectures, talks on engineering /technology; Speaking - introduction to technical presentations; Reading - longer texts both general and technical, practice in speed reading; Writing - Describing a technical process; Vocabulary Development - Sequence words - Misspelled words; Grammar - Embedded sentences ; Soft skills - Decision making</td></tr>
<tr><td>UNIT IV</td><td colspan="4">JOB APPLICATIONS</td><td>9</td></tr>
<tr><td colspan="6">Listening - Listening to documentaries and making notes. Speaking - Mechanics of presentations; Reading - Reading for detailed comprehension; Writing - Email etiquette - job application - Cover Letter - Resume preparation(via email and hard copy) - Analytical essay writing - Vocabulary Development - finding suitable synonyms - paraphrasing; Grammar - clauses - If conditionals - Soft skills - Time Management</td></tr>
<tr><td>UNIT V</td><td colspan="4">GROUP DISCUSSION AND REPORT WRITING</td><td>9</td></tr>
<tr><td colspan="6">Listening - TED talks; Speaking - Participating in a group discussion - Reading - Reading and understanding technical articles; Writing - Writing reports - Survey report, accident report and minutes of a meeting - Vocabulary Development - Verbal analogies; Grammar - reported speech; Soft skills - Conflict Resolution.</td></tr>
</table>

	TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able to:

CO1: Interpret by reading information in technical texts

CO2: Choose appropriate language to write convincing job applications, resume and reports

CO3: Formulate the technical ideas effectively in spoken and written forms

CO4: Analyze and understand spoken language in lectures and talks

CO5: Demonstrate basic soft skills in life

TEXT BOOKS:

1. Board of Editors, Fluency in English-A Course book for Undergraduate Engineers and Technologist. Orient Blackswan Pvt Ltd, Hyderabad: 2018
2. Jawahar, Jewelcy & Rathna.P. Communicative English Workbook. VRB Publishers Pvt Ltd. Chennai. 2018.
3. Board of Editors, Department of English, Anna University, Chennai. Mindscapes-English for Technologists and Engineers. Orient Black Swan Pvt Ltd, Chennai, 2012.

REFERENCES:

1. Verma, Shalini. Technical Communication for Engineers. Vikas Publishing House Pvt Ltd. New Delhi. 2015
2. Raman, Meenakshi & Sharma, Sangeeta. Technical Communication English Skills for Engineers. Oxford University Press. 2008.
3. Rizvi, Ashraf.M. Effective Technical Communication. MC Graw Hill Education Pvt Ltd. New Delhi. 2016.

<table>
<tr><td rowspan="2">21MA102</td><td rowspan="2">VECTOR CALCULUS AND COMPLEX VARIABLES
(Common to B.E. CIVIL Engg., EEE & MECH Engg.)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>2</td><td>0</td><td>4</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:
• To explain the students with the concepts of vector calculus, needed for problem solving in all engineering disciplines.
• To choose the effective mathematical methods for finding the solutions of partial differential equations.
• To identify and develop the standard techniques of complex variables.
• To apply with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.
• To prepare the student to acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.</td></tr>
<tr><td>UNIT I</td><td colspan="4">VECTOR CALCULUS</td><td>12</td></tr>
<tr><td colspan="6">Gradient , Divergence and Curl – Directional derivation – Irrotational and solenoidal vector fields – Vector integration – Greens theorem in a plane , Gauss Divergence theorem and Stoke's theorem (excluding proof) – Simple applications involving cubes and rectangular parallelepiped</td></tr>
<tr><td>UNIT II</td><td colspan="4">PARTIAL DIFFERENTIAL EQUATIONS</td><td>12</td></tr>
<tr><td colspan="6">Formation of partial differential equations – Solutions of standard types of first order PDE :
f(p, q) = 0, f(z ,p,q)=0, z=px+ qy + f(p,q), f(x, p) = f(y, q) – Lagrange's linear equations – linear partial differential equations of second and higher order with constant coefficients of homogeneous type.</td></tr>
<tr><td>UNIT III</td><td colspan="4">ANALYTIC FUNCTIONS</td><td>12</td></tr>
<tr><td colspan="6">Analytic functions – necessary and sufficient conditions for analyticity-properties – Harmonic conjugates- construction of analytic function – conformal mapping –Mapping by functions- Bilinear transformation $w = c + z , az , \frac{1}{z}, z^2$.</td></tr>
<tr><td>UNIT IV</td><td colspan="4">COMPLEX INTEGRATION</td><td>12</td></tr>
<tr><td colspan="6">Complex Integration – Cauchy's integral theorem and integral formula (excluding proof)-Taylor series and Laurent's series –Residues – Cauchy's residue Theorem (excluding proof) – Application of Residue theorem to evaluate real integrals around unit circle and semi- circle (excluding poles on the real axis).</td></tr>
<tr><td>UNIT V</td><td colspan="4">ORDINARY DIFFERENTIAL EQUATIONS</td><td>12</td></tr>
<tr><td colspan="6">Linear equations of second order with constant and variable coefficients-Homogeneous equations of Euler type – Equations reducible to homogeneous form –Variation of parameters-Simultaneous first order with constant coefficients.</td></tr>
<tr><td colspan="2"></td><td colspan="4">TOTAL: 60 PERIODS</td></tr>
<tr><td colspan="6">COURSE OUTCOMES:
At the end of the course, learners will be able to
CO1: Apply the concept of vector calculus which naturally arises in many engineering Problems.
CO2: Solve the Partial Differential Equations by using various techniques.</td></tr>
</table>

CO3: Construct an analytic function using the properties of analytic function.

CO4: Apply suitable formula to evaluate the given integral.

CO5: Use a suitable method, solve the given differential equation of first & second order.

TEXT BOOKS:

1. Kreyszig Erwin, "Advanced Engineering Mathematics ", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. James Stewart, " Calculus: Early Transcendentals", 8th Edition, Cengage Learning New Delhi, 2015.
3. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson Education, 2018.

REFERENCES :

1. B.S.Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2015.
2. P. Kandasamy, Thilagavathy and K.Gunavathy, "Engineering Mathematics Vol-II", 3rd Edition, S. Chand Limited, 2015.
3. P. Kandasamy, Thilagavathy and K.Gunavathy, "Engineering Mathematics Vol-III", 3rd Edition, S. Chand Limited, 2015.

21PH106	PHYSICS FOR MECHANICAL ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To explain the basics of crystallography and its importance in studying materials properties.
- To illustrate the electrical properties of materials including free electron theory, applications of quantum mechanics and magnetic materials.
- To infer the knowledge on physics of semiconductors, determination of charge carriers and device applications
- To summarize the knowledge on different optical properties of materials, optical displays and applications
- To translate the significance of nano structures, quantum confinement in nano device applications.

UNIT I	CRYSTALLOGRAPHY	9

Crystal structures: BCC, FCC and HCP - Directions and planes - Linear and planar densities - Crystal imperfections- Edge and screw dislocations - Grain and twin boundaries - Burgers vector and elastic strain energy - Slip systems, plastic deformation of materials - X-ray diffraction - Braggs law - Powder X-ray diffraction.

UNIT II	ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS	9

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Quantum free electron theory: Tunneling – degenerate states - Fermi-Dirac statistics - Density of energy states - Electron effective mass - Concept of hole. Magnetic materials: dia, para and ferromagnetic effects - Domain theory of ferromagnetism - Hysteresis behaviour - quantum interference devices - GMR devices.

UNIT III	SEMICONDUCTORS AND TRANSPORT PHYSICS	9

Intrinsic Semiconductors - Energy band diagram - direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - extrinsic semiconductors - Carrier concentration in n-type & p-type semiconductors - Variation of carrier concentration with temperature - Carrier transport in Semiconductors: Drift, mobility and diffusion - Hall effect and devices - Ohmic contacts - Schottky diode.

UNIT IV	OPTICAL PROPERTIES OF MATERIALS	9

Classification of optical materials - Optical processes in semiconductors: optical absorption and emission, charge injection and recombination, optical absorption, loss and gain. Optical processes in quantum wells - Optoelectronic devices: light detectors and solar cells - light emitting diode - laser diode - optical processes in organic semiconductor devices - excitonic state - Electro-optics and nonlinear optics: Modulators and switching devices.

UNIT V	NANOELECTRONIC DEVICES	9

Quantum confinement - Quantum structures - quantum wells, wires and dots - Zener - Bloch oscillations - Resonant tunneling - Quantum interference effects - Mesoscopic structures - Single electron phenomena - Single electron Transistor. Semiconductor photonic structures - 1D, 2D and 3D photonic crystal. - Photo processes - Spintronics - Carbon nanotubes: properties and applications.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the basics of crystallography and its importance for various material properties.

CO2: Infer the electrical and magnetic properties of materials and their applications.

CO3: Relate the semiconductor physics and functioning of semiconductor devices.

CO4: Summarize the optical properties of materials and working principles of various optical devices.

CO5: Translate the importance of functional nanoelectronic devices.

TEXT BOOKS:

1. V. Raghavan, "Materials Science and Engineering: A First Course", 6^{th} Edition, Prentice Hall India Learning Private Limited, 2015.
2. S.O. Kasap, "Principles of Electronic Materials and Devices", 4^{th} Edition (Indian Edition), Mc-Graw Hill Publication, 2018.
3. Jasprit Singh, "Semiconductor Devices: Basic Principles", 1^{st} Edition (Indian Edition), Wiley Publication, 2007.
4. Jasprit Singh, "Semiconductor Optoelectronics: Physics and Technology", 1^{st} Edition (Indian Edition) Mc-Graw Hill Publication, 2019.
5. G.W. Hanson, "Fundamentals of Nanoelectronics", Indian Standard Edition, Pearson Education, 2009.

REFERENCES

1. R. Balasubramaniam, "Callister's Materials Science and Engineering", 2^{nd} Edition (Indian Edition), Wiley Publication, 2014.
2. Wendelin Wright and Donald Askeland, "Essentials of Materials Science and Engineering", 1^{st} Edition, CL Engineering Publishers, 2013.
3. Robert F. Pierret, "Semiconductor Device Fundamentals", Standard Edition, Pearson Education, 2006.
4. Pallab Bhattacharya, "Semiconductor Optoelectronic Devices", 1^{st} Edition, Pearson Education, 2017.
5. Ben Rogers, Jesse Adams and Sumita Pennathur, "Nanotechnology: Understanding Small Systems", 1^{st} Edition, CRC Press, 2017.

21ME101	ENGINEERING GRAPHICS (Common to all B.E./B.Tech. Programmes)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To sketch the projection of points, lines and planes.
- To sketch the projection of simple solids
- To sketch the projection of sectioned solids and development of lateral surfaces
- To sketch the isometric and perspective views of simple solids.
- To sketch the orthographic projection of various objects freehandly.

UNIT I	**PROJECTIONS OF POINTS, LINES AND PLANE SURFACE**	**12**

Importance of graphics in engineering applications – Use of drafting instruments - Lettering and dimensioning.

Introduction to Orthographic projections - Principles -Principal planes-First angle projection. Projection of points located in all quadrants. Projection of straight lines inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.

Projection of planes (regular polygonal and circular surfaces) inclined to both the principal planes by rotating object method. (Not for Examination)

UNIT II	**PROJECTION OF SOLIDS**	**12**

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT III	**PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES**	**12**

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT IV	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**12**

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- Perspective projection of simple solids- Prisms, pyramids and cylinders by visual ray method .

UNIT V	**FREEHAND SKETCHING**	**12**

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.

Introduction to drafting packages and demonstration. (Not for examination).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Construct the orthographic projections of points, straight lines and plane surfaces. CO2: Sketch the orthographic projections of simple solids CO3: Sketch the orthographic projections of sectional solids and lateral surfaces of the solids. CO4: Construct the isometric projections and perspective projections of simple solids. CO5: Sketch the orthographic projection of objects using freehand.
TEXT BOOKS:
1. Natarajan K.V., “A text book of Engineering Graphics”, 31st Edition, Dhanalakshmi Publishers, Chennai, 2018. 2. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, 15th Edition, New Age International (P) Limited, 2018. 3. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, 53rd Edition, Charotar Publishing House, 2014.
REFERENCES:
1. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, 2nd Edition, Tata McGraw Hill Publishing Company Limited, 2013. 2. Parthasarathy N. S. and Vela Murali, “Engineering Graphics”, 2nd Edition, Oxford University, Press, New Delhi, 2015. 3. Shah M.B., and Rana B.C., “Engineering Drawing”, 2nd Edition, Pearson, 2009.

21ME102	ENGINEERING MECHANICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To calculate the effect of force in particle and rigid bodies.
- To interpret various forces acting on a structure.
- To predict the centroid and moment of inertia.
- To demonstrate the laws of motion, kinematics of motion and their relation.
- To calculate the types of friction for moving bodies and problems related to friction.

UNIT I	STATICS OF PARTICLES AND RIGID BODIES	9

STATICS OF PARTICLES: Force on a particle – resultant of two forces and several concurrent forces – resolution of a force – equilibrium of a particle-free body diagram – force in space – equilibrium of a particle in space.

STATICS OF RIGID BODIES: External, Internal forces – transmissibility – moment of a force – Varignon‘s theorem – moment of a couple – resolution of a force into a force and a couple – reduction of a system of forces – reactions at supports and connections – equilibrium of a two and three force bodies –case studies.

UNIT II	ANALYSIS OF STRUCTURES	9

Simple trusses-Method of joints, method of sections – joints under special loading conditions – space trusses – analysis of frames

UNIT III	PROPERTIES OF SURFACES AND SOLIDS	9

Centroids of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia-radius of gyration – mass moment of inertia of simple solids

UNIT IV	DYNAMICS OF PARTICLES	9

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion - Newton’s laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V	FRICTION AND RIGID BODY DYNAMICS	9

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL PERIODS 45

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Solve problems on particles and rigid bodies using the concept of static equilibrium.

CO2: Interpret the effect of structure on acting forces

CO3: Calculate the center of gravity and moment of inertia of the given geometry

CO4: Determine a suitable method for solving problems on kinematics and kinetics of particles

CO5: Predict the effect of friction in rigid bodies.

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8^{th} Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Meriam J.L and Kraig L.G, 'Engineering Mechanics-Statics and Dynamics', 9^{th} Edition, John Wiley & sons, 2021.
3. Vela Murali, "Engineering Mechanics", 3^{rd} Edition, Oxford University Press, 2017.

REFERENCES:

1. Hibbler, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11^{th} Edition, Pearson Education (2010).
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics",4^{th} Edition, Pearson Education (2006)
3. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3^{rd} Edition, Vikas Publishing House Pvt. Ltd., (2005).
4. Bhavikatti, S.S, and Rajashekarappa, K.G., "Engineering Mechanics", 5^{th} Edition, New Age International (P) Limited Publishers, 2015.
5. Kumar, K.L., "Engineering Mechanics", 3^{rd} Revised Edition, Tata McGraw-Hill Publishing Company, 2008.

21CH103	ENVIRONMENTAL SCIENCE *(Common to all B.E / B.Tech. Programmes)*	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To describe the structure and function of an ecosystem and biodiversity
- To interpret the environmental impacts of natural resources.
- To demonstrate causes, effects and control measures of different types of pollution.
- To manipulate the importance of disaster management, environmental ethics and values.
- To dramatize the important social issues and sustainable practices.

UNIT-I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	6

Multidisciplinary nature of environmental studies - ecosystem- general structure and function of an ecosystem- ecological succession-biodiversity-types-values of biodiversity- endangered and endemic species-red data book- hot spots of biodiversity-criteria- hot spots in India-threats to biodiversity(man-animal conflicts, habitat loss, poaching)-case studies-conservation of biodiversity-in-situ and ex-situ conservation.

UNIT-II	NATURAL RESOURCES AND ITS ENVIRONMENTAL IMPACTS	6

Natural resources-forest resource-ecological functions – causes, effects and control measures of deforestation-water resource-sources-conflict over water-dams benefits and problems-food resource-overgrazing- impacts of over grazing- impacts of modern agriculture-energy resource-environmental impacts of wind mills and solar panels- role of an individual in conservation of natural resources.

UNIT III	ENVIRONMENTAL POLLUTION AND CONTROL	6

Air pollution-causes, effects and control methods - water pollution- causes, effects-waste water treatment-soil pollution-causes, effects-solid waste management–e-waste- causes, effects and management-Pollution control acts-air(prevention and control of pollution) act,1981- water(prevention and control of pollution) act,1974- wildlife (protection) act,1972 - e-waste management rules,2016-case studies - role of an individual in control of pollution.

UNIT IV	DISASTER MANAGEMENT AND ENVIRONMENTAL ETHICS	6

Disaster management-causes, effects and management of- flood, landslide, earthquake and tsunami-case studies- environmental ethics- value education-traditional value systems in India-water conservation-rain water harvesting-watershed management.

UNIT V	SOCIAL ISSUES AND SUSTAINABLE PRACTICES	6

Unsustainable development- social issues-climate change-causes, effects and control measures-global warming-causes, effects and control measures-Acid rain-causes, effects and control measures-ozone layer depletion-causes, effects and control measures-nuclear accident and holocausts-EIA-Sustainable development-goals-target- green buildings- ISO 14000 series.

30 PERIODS

COURSE OUTCOMES : At the end of the course, learners will be able to

CO1: Explain the concept, structure and function of an ecosystem and biodiversity.
CO2: Demonstrate the environmental impacts of natural resources.
CO 3: Illustrate the suitable management method for pollution control.
CO 4: Relate the proper way of managing disaster with environmental ethics.
CO 5: Apply social issues and adopt suitable sustainable practices.

Text Books:

1. Kaushik, A &Kaushik. C.P, “Environmental Science and Engineering”, 6th Edition, New Age

International, 2018.

2. Garg S.K &Garg, Ecological and Environmental studies, Khanna Publishers, 2015.
3. Wright &Nebel, Environmental science towards a sustainable future, 12th Editon, Prentice Hall of India Ltd, 2015.

Reference Books:

1. ErachBharucha, "Text book of Environmental studies for Undergraduate courses", 3rd Edition, UGC, 2021.
2. Ravi P. Agrahari, Environmental ecology, Biodiversity, climatic change & Disaster management, 1st Edition, McGraw Hill, 2020
3. Benney Joseph, "Environmental Science and Engineering", 1st Edition, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017.

21EE103	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING** (Theory with Practical Course) *(Common to B.E., Civil Engg. & Mechanical Engg.)*	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To outline the basics of electric circuits and analysis
- To classify wires and domestic wiring
- To summarize the working principles and application of electrical machines
- To outline the characteristics of semiconductor devices
- To explain the functional elements and working of transducers

UNIT I	**ELECTRICAL CIRCUITS**	**9**

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor.

UNIT II	**MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS**	**9**

Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density, fringing, self and mutual inductances-simple problems.

Domestic wiring , types of wires and cables, earthing, protective devices- switch, fuse unit - safety precautions and First Aid.

UNIT III	**ELECTRICAL MACHINES**	**9**

Construction and Working principle- DC Separately and Self excited Generators, Types and Applications. Working Principle of DC motors, Types and Applications. Construction, Working principle and Applications of Transformer, working of Three phase Alternator and Three Phase Induction Motor.

UNIT IV	**ANALOG & DIGITAL ELECTRONICS**	**9**

Resistor, Inductor and Capacitor in Electronic Circuits- Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, Rectifier.

Review of number systems, binary codes, Combinational logic - representation of logic functions.

UNIT V	**INSTRUMENTATION SYSTEM**	**9**

Classification of instruments – Operating Principles of indicating Instruments and Digital Energy meter. Strain gauge, LVDT, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

TOTAL: 45 PERIODS

PRACTICAL COURSE	**15**

List of Experiments

1. Verification of Ohms Laws
2. Verification of Kirchhoff's Laws
3. Residential Wiring
4. Load test on DC Shunt Motor
5. Characteristics of PN Diode
6. Characteristics of Zener Diode
7. Ripple factor calculation for half wave rectifier
8. Measurement of displacement of LVDT

TOTAL: 60 PERIODS

OUTCOMES: At the end of the course, learners will be able to:

CO1. Summarize the electric circuit parameters for simple problems

CO2: Outline the safety precautions in electrical installation

CO3. Explain the working principle and applications of electrical machines

CO4. Show VI characteristics of semiconductor devices

CO5. Demonstrate the types and operating principles of sensors and transducers

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", 2nd Edition, McGraw Hill Education, 2020
2. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", 2nd Edition Pearson Education, 2017.
3. Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
4. James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Coursein Electrical & Electronic Measurements &Instrumentation', Dhanpat Rai and Co, 2015.

REFERENCES

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", 4th Edition, McGraw HillEducation, 2019.
2. Thomas L. Floyd, 'Digital Fundamentals', 11th Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, 'Electronic Principles, McGraw Hill Education; 7th Edition, 2017.
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGrawHill, 2002.
5. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

21EM101	ENGINEERING PRACTICES LABORATORY *(Common to all B.E / B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To draw pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- To demonstrate the basic switch board wiring, fluorescent lamp wiring and stair case wiring using various electrical components.
- To choose various joints in steel plates using arc welding work and machining various simple processes like turning, drilling, tapping in parts
- To build a tray out of metal sheet using sheet metal work.
- To develop electronic circuit and testing for soldering and desoldering using PCB board.

LIST OF EXPERIMENTS:

GROUP – A (CIVIL & ELECTRICAL)

PART – I

CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

- Sawing,
- Planning and Making joints like T-Joint, Cross lap and Dovetail joint.

PART – II

ELECTRICAL ENGINEERING PRACTICES

- Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
- Staircase wiring
- Fluorescent Lamp wiring with introduction to CFL and LED types.
- Energy meter wiring and related calculations/ calibration
- Study of Iron Box wiring and assembly
- Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
- Measurement of resistance to earth of an electrical equipment.

GROUP – B (MECHANICAL & ELECTRONICS)

PART III
MECHANICAL ENGINEERING PRACTICES **WELDING WORK:** • Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding. • Practicing gas welding. **BASIC MACHINING WORK:** • Usage of Spanners and screw drivers • Facing and Turning. • Taper Turning **ASSEMBLY WORK:** • Assembling a centrifugal pump. • Assembling a household mixer. • Assembling an air conditioner. **SHEET METAL WORK:** • Making of a square tray **FOUNDRY WORK:** • Demonstrating basic foundry operations.
PART IV
ELECTRONIC ENGINEERING PRACTICES **SOLDERING WORK:** • Soldering simple electronic circuits and checking continuity. **ELECTRONIC ASSEMBLY AND TESTING WORK:** • Assembling and testing electronic components on a small PCB. **ELECTRONIC EQUIPMENT STUDY:** • Study elements of smart phone. • Assembly and dismantle of computer / laptop
TOTAL: 60 PERIODS
COURSE OUTCOMES:
At the end of the course, learners will be able to CO1: Build various plumbing joints CO2: Develop various carpentry joints. CO3: Construct various wiring electrical joints in common household electrical wire work. CO4: Construct various welded joints, sheet metal and basic machining operations CO5: Develop the electronic circuit for soldering and testing using PCB board.

			L	T	P	C
21MA201	**TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS** **(*Common to B.E. CIVIL Engg., ECE & MECH. Engg.*)**		**3**	**2**	**0**	**4**

COURSE OBJECTIVES:

- To use various methods of Laplace transforms for efficiently solving the problems that occur in various branches of engineering disciplines.
- To identify Fourier series which is essential to many applications in engineering.
- To explain the mathematical tools for the solutions of partial differential equations that model several physical processes.
- To explain the student with Fourier transform techniques used in wide variety of situations.
- To develop Z transform techniques to solve difference equations for discrete time systems

UNIT I	**LAPLACE TRANSFORM**	**12**

Laplace transform- conditions for existence –Transform of elementary functions –Basic properties – First shifting theorem –Transform of derivatives on $t\,f(t), f(t)/t$ and periodic functions-Transform of unit step function and impulse functions. Inverse Laplace transform by partial function method and convolution theorem (excluding proof)-Initial and finial value theorems-Solutions of linear ODE of second order with constant coefficients using Laplace transform techniques.

UNIT II	**FOURIER SERIES**	**12**

Dirichlet's conditions – General Fourier series odd and even functions – Half range sine series – half range cosine series – Parseval's identity – Harmonic Analysis.

UNIT III	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**12**

Classifications of PDE – Solutions of one dimensional wave equations – one dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV	**FOURIER TRANSFORMS**	**12**

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transform – Properties – Transforms of simple functions – convolution theorem – Parseval's identity.

UNIT V	**Z- TRANSFORMS AND DIFFERENCE EQUATIONS**	**12**

Z- Transforms – Elementary properties – Inverse Z- Transforms (Using partial fractions and residues) – Convolution theorem – Formation of difference equations – Solution of difference equations using Z-transforms.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1**:** Calculate Laplace transform and inverse Laplace transform of different functions.

CO2: Express the Fourier series expansion to represent the given function in the given interval.

CO3: Classify the second order PDE and to know about solving initial and final value problems.

CO4: Apply Fourier transform techniques to evaluate the given integral.

CO5: Solve the given difference equations using Z-transforms.

TEXT BOOKS:

1. Kreyszig Erwin, "Advanced Engineering Mathematics ", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. Peter V.O. Neil "Advanced Engineering Mathematics", 7th Edition, Cengage, New Delhi, 2012.
3. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2016.

REFERENCES:

1. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2. Wylie C. R. and Barrett L. C "Advanced Engineering Mathematics", 6th Edition, Tata McGraw-Hill, New Delhi, 2012.
3. Datta K.B., "Mathematical Methods of Science and Engineering", 2nd Edition, Cengag Learning India Pvt Ltd, Delhi, 2013.

21ME201	ENGINEERING THERMODYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate units and notations in Thermodynamics.
- To apply the principles of thermodynamics and to use it in accounting for the bulk behaviour of the simple physical systems.
- To integrate study of thermodynamic principles, state and relations.
- To apply principles of psychrometric and properties of pure substances.
- To demonstrate basic concepts of Vapour power cycles.

UNIT I	BASIC CONCEPTS AND FIRST LAW OF THERMODYNAMICS	9

Basic concepts - concept of continuum, macroscopic approach. Thermodynamic systems - closed, open and isolated. Property, state, path and process, quasi-static process, work, modes of work, Zeroth law of thermodynamics – concept of temperature and heat. First law of thermodynamics – application to closed and open systems, steady flow process with reference to various thermal equipment.

UNIT II	SECOND LAW OF THERMODYNAMICS	9

Second law of thermodynamics – Kelvin-Planck and Clausius statements of second law, Reversibility and irreversibility. Carnot theorem, Carnot cycle, reversed Carnot cycle, efficiency, Coefficient of Performance (COP). Thermodynamic temperature scale, Clausius inequality, concept of entropy, entropy of ideal gas, principle of increase of entropy –Availability and Unavailability (Qualitative treatment).

UNIT III	PROPERTIES OF PURE SUBSTANCE	9

Properties of pure substances, thermodynamic properties of pure substances in solid, liquid and vapour phases, phase rule, P-V, P-T, T-V, T-S, H-S diagrams, PVT surfaces, thermodynamic properties of steam, Calculations of work done and heat transfer in non-flow and flow processes. Rankine cycle.

UNIT IV	IDEAL, REAL GASES AND THERMODYNAMIC RELATIONS	9

Properties of ideal and real gases, equation of state, Avogadro's Law, Van der Waal's equation of state, compressibility factor, Exact differentials. Thermodynamic Relations, Maxwell's Equations, Tds equations, Clausius- Clapeyron Equation, Thermodynamic relations for changes in Entropy, Enthalpy & Internal Energy, Joule-Thomson coefficient & inversion curve.

UNIT V	PROPERTIES OF MIXTURES AND PSYCHROMETRY	9

Ideal gas mixtures – Evaluation of properties, Dalton's law of partial pressure, properties of air-water vapour mixtures: DBT, WBT, RH, dew point temperature, degree of saturation, thermodynamic wet bulb temperature, enthalpy of moist air, psychrometric processes, bypass factor, calculating the properties of air using psychrometric table and chart.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:	Demonstrate the first law of thermodynamics for systems and processes
CO2:	Apply the second law of thermodynamics for systems and processes
CO3:	Assess the thermodynamics laws for pure substances
CO4:	Apply the thermodynamics relations for ideal and real gases.
CO5:	Demonstrate the psychrometric processes in air-water vapor mixtures.

TEXT BOOKS:

1. Yunus A. Cengel & Michael A. Boles, "Thermodynamics-An Engineering Approach", 9th Edition, 2019.
2. R.K.Rajput, "A Text Book of Engineering Thermodynamics ", 6th Edition, Laxmi Publications, 2019.
3. Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", 8th Edition, Willey, 2014.

REFERENCES:

1. Arora C.P, "Thermodynamics", 12th Edition, Tata McGraw-Hill, 2017.
2. Borgnakke &Richard E. Sonnatag, "Fundamental of Thermodynamics", 8th Edition, 2016.
3. Chattopadhyay, P, "Engineering Thermodynamics", 2nd Edition, Oxford University Press, 2016.
4. Nag. P.K., "Engineering Thermodynamics", 6th Edition, Tata McGraw-Hill, 2017.

21ME202	STRENGTH OF MATERIALS FOR MECHANICAL ENGINEERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the concepts of stress, strain, principal stresses and principal planes.
- To use the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses.
- To calculate stresses and deformation in circular shafts and helical spring due to torsion.
- To compute slopes and deflections in determinate beams by various methods.
- To predict the stresses and deformations induced in thin and thick cylindrical shells

UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 9

Rigid bodies and deformable solids – Tension, Compression and Shear Stresses - Deformation of simple and compound bars – Thermal stresses – Elastic constants – Volumetric strains – Stresses on inclined planes – principal stresses and principal planes – Mohr's circle of stress

UNIT II TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM 9

Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending – bending stress distribution – Load carrying capacity – Proportioning of sections.

UNIT III TORSION OF SHAFTS AND SPRINGS 9

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts - Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

UNIT IV DEFLECTION OF BEAMS 9

Double Integration method – Macaulay's method – Area moment method for computation of slopes and deflections in beams - Conjugate beam and strain energy – Maxwell's reciprocal theorems

UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9

Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses and deformation in thin and thick cylinders – spherical shells subjected to internal pressure – Deformation in spherical shells – Lame's theorem

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply Hooke's law in structural members.

CO2: Construct the shear force and bending moment diagrams for various beams.

CO3: Interpret the design of shafts and springs.

CO4: Calculate the slope and deflection of beams

CO5: Solve the stresses and deformations in cylindrical and spherical shells.

TEXT BOOKS:

1. Bansal, R.K., "Strength of Materials", 6th Edition, Laxmi Publications (P) Ltd., 2022
2. Egor. Popov "Engineering Mechanics of Solids" 2nd Edition, Prentice Hall of India, 2015.
3. Subramanian R., "Strength of Materials", 3rd Edition, Oxford University Press, Oxford

Higher Education Series, 2016.
REFERENCES:
1. Jindal U.C., "A text book on Strength of Materials", 2nd Edition, Asian Books Pvt. Ltd., 2012 2. Ferdinand P. Beer, Russell Johnson, J.r. and John T. Dewolf "Mechanics of Materials", 7th Edition, Tata McGraw Hill Publishing ‘co. Ltd., 2014. 3. Hibbeler, R.C., "Mechanics of Materials", 9th Edition, Pearson Education, Low Price Edition, 2018.

21ME203	**ENGINEERING METALLURGY** (Theory with Practical Course)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To apply the concepts of alloys, microstructure and properties of steel and iron.
- To illustrate the concept of various heat treatment process and its effects on materials.
- To demonstrate the composition and properties of various ferrous and non-ferrous metals.
- To relate the composition and properties of various non-metallic materials.
- To illustrate deformation mechanisms and mechanical properties of materials.

UNIT I	**ALLOYS AND PHASE DIAGRAMS**	**9**

Crystal structure – BCC, FCC and HCP structure – unit cell, Crystallographic planes and directions, Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphous, eutectoid, eutectic, peritectic, and peritectroid reactions, Iron – Iron carbide equilibrium diagram. Classification of steel and cast Iron, microstructure, properties and applications.

UNIT II	**HEAT TREATMENT**	**9**

Definition – Full annealing, stress relief, recrystallisation and spheroidising – normalising, hardening and Tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram CCR – Hardenability, Jominy end quench test - Austempering, martempering – case hardening, carburizing, Nitriding, cyaniding, carbonitriding – Flame and Induction hardening – Vacuum and Plasma hardening.

UNIT III	**FERROUS AND NON-FERROUS METALS**	**9**

Effect of alloying additions on steel- α and β stabilisers– stainless and tool steels – HSLA, Maraging steels – Cast Iron - Grey, white, malleable, spheroidal – alloy cast irons, Copper and copper alloys – Brass, Bronze and Cupronickel – Aluminium and Al-Cu – precipitation strengthening treatment – Bearing alloys, Mg-alloys, Ni-based super alloys and Titanium alloys.

UNIT IV	**NON-METALLIC MATERIALS**	**9**

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of various thermosetting and thermoplastic polymers (PP, PS, PVC, PMMA, PET,PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE, Polymers – Urea and Phenol formaldehydes)- Engineering Ceramics – Properties and applications of Al2O3, SiC, Si3N4, PSZ and SIALON –Composites- Classifications- Metal Matrix and FRP - Applications of Composites.

UNIT V	**MECHANICAL PROPERTIES AND DEFORMATION MECHANISMS**	**9**

Mechanisms of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), hardness tests, Impact test lzod and charpy, fatigue and creep failure mechanisms. Surface Treatments: Hard facing - Hard chromium plating – Metal Spraying.

TOTAL: 45 PERIODS

PRACTICAL COURSE	**15**

LIST OF EXPERIMENTS:

1. Tension test on a mild steel rod
2. Double shear test on Mild steel and Aluminium rods

3. Torsion test on mild steel rod
4. Impact test on metal specimen
5. Hardness test on metals - Brinell and Rockwell Hardness Number
6. Deflection test on beams
7. Compression test on helical springs
8. Strain Measurement using Rosette strain gauge
9. Effect of hardening- Improvement in hardness and impact resistance of steels.
10. Tempering- Improvement Mechanical properties Comparison
    (i) Unhardened specimen
    (ii) Quenched Specimen and
    (iii) Quenched and tempered specimen.
11. Microscopic Examination of
    (i) Hardened samples and
    (ii) Hardened and tempered samples.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret material constituents from phase diagram

CO2: Prepare the various heat treatment process

CO3: Predict the effect of alloying elements on ferrous and non-ferrous metals.

CO4: Illustrate the properties and applications of non-metallic materials.

CO5: Predict the various mechanical properties of materials.

TEXT BOOKS:

1. Avner, S.H, “Introduction to Physical Metallurgy”, 2nd edition, McGraw Hill Education, 2017.
2. Williams D Callister, “Material Science and Engineering An Introduction” 9th Edition, Wiley India Pvt Ltd, 2013.
3. Kenneth G.Budinski and Michael K. Budinski, “Engineering Materials”, 9th Edition, Prentice Hall of India Private Limited, 2009.

REFERENCES:

1. Raghavan.V, “Materials Science and Engineering”, 6th Edition, Prentice Hall of India Pvt. Ltd., 2015.
2. U.C.Jindal, "Engineering Materials and Metallurgy", 1st Edition, Pearson, 2011.
3. Upadhyay. G.S. and Anish Upadhyay, “Materials Science and Engineering”, 1st Edition, Viva Books Pvt. Ltd., New Delhi, 2006.

21ME204	**MANUFACTURING TECHNOLOGY – I** (Theory with Practical Course)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To apply the working principles of various metal casting processes.
- To demonstrate and select suitable materials for various engineering applications.
- To illustrate the working principles of various metal joining processes.
- To experiment various metal forming processes.
- To demonstrate the working principles of plastics moulding.

UNIT I	**METAL CASTING PROCESSES**	**9**

Sand Casting: Sand Mould – Type of patterns - Pattern Materials – Pattern allowances – Moulding sand Properties – Cores –Types and applications – Melting furnaces: Blast and Cupola Furnaces; Principle of special casting processes: Shell - investment –Defects in Sand casting.

UNIT II	**BASIC MACHINING PROCESSES**	**9**

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Shaper - Types of operations.

UNIT III	**JOINING PROCESSES**	**9**

Operating principle, basic equipment, merits and applications of: Fusion welding processes: Gas welding - Types – Flame characteristics; Manual metal arc welding – Gas Tungsten arc welding - Gas metal arc welding – Submerged arc welding – Electro slag welding; Operating principle and applications of: Resistance welding - Plasma arc welding. Weld defects: types, causes and cure.

UNIT IV	**METAL FORMING PROCESSES**	**9**

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – forging operations. Rolling of metals– Types of Rolling – Flat strip rolling – shape rolling operations–Drawing Process: Wire and tube drawing - Sheet metal characteristics – shearing, bending and drawing operations – Stretch forming operations – Formability of sheet metal – Working principle and applications.

UNIT V	**MANUFACTURE OF PLASTIC COMPONENTS**	**9**

Plastic forming Processes: Plastics, general properties and applications of thermo plastics and thermosets, Forming/shaping and applications of plastics: Extrusion, Injection Moulding, Blow Moulding, Rotational Moulding, Thermoforming and Compression Moulding – Powder metallurgy – Introduction – Process – Applications.

TOTAL: 45 PERIODS

PRACTICAL COURSE	**15**

LIST OF EXPERIMENTS:

1. Preparation of green sand moulds.
2. Taper & eccentric turning
3. Internal thread cutting
4. External thread cutting
5. Knurling
6. Square head shaping
7. Hexagonal head shaping
8. Fabrication of simple structural shapes using Arc Welding

9. Joining of plates using arc welding
10. Manufacturing of simple sheet metal components using shearing and bending operations

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Predict the various metal casting processes.
CO2: Relate the various metal joining processes.
CO3: Illustrate the various metal forming processes.
CO4: Interpret the various sheet metal processes.
CO5: Demonstrate various types of manufacturing of plastic components.

TEXT BOOKS:

1. Rao, P.N. "Manufacturing Technology Foundry, Forming and Welding", 4th Edition, Tata Machgraw Hill, 2017
2. Kalpakjian. S, "Manufacturing Engineering and Technology", 7th Edition, Pearson Education India, 2014.
3. Roy. A. Lindberg, "Processes and Materials of Manufacture", 3rd Edition, Pearson education, 2015

REFERENCES:

1. Hajra Chouldhary S.K and Hajra Choudhury. AK. "Elements of workshop Technology", volume I and II, 15th Edition, Media promoters and Publishers Private Limited, 2008.
2. Paul Degarmo E, Black J.T and Ronald A. Kosher, "Materials and Processes, in Manufacturing" 13th Edition, Prentice – Hall of India, 2019.
3. Sharma, P.C., "A Text book of production Technology", 4th Edition, S.Chand and Co. Ltd., 2014.

21EE216	ELECTRICAL DRIVES AND CONTROL (Theory with Practical Course)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To explain the basic concepts of different types of electrical machines.
- To illustrate the Drive motor characteristics.
- To summarize different methods of starting DC motors and induction motors.
- To relate the conventional and solid-state drives for DC drives.
- To compare the conventional and solid-state drives for AC drives.

UNIT I	**INTRODUCTION**	**9**

Basic Elements – Types of Electric Drives – factors influencing the choice of electrical drives – heating and cooling curves – Loading conditions and classes of duty – Selection of power rating for drive motors with regard to thermal overloading and Load variation factors

UNIT II	**DRIVE MOTOR CHARACTERISTICS**	**9**

Mechanical characteristics – Speed-Torque characteristics of various types of load and drive motors – Braking of Electrical motors – DC motors: Shunt, series - single phase and three phase induction motors – Specifications and sizing of Machines

UNIT III	**STARTING METHODS**	**9**

Types of D.C Motor starters – Typical control circuits for shunt and series motors – Three phase squirrel cage and slip ring induction motors.

UNIT IV	**SPEED CONTROL OF D.C. DRIVES**	**9**

Speed control of DC series and shunt motors – Armature and field control, Ward-Leonard control system - Using controlled rectifiers and DC choppers –applications.

UNIT V	**SPEED CONTROL OF A.C. DRIVES**	**9**

Speed control of three phase induction motor – Voltage control, voltage / frequency control, slip power recovery scheme – Using inverters and AC voltage regulators – applications.

TOTAL: 45 PERIODS

PRACTICAL COURSE	**15**

LIST OF EXPERIMENTS

1. Load test on DC Shunt motor
2. Load test on DC Series motor
3. O.C.C & Load characteristics of DC Shunt generator
4. O.C.C & Load characteristics of DC Series generator
5. Speed control of DC shunt motor (Armature, Field control)
6. Dynamic Braking on DC Drives
7. Regulation of an alternator by EMF & MMF methods.
8. Load test on three phase squirrel cage Induction motor
9. Speed control of three phase slip ring Induction Motor
10. Study of DC & AC Starters

TOTAL: 60 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Classify different types of electrical drives

CO2: Summarize various characteristics of Drive motors and understand their working principle.

CO3: Compare the usage of different types of Starters in DC and AC motors

CO4: Construct suitable Conventional and Solid-state Electric drives for DC motors.

CO5 : Interpret Conventional and Solid-state Electric drives for AC motors

TEXT BOOKS:

1. Vedam Subramanian, “Electric Drives Concepts and Applications”, 2nd Edition, Tata McGraw-Hill, 2011.
2. Nagrath.I.J & Kothari.D.P, “Electrical Machines”, 4th Edition, Tata McGraw-Hill, 2010.
3. Pillai.S.K “A First Course on Electric Drives”, 3rd Edition, Wiley Eastern Limited, 2012.

REFERENCES

1. Singh. M.D., K.B.Khanchandani, “Power Electronics”, 2nd Edition, Tata McGraw-Hill, 2006.
2. Partab. H., “Art and Science and Utilization of Electrical Energy”, 6th Edition, Dhanpat Rai and Sons, 2017.
3. Gnanavadivel.J, Karthikeyan.J, Chitra Selvi.S, Yogalakshmi.P, “Electrical Drives and Control”,4th Edition, Anuradha Publications, 2019.

21EN201	Interpersonal Skills Laboratory-Listening and Speaking (B.E. - Mechanical Engineering)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1. To demonstrate their ability to comprehend English language in different accents and speak fluently in neutral accent
2. To develop the English language skills required for the successful undertaking of academic studies with primary emphasis on academic speaking and listening skills.
3. To choose appropriate spoken language and use in basic general classroom conversation and to engage in specific academic speaking activities.
4. To discriminate the language of general topics with academic domain
5. To express ideas effectively in presentations.

UNIT I	Basic Pronunciation and Articulation	6

Listening as a key skill - Its importance - Speaking - To give personal information - Ask for personal information - Express ability - Enquire about ability - Ask for clarification Improving pronunciation -Sounds of English - Consonant Sounds - Pronunciation basics - Taking lecture notes - Preparing to listen to a lecture - Articulate a complete idea as opposed to producing fragmented utterances.

UNIT II	Simple Conversations in English	6

Listen to process information - Give information, as part of a simple explanation - Conversation starters: small talk - Sounds of English - Vowel Sounds - Stressing syllables and speaking clearly - Intonation patterns - Compare and contrast information and ideas from multiple sources - Converse with reasonable accuracy over a wide range of everyday topics.

UNIT III	Greetings and Intonation	6

Lexical chunking for accuracy and fluency - Factors influence fluency - Intonation - Deliver a five -minute informal talk - Greet - Respond to greetings - Describe health and symptoms - Invite and offer - Accept - decline - Take leave - Listen for and follow the gist - Listen for detail

UNIT IV	Non Verbal Communication in Presentation and Group Discussion	6

Being an active listener: giving verbal and non - verbal feedback - Extempore Activity - Small Talks - participating in a group discussion - summarizing academic readings and lectures conversational speech listening to and participating in conversations - persuade.

UNIT V	Academic Presentation	6

Formal and informal talk - Listen to follow and respond to explanations, directions and instructions in academic and business contexts - Strategies for presentations and interactive communication - Group/pair presentations - Negotiate disagreement in group work.

TOTAL: 30 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to:

CO1. Comprehend the spoken words of native speakers

CO2. Respond appropriately to the speeches of native speakers

CO3. Take part in group discussions

CO4. Make effective presentations

CO5. Take part confidently and appropriately in both formal and informal conversations

TEXT BOOKS:

1. Ladousse, Gillian Porter. Role Play. Oxford University Press: Oxford, 2014
2. Brooks, Margret. Skills for Success. Listening and Speaking. Level 4 Oxford University Press, Oxford: 2011.
3. Richards, C. Jack. & David Bholke. Speak Now Level 3. Oxford University Press, Oxford: 2010

REFERENCES:

1. Bhatnagar, Nitin and Mamta Bhatnagar. Communicative English for Engineers and Professionals. Pearson: New Delhi, 2010.
2. Hughes, Glyn and Josephine Moate. Practical English Classroom. Oxford University Press: Oxford, 2014.
3. Vargo, Mari. Speak Now Level 4. Oxford University Press: Oxford, 2013.
4. Richards C. Jack. Person to Person (Starter). Oxford University Press: Oxford, 2006.

<table>
<tr><td rowspan="2">21MA204</td><td rowspan="2">PROBABILITY, STATISTICS AND NUMERICAL METHODS
(COMMON TO B.E. MECH Engg. & CIVIL Engg.)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>2</td><td>0</td><td>4</td></tr>
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COURSE OBJECTIVES:

- To describe the necessary basic concepts in probability
- To explain the concept of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To discuss the basic concepts of solving algebraic and transcendental equations and numerical techniques of integration which plays an important role in engineering and technology disciplines.
- To describe various techniques and methods of solving ordinary differential equations.
- To explain various techniques and methods of solving partial differential equations.

UNIT I	**PROBABILITY**	**12**

Introduction-Sample Spaces and Events-Axioms of Probability-Interpretations and Properties of Probabilities-Conditional Probabilities - Baye's theorem- Independence.

UNIT II	**TESTING OF HYPOTHESIS**	**12**

Large sample test based on Normal distribution for single mean and difference of means – Tests based on t, $\chi 2$ and F distributions for testing means and variances – Contingency table (Test for Independency) – Goodness of fit.

UNIT III	**SOLUTION OF EQUATIONS AND NUMERICAL INTEGRATION**	**12**

Newton Raphson method – Solution of linear system of equations: Gauss elimination method – Pivoting – Gauss Jordan method – Gauss Seidel method – Numerical integration by Trapezoidal and Simpson's rule.

UNIT IV	**NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS**	**12**

Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equation – Milne's Predictor and Corrector method – Adam's Bashforth predictor – corrector method for solving first order equation.

UNIT V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS**	**12**

Finite difference methods for solving second order two-point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit methods – One dimensional wave equation by explicit method.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1**:** Use the basic concepts of Probability and Random variables.

CO2 : Explain the test of hypothesis for small and large samples by using various test

Like t-test, F-test, Z-test and $\chi 2$ test.

CO3**:** Apply a suitable method to solve algebraic and transcendental equations.

CO4 : Explain the knowledge of various techniques and methods for solving first and second order Ordinary differential equations.

CO5 : Solve the partial and ordinary differential equations with initial and Boundary conditions by Using certain techniques with engineering applications.

TEXT BOOKS:

1. JAY.L. Devore, "Probability and Statistics for Engineering and the Science", 8th Edition, Cengage Learning, 2012.
2. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis", 7th Edition, Pearson Education, Asia, New Delhi, 2006.
3. Johnson, R.A., Miller, I and Freund J, "Probability and Statistics for Engineers", 8th Edition, Pearson Education, Asia, 2015.

REFERENCES:

1. S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", 11th Edition, Sultan Chand & Sons, 2015.
2. Chapra. S.C. and Canale. R.P, "Numerical Methods for Engineers", 5th Edition, Tata McGraw Hill, New Delhi, 2007.
3. S.K.Gupta, "Numerical Methods for Engineers", 7th Edition, New age international private Ltd publishers, 2015.

21ME205	MANUFACTURING TECHNOLOGY – II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the mechanism of chip formation
- To demonstrate the working procedure and various process of turning machine
- To demonstrate the working principle of drilling, milling and Gear cutting machines
- To interpret the various types of grinding and broaching machines
- To demonstrate the CNC program

UNIT I	THEORY OF METAL CUTTING	9

Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools– nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability

UNIT II	ADVANCED TURNING MACHINES	9

Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle.

UNIT III	DRILLING, MILLING AND GEAR CUTTING MACHINES	9

Drilling, reaming, boring and tapping. Milling operations-types of milling cutter. Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes –finishing of gears.

UNIT IV	ABRASIVE PROCESS AND BROACHING	9

Abrasive processes: grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centreless grinding and internal grinding- Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines

UNIT V	CNC MACHINING	9

Numerical Control (NC) machine tools – CNC types, constructional details, special features, machining centre, part programming fundamentals CNC – manual part programming – micromachining – wafer machining.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the mechanism of material removal processes.

CO2: Relate the constructional and operational features of centre lathe and other special purpose lathes

CO3: Demonstrate the constructional and operational features of shaper, milling, and gear manufacturing process.

CO4: Describe the grinding and other finishing processes.

CO5: Relate CNC part programming

TEXT BOOKS:

1. Rao. P.N "Manufacturing Technology - Metal Cutting and Machine Tools", 4th Edition, Tata McGraw-Hill, New Delhi, 2018.

2. Serope Kalpakjian and Steven R.Schmid, 'Manufacturing Engineering and Technology', 8th Edition, PHI, 2020. 3. Hajra Choudhury, "Elements of Workshop Technology", Vol-II, 15th Edition, Media Promoters 2016.
REFERENCES:
1. Paul Degarma E., Black J.T. and Ronald A. Kosher, "Materials and Processes, in Manufacturing", 8th Edition, Prentice Hall of India, 1997. 2. Sharma, P.C., "A Textbook of Production Technology", 10th Edition, S.Chand and Co. Ltd., 2004. 3. Geofrey Boothroyd, "Fundamentals of Metal Machining and Machine Tools", 3rd Edition, Mc Graw Hill, 2005.

21ME206	KINEMATICS AND DYNAMICS OF MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the basic components and layout of linkages in the assembly of a system /machine.
- To apply the principles of displacement, velocity and acceleration at any point in a link of a mechanism.
- To sketch the cam profile
- To apply the concepts of toothed gearing and kinematics of gear trains
- To illustrate the balancing of rotating and reciprocating masses

UNIT I	BASICS OF MECHANISMS	9

Classifications of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, Mobility – Kutzbach criterion, Gruebler's criterion – Grashof's Law – Kinematic inversions of four-bar chain and slider crank chains – Limit positions – Mechanical advantage – Transmission Angle – Description of some common mechanisms – Quick return mechanisms, Straight line generators, Universal Joint – rocker mechanisms.

UNIT II	KINEMATICS OF LINKAGE MECHANISMS	9

Displacement, velocity and acceleration analysis of simple mechanisms – Graphical method– Velocity and acceleration polygons – Velocity analysis using instantaneous centres – kinematic analysis of simple mechanisms – Coincident points – Coriolis component of Acceleration

UNIT III	KINEMATICS OF CAM MECHANISMS	9

Classification of cams and followers – Terminology and definitions – Displacement diagrams – Uniform velocity, parabolic, simple harmonic and cycloidal motions – Derivatives of follower motions – Layout of plate cam profiles – Specified contour cams – Circular arc and tangent cams – Pressure angle and undercutting – sizing of cams.

UNIT IV	GEARS AND GEAR TRAINS	9

Law of toothed gearing – Involutes and cycloidal tooth profiles –Spur Gear terminology and definitions –Gear tooth action – contact ratio – Interference and undercutting. Helical, Bevel, Worm, Rack and Pinion gears [Basics only]. Gear trains – Sped ratio, train value – Parallel axis gear trains – Epicyclic Gear Trains

UNIT V	BALANCING	9

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Relate the fundamental principles of kinematics and kinetics for simple mechanisms.
CO2: Sketch the velocity and acceleration diagram for simple mechanisms.
CO3: Sketch the profile of the cam mechanisms.
CO4: Assess the law of toothed gearing in various gear trains.

CO5:	Calculate the balancing of rotating and reciprocating masses.

TEXT BOOKS:

1. Uicker, J.J., Penock G.R and Shigley, J.E., “Theory of Machines and Mechanisms”, 4th Edition, Oxford University Press, 2014.
2. Ratan, S.S, “Theory of Machines”, 5th Edition, Tata McGraw-Hill, 2019.
3. R.S. Khurmi, “Theory of Machine”, 14th Edition, S Chand, 2020.

REFERENCES:

1. Cleghorn. W. L, “Mechanisms of Machines”, 2nd Edition, Oxford University Press, 2014
2. Ghosh. A and Mallick, A.K., “Theory of Mechanisms and Machines", 3rd Edition, Affiliated East-West Pvt. Ltd., New Delhi, 2006.
3. Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2005.

21ME207	THERMAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the principles of thermodynamics and gas power cycle
- To demonstrate the basic concepts of vapour power cycles
- To experiment the performance of compressors
- To apply the thermodynamic concepts into various thermal application like IC engines andrefrigeration
- To manipulate the principle of Refrigeration and Air conditioning system

UNIT I	GAS POWER CYCLES	9

Air Standard Cycles - Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison.

UNIT II	AIR COMPRESSORS	9

Classification and working principle, work of compression with and without clearance, Volumetric efficiency, Isothermal efficiency and Isentropic efficiency, working principle of Multistage air compressor and intercooling.

UNIT III	INTERNAL COMBUSTION ENGINES	9

IC engine – Classification, working, components and their functions. - two stroke & four stroke SI & CI engines – comparison. of SI and CI engines.– Knocking – phenomena and control, Ignition systems – Magneto, Battery and Electronic. Lubrication and Cooling systems.

UNIT IV	STEAM NOZZLE AND BOILER	9

Types and Shapes of nozzles, Flow of steam through nozzles, Critical pressure ratio, Variation of mass flow rate with pressure ratio. Effect of friction. Metastable flow. Boiler - types and Comparison-Mountings and Accessories. - Boiler trial. IBR Certification.

UNIT V	REFRIGERATION	9

Vapour compression refrigeration cycle, Effect of Superheat and Sub-cooling, Performance calculations, Working principle of air refrigeration cycle, vapour absorption system, and Thermoelectric refrigeration. Eco friendly refrigerants.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply thermodynamic concepts to different air standard cycles and solve problems.
CO2: Solve problems in single stage and multistage air compressors
CO3: Calculate the functioning and features of IC engines, components and performance parameters of IC Engines
CO4: Solve problems for steam nozzle and boilers.
CO5: Solve problems using refrigerant table.

TEXT BOOKS:

1. Rajput. R. K., “Thermal Engineering” 11th Edition, Laxmi Publications, 2020.

2. Kothandaraman. C.P., Domkundwar. S,Domkundwar. A.V., "A course in thermal Engineering", 15th Edition, Dhanpat Rai & sons, 2016.
3. T.D Eastop "Applied Thermodynamics for engineering technologists" 5th Edition, Longman, 1993.

REFERENCES:

1. Ganesan V." Internal Combustion Engines" , 3rd Edition, Tata Mc graw- Hill, 2012
2. Ramalingam. K.K., "Thermal Engineering", 2nd Edition, Scitech Publications (India) Pvt. Ltd., 2009.
3. Rudramoorthy, R, "Thermal Engineering", 3rd Edition, Tata McGraw-Hill, New Delhi,2003

21ME208	FLUID MECHANICS AND MACHINERY (Theory with Practical Course)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To describe the properties of fluids and Pressure measurement.
- To explain law of conservation in flow through pipes.
- To interpret the importance of dimensional analysis.
- To relate the importance of various types of flow in pumps.
- To discuss the importance of various types of flow in turbines.

UNIT I	FLUID PROPERTIES AND FLOW CHARACTERISTICS	9

Units and dimensions- Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, surface tension and capillarity. Flow characteristics –pressure measurement - application of continuity equation, energy equation and momentum equation. Buoyancy.

UNIT II	FLOW THROUGH CIRCULAR CONDUITS	9

Hydraulic and energy gradient - Laminar flow through circular conduits and circular annuli- Boundary layer concepts – types of boundary layer thickness – Darcy Weisbach equation –friction factor- Moody diagram- commercial pipes- minor losses – Flow through pipes in series and parallel.

UNIT III	DIMENSIONAL ANALYSIS	9

Need for dimensional analysis – methods of dimensional analysis – Similitude –types of similitude - Dimensionless parameters- application of dimensionless parameters – Model analysis.

UNIT IV	PUMPS	9

Impact of jets - Euler’s equation - Theory of roto-dynamic machines – various efficiencies– velocity components at entry and exit of the rotor- velocity triangles - Centrifugal pumps– working principle - work done by the impeller -Reciprocating pump- working principle.

UNIT V	TURBINES	9

Classification of turbines – heads and efficiencies – velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles - work done by water on the runner – draft tube. Specific speed - unit quantities.

TOTAL: 45 PERIODS

PRACTICAL COURSE	15

LIST OF EXPERIMENTS

1. Determination of the Coefficient of discharge of given Orificemeter.
2. Determination of the Coefficient of discharge of given Venturimeter.
3. Calculation of the rate of flow using Rotameter.
4. Determination of friction factor for a given set of pipes.
5. Conduct experiments and drawing the characteristic curves of centrifugal pump/ submergible pump
6. Conduct experiments and drawing the characteristic curves of reciprocating pump.
7. Conduct experiments and drawing the characteristic curves of Gear pump.
8. Conduct experiments and drawing the characteristic curves of Pelton wheel.

9. Conduct experiments and drawing the characteristics curves of Francis turbine.
10. Conduct experiments and drawing the characteristic curves of Kaplan turbine.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply mathematical knowledge to predict the properties and characteristics of a fluid.
CO2: Relate and correlate major and minor losses associated with pipe flow in piping network.
CO3: Solve the dimensional analysis.
CO4: Calculate the performance of pumps.
CO5: Illustrate the performance of turbines.

TEXT BOOKS:

1. Bansal, R. K., “Textbook of fluid mechanics and hydraulic machine: SI units” 10th Edition, Laxmi Publication, 2018.
2. White, Frank M., “Fluid Mechanics” 8th Edition, McGraw-Hill, 2017.
3. Modi P.N. and Seth, S.M. "Hydraulics and Fluid Mechanics", 22nd Edition, Standard Book House, 2019.

REFERENCES:

1. Kumar K. L., "Engineering Fluid Mechanics", 8th Revised Edition, Eurasia Publishing House(p) Ltd., 2014,
2. Robert W.Fox, Alan T. McDonald, Philip J.Pritchard, “Fluid Mechanics and Machinery”, 8th Edition, John Wiley & Sons, 2011.
3. Streeter, V. L. and Wylie E. B., "Fluid Mechanics", 9th Edition, McGraw Hill Publishing Co., 2017.

21ME209	MANUFACTURING TECHNOLOGY LABORATORY – II	L	T	P	C
		0	0	4	2

COURSE OBJECTIVE

- To demonstrate various gear cutting in milling machine
- To experiment gear cutting in hobbing and shaping machine
- To demonstrate various grinding operation in grinding machine
- To calculate various cutting forces in lathe and milling using instruments
- To use CNC part programming

LIST OF EXPERIMENTS

1. Spur gear cutting in milling machine
2. Helical Gear Cutting in milling machine
3. Gear generation in hobbing machine
4. Gear generation in gear shaping machine
5. Plain Surface grinding
6. Cylindrical grinding
7. Tool angle grinding with tool and Cutter Grinder
8. Measurement of cutting forces in Milling / Turning Process
9. CNC Part Programming

TOTAL: 60 PERIODS

At the end of the course, learners will be able to

CO1: Manipulate gear cutting operation in milling machine.

CO2: Manipulate gear cutting operation in shaping and gear hobbing machine.

CO3: Manipulate various operation in grinding machine.

CO4: Evaluate various cutting forces in lathe and milling machine.

CO5: Apply CNC part programing for given geometry.

21ME210	THERMAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To illustrate value timing-V diagram and performance of IC Engines.
- To demonstrate characteristics of fuels/Lubricates used in IC Engines.
- To illustrate of steam generator/ turbine.
- To demonstrate Load test on a single cylinder -Diesel engine.
- To illustrate Load test on multi-cylinder petrol engine

LIST OF EXPERIMENTS

1. Valve Timing and Port Timing diagrams.
2. Actual p-v diagrams of IC engines.
3. Performance Test on 4 – stroke Diesel Engine.
4. Heat Balance Test on 4 – stroke Diesel Engine.
5. Morse Test on Multi-cylinder Petrol Engine.
6. Retardation Test on a Diesel Engine.
7. Determination of Flash Point and Fire Point of various fuels / lubricants.
8. Study on Steam Generators and Turbines.
9. Performance and Energy Balance Test on a Steam Generator.
10. Performance and Energy Balance Test on Steam Turbine.

TOTAL: 60 PERIODS

COURSE OUTCOME:

At the end of the course, learners will be able to

CO1: Sketch the various components and mechanisms of I. C. Engines.

CO2: Evaluate performance characteristics of single-cylinder petrol engines at different loads.

CO3: Demonstrate indicated power of individual cylinders of an engine by using the morse test.

CO4: Evaluate the tests Steam Turbine.

CO5: Evaluate the tests Steam generators.

21ME211	KINEMATICS AND DYNAMICS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES

- To calculate the mass moment of inertia.
- To relate the effect of gyroscope and governors.
- To sketch the cam profile for followers.
- To demonstrate the vibration effect for springs under loading condition.
- To calculate the critical speed for shaft with concentrated loads

LIST OF EXPERIMENTS

1. Determination of Mass Moment of Inertia using compound pendulum/ Bifilar Suspension/ Trifilar Suspension
2. Motorized gyroscope – Study of gyroscopic effect and couple.
3. Characteristics of watt / Porter / Proell/ Hartnell governor by fixing the mechanism properly to spindle shaft.
4. Cams – Cam profile drawing, Motion curves and study of jump phenomenon.
5. Free vibration of spring mass system.
6. Longitudinal vibration of helical spring.
7. Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
8. Transverse vibrations of simply supported beam and Cantilever Beam.
9. Balancing of Rotating and Reciprocating masses.
10. Study of Damped Torsional vibration of single rotor system.
11. Study of undamped Torsional vibration of single rotor system.

TOTAL: 60 PERIODS

COURSE OUTCOME:

At the end of the course, learners will be able to

CO1: Calculate mass moment of inertia.
CO2: Interpret the effect of gyroscope and governors.
CO3: Sketch the cam profile for various applications.
CO4: Demonstrate the vibrations effect for spring mass system
CO5: Calculate the critical speed for shafts under different loading system

21EN202	ADVANCED READING AND WRITING LABORATORY	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

1. To use relevant strategies for reading critically and writing purposely.
2. To choose relevant skills required to study engineering topics.
3. To discriminate between general writing and technical writing.
4. To develop students' critical thinking skills.
5. To propose research ideas and develop their project in writing.

UNIT I	BASICS OF PARAGRAPH READING AND WRITING	6

Reading - Strategies for effective reading **-** Usage of glossaries and footnotes to aid reading Comprehension **-** Read and recognize different text types **-** Predicting content using photos and title; **Writing -** Plan before writing **-** Synopsis Preparation **-** Develop a paragraph: topic sentence, supporting sentences, concluding sentence **-**Write a descriptive paragraph

UNIT II	ORGANISATION OF WRITING	6

Reading - Read for details **-** Use of graphic organizers to review and aid comprehension **Writing** - State reasons and examples to support ideas in writing **-** Parallel paragraph **-** Write a paragraph with reasons and examples **-** Write an opinion paragraph

UNIT III	COMPONENTS OF LONGER TEXTS	6

Reading - Understanding pronoun reference and use of connectors in a passage **-** speed reading techniques; **Writing -** Hints Developing **-** Elements of a good essay **-**Types of essays – Descriptive, Narrative, Issue-based, Argumentative **-** Analytical.

UNIT IV	WRITING IN PERSONAL AND TECHNICAL CONTEXTS	6

Reading - Cohesion of ideas, Organization of Ideas; **Writing -** Email writing **-** Resumes **-** Writing Job application **-** Formats of project proposals.

UNIT V	LANGUAGE AT WORKPLACES	6

Reading - Critical reading and thinking **-** Reading and comprehending texts of different domains – Identify; **Writing -** Statement of Purpose **-** Letter of recommendation

TOTAL: 30 PERIODS

OUTCOMES:

At the end of the course, learners will be able to:

CO1: Strengthen the reading skills of students of engineering.

CO2: Enhance their writing skills with specific reference to technical writing.

CO3: Develop students' critical thinking skills.

CO4: Communicate well at workplaces

CO5: Provide more opportunities to develop their project and proposal writing skills.

TEXT BOOKS:

1. E. Suresh Kumar and et al. “Enriching Speaking and Writing Skills”, 2nd Edition.Orient BlackSwan: Hyderabad, 2012
2. Debra Daise, CharlNorloff, and Paul Carne Reading and Writing (Level 4) Oxford University Press: Oxford, 2011
3. Gramer F. Margot and Colin S. Ward Reading and Writing (Level 3) Oxford University Press:Oxford, 2011

REFERENCES:

1. Davis, Jason and Rhonda LIss. Effective Academic Writing (Level 3) Oxford University Press: Oxford, 2006
2. Withrow, Jeans and et al. Inspired to Write. Readings and Tasks to develop writing skills. Cambridge University Press: Cambridge, 2004
3. Petelin, Roslyn and Marsh Durham. The Professional Writing Guide: Knowing Well and Knowing Why. Business & Professional Publishing: Australia, 2004
4. Goatly, Andrew. Critical Reading and Writing. Routledge: United States of America, 2000

21ME301	DESIGN OF MACHINE ELEMENTS (Usage of PSG Design Data Book is permitted in the end semester examinations)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the concepts of stress in design of machine elements subjected to steady and variable loading
- To use design procedure to validate strength of shafts and couplings
- To execute the design procedure for spring and connecting rod to validate the strength based upon the application and requirements
- To demonstrate the design procedure for joints and suggest the suitable dimension for various mechanical applications
- To choose the appropriate bearings based on standard procedure for specific applications

UNIT I	**STEADY STRESSES AND VARIABLE STRESSES**	**9**

Factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers, fits and tolerances, Factor of safety - principle stresses for various load combinations, curved beams - Crane hook – Crane sling, Theories of failure - Design for variable loading

UNIT II	**DESIGN OF SHAFTS AND COUPLINGS**	**9**

Design of solid and hollow shafts based on strength, rigidity and critical speed - Keys, keyways and Splines - Rigid and flexible couplings

UNIT III	**ENERGY STORING ELEMENTS**	**9**

Coil Springs: Tension Springs -Compression Springs - Optimization of helical springs - Leaf Springs – Design of Connecting Rods and crank shafts.

UNIT IV	**TEMPORARY AND PERMANENT JOINTS**	**9**

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Welded joints, riveted joints for structures

UNIT V	**DESIGN AND SELECTION OF BEARINGS**	**9**

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi and Boyd graphs - Selection of Rolling Contact bearings.
Case Studies on Machine Elements using Software (Not for an Examination)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explin the concepts of stress in design of machine elements subjected to steady and variable loading.

CO2: Use design procedure to validate strength of shafts and couplings.

CO3: Execute the design procedure for spring and connecting rod to validate the strength based upon the application and requirements.

CO4: Apply the design procedure for joints and suggest the suitable dimension for various mechanical applications

CO5: Demonstrate the appropriate bearings based on standard procedure for specific applications.

TEXT BOOKS:

1. Joseph Edward Shigley and Charles R. Misucke, “Mechanical Engineering Design”, 10^{th} Edition, Tata McGraw Hill, 2015.

2. Bhandari V, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Book Co, 2016.
3. Sharma and Purohit, “Design of Machine Elements”, 4th Edition, PHI Learning, 2003.

REFERENCES:

1. Jalaludeen S, “Machine Design, Vol -1”, 4th Edition, Reprint Anuradha Publications, 2021
2. M.F. Spott, “Design of Machine Elements”, 8th Edition, Pearson Education, 2019
3. R.B. Patel, “Design of Machine Elements”,7th Edition, MacMillan Publishers India P Ltd., Tech-Max Educational resources, 2011.
4. PSG, “Design Data Book”, Kalaikathir Achhangham Coimbtore, 2018.

21ME302	PRODUCTIVITY AND QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate them to know the evolution of Productivity and Quality Management.
- To use the tools productivity management.
- To apply the functions and principles of management.
- To discussion the application of the quality principles in an organization.
- To apply the tools for quality and productivity improvements.

UNIT I	INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS	9

Definition of Management – Science or Art – Manager Vs Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises -

UNIT II	PRODUCTIVITY MANAGEMENT	9

Evolution of Industrial Engineering, Productivity definition, means of increasing productivity, **Method study**: Selection of jobs, recording tools and techniques – Flow chart, Process chart, Man-machine chart, two handed process chart, Process flow diagram, Process Flow Analysis, Analyzing, and Development of improved methods**. Work Measurement**: Time study equipment, performance rating, allowances, number of cycles to be studied, and determination of standard time. Work place design - Ergonomics.

UNIT III	PRINCIPLES AND CONCEPTS OF TOTAL QUALITY MANAGEMENT	9

Need for quality - Evolution of quality - Definitions of quality - Introduction Productivity metrics – Quality route to productivity - Dimensions of product and service quality - Basic concepts of TQM - Customer focus –Leadership -Employee involvement -Performance appraisal - Continuous process improvement -Supplier partnership TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements

UNIT IV	SUPPORTING TOOLS, ACTIVITIES AND TECHNIQUES IN TQM PROJECTS	9

The seven traditional tools of quality - New management tools -, - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types. Quality Function Deployment (QFD) - Taguchi quality loss function -

UNIT V	QUALITY AND PRODUCTIVITY SYSTEMS	9

JIT concepts and enablers - Kanban principles - evaluate inventory norm in the supply chain, Changeover time compression techniques, TPM - Concepts, improvement needs - Six sigma: Concepts, Methodology - The structure of ISO 9000 – 2015 series standards – Development of quality statement complying different classes - certification process.

TOTAL PERIOD	**45**

Course Outcomes:

At the end of the course, learners will be able to
CO1: Discuss the need for Productivity and Quality
CO2: Demonstrate the various productivity tools and techniques
CO3: Apply the various TQM principles in meeting the customer expectations from a product/service
CO4: Demonstrate various quality management tools, techniques and systems
CO5: Discuss the need for Implement the Productivity and Quality Management Systems in a

different organization environment

TEXT BOOKS

1. Harold Koontz & Heinz Weihrich, “Essentials of Management: An International, Innovation and Leadership Perspective”, 5^{th} edition, McGraw Hill, 2015.
2. ILO, “Introduction to Work Study”, 4^{th} Edition, Universal Publishing Corporation, Bombay, 1992.
3. Dale H. Besterfiled, et at., "Total quality Management", 5^{th} Edition, Pearson Education Asia, Indian Reprint, 2018

REFERENCES

1. Stephen A. Robbins & David A. Decenzo & Mary Coulter, “Fundamentals of Management”, 7^{th} Edition, Pearson Education, 2011.
2. Tripathy PC & Reddy PN, “Principles of Management”, 4^{th} edition, Tata Mcgraw Hill, 1999
3. Panneerselvam R, "Production and Operations Management”, 3^{rd} edition, PHI, New Delhi, 2006

21ME303	FLUID POWER AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss the application of fluid power in process, construction and manufacturing Industries.
- To demonstrate the working of hydraulic actuators and control components
- To apply the hydraulic circuits and systems
- To demonstrate the working of pneumatic and electro pneumatic systems
- To apply a measurable degree of competence in the design, construction and operation of fluid power circuits

UNIT I — FLUID POWER PRINICIPLES AND HYDRAULIC PUMPS — 9

Introduction to Fluid power – Advantages and Applications – Fluid power systems – Types of fluids – Basics of Hydraulics – Pascal's Law – Principles of flow – Sources of Hydraulic power: Pumping Theory – Pump Classification – Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criteria of Linear and Rotary – Fixed and Variable displacement pumps

UNIT II — HYDRAULIC ACTUATORS AND CONTROL COMPONENTS — 9

Hydraulic Actuators: Cylinders – Types and construction, Application, Hydraulic cushioning – Hydraulic motors - Control Components : Direction Control, Flow control and pressure control valves – Types, Construction and Operation – Servo and Proportional valves – Applications – Accessories : Reservoirs, Pressure Switches – Applications – Fluid Power ANSI Symbols

UNIT III — HYDRAULIC CIRCUITS AND SYSTEMS — 9

Accumulators, Intensifiers, Industrial hydraulic circuits – Regenerative, Pump Unloading, Double- Pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-Safe, Speed Control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical hydraulic servo systems.

UNIT IV — PNEUMATIC AND ELECTRO PNEUMATIC SYSTEMS — 9

Properties of air – Perfect Gas Laws – Compressor – Filters, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust Valves, Pneumatic actuators, Design of Pneumatic circuit – Cascade method – Electro Pneumatic System – Elements – Ladder diagram – Problems, Introduction to fluidics and pneumatic logic circuits.

UNIT V — TROUBLE SHOOTING AND APPLICATIONS — 9

Installation, Selection, Maintenance, Trouble Shooting and Remedies in Hydraulic and Pneumatic systems, Design of hydraulic circuits for Drilling, Planning, Shaping, Surface grinding, Press and Forklift applications. Design of Pneumatic circuits for Pick and Place applications and tool handling in CNC Machine tools – Low cost Automation – Hydraulic and Pneumatic power packs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the Fluid power and operation of different types of pumps.

CO2: Summarize the features and functions of Hydraulic motors, actuators and Flow control valves

CO3: Explain the different types of Hydraulic circuits and systems

CO4: Explain the working of different pneumatic circuits and systems

CO5: Summarize the various trouble shooting methods and applications of hydraulic and pneumatic systems.

TEXT BOOKS:

1. Anthony Esposito, "Fluid Power with Applications", 3rd edition, Pearson Education 2005.
2. Majumdar S.R., "Oil Hydraulics Systems- Principles and Maintenance", 2nd edition, Tata McGraw-Hill, 2001.
3. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", 5th edition,Chand & Co, 2006.

REFERENCES:

1. Anthony Lal, "Oil hydraulics in the service of industry", 4th edition, Allied publishers, 1982.
2. Dudelyt, A. Pease and John T. Pippenger, "Basic Fluid Power", 3rd edition,Prentice Hall, 1987.
3. Majumdar S.R., "Pneumatic systems – Principles and maintenance", 4th edition,Tata McGraw Hill, 1995

21ME304	**HEAT AND MASS TRANSFER** (Theory with Practical Course)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To solve the problems on conductive Heat transfer
- To demonstrate the problems on convective Heat Transfer.
- To solve the problems on radioactive Heat Transfer
- To calculate the Heat Exchanger parameters.
- To solve the problems on Mass Transfer.

UNIT I	**CONDUCTION**	**9**

Basic concepts – Mechanism of Heat Transfer - Fourier Law of Conduction - General Differential equation of Heat Conduction – Cartesian and Cylindrical Coordinates – One Dimensional Steady State Heat Conduction–Conduction through Plane Wall, Cylindrical system – Composite Systems

UNIT II	**CONVECTION**	**9**

Free and Forced Convection - Hydrodynamic and Thermal Boundary Layer. Free and Forced Convection during external flow over Plates and Cylinders- Internal flow- Flow through pipes

UNIT III	**RADIATION**	**9**

Black Body Radiation – Grey body radiation - Shape Factor, Planes perpendicular to each other, Plane parallel to each other, Circular disc – Radiation Shields and its applications

UNIT IV	**HEAT EXCHANGERS**	**9**

Types of Heat Exchangers–Heat Exchanger Analysis –LMTD Method and NTU-Effectiveness–Overall Heat Transfer Coefficient–Fouling Factors- Boiling and Condensation.

UNIT V	**MASS TRANSFER**	**9**

Basic Concepts– Diffusion Mass Transfer–Fick’s Law of Diffusion–Steady state Molecular Diffusion– Convective Mass Transfer–Momentum, Heat and Mass Transfer Analogy–

TOTAL: 45 PERIODS

PRACTICAL COURSE	**15**

LIST OF EXPERIMENTS:

1. Thermal conductivity measurement using guarded plate apparatus.
2. Thermal conductivity measurement of pipe insulation using lagged pipe apparatus.
3. Determination of heat transfer coefficient under natural convection from a vertical cylinder.
4. Determination of heat transfer coefficient under forced convection from a tube.
5. Determination of Thermal conductivity of composite wall.
6. Determination of Thermal conductivity of insulating powder.
7. Heat transfer from pin-fin apparatus (natural & forced convection modes)
8. Determination of Stefan – Boltzmann constant.
9. Determination of emissivity of a grey surface.
10. Effectiveness of Parallel / counter flow heat exchanger.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate the problems on conductive Heat transfer

CO2: Apply the problems on convective Heat Transfer.

CO3: Solve the problems on radioactive Heat Transfer

CO4: Calculate the Heat Exchanger parameters.

CO5: Calculate the problems on Mass Transfer

TEXT BOOKS:

1. Cengel, Y.A., “Heat Transfer-A Practical Approach”, 3rd Edition, McGraw-Hill, 2002.
2. Sachdeva R C, “Fundamentals of Engineering Heat and Mass Transfer”, 4th Edition New Age International, 2017.
3. Incropera, Frank P. DeWitt, David P. Bergman, Theodore L, Lavine, Adrienne S , “Fundamentals of Heat and Mass Transfer”, 3rd Edition, John Wiley and Sons,2011.

REFERENCES:

1. Yadav R “Heat and Mass Transfer” 4th Edition, Central Publishing House-Allahabad, 1992.
2. Nag P.K, “Heat Transfer”, 3rd Edition, Tata McGraw-Hill, New Delhi, 2011.
3. Kothandaraman. C.P, “Fundamentals of Heat and Mass Transfer,” 4th Edition New Age International, New Delhi, (Reprint 2015).

21ME305	METROLOGY AND MEASUREMENTS (Theory with Practical Course)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To demonstrate knowledge on various basic concepts of metrology.
- To examine Linear and Angular measurements.
- To experiment with advanced measuring equipment's.
- To apply knowledge on the form measurement techniques.
- To calculate of power, flow and temperature measurements.

UNIT I	BASICS OF METROLOGY	9

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards.

UNIT II	LINEAR AND ANGULAR MEASUREMENTS	9

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar– Autocollimator – Applications

UNIT III	ADVANCES IN METROLOGY	9

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

UNIT IV	FORM MEASUREMENT	9

Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

UNIT V	MEASUREMENT OF POWER, FLOW AND TEMPERATURE	9

Force, torque, power - mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer

TOTAL: 45 PERIODS

PRACTICAL COURSE	15

LIST OF EXPERIMENTS:

1. Calibration and use of measuring instruments – Vernier caliper
2. Calibration and use of measuring instruments - Micrometer
3. Calibration and use of measuring instruments - Vernier height gauge
4. Calibration and use of measuring instruments – telescopic gauge
5. Measurement of angles using sine bar
6. Measurement of gear parameters – gear tooth vernier caliper
7. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM)
8. Measurement of torque and temperature

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1 -Summarize the Metrological basis, concept of measurement errors, uncertainty in measurements

CO2 - Explain the linear and angular measuring instruments and their applications

CO3 -Apply measurement strategies and diagnose various methods of measuring Mechanical parameters.

CO4 -Demonstrate effective methods of various form measurements

CO5 – Calculate power, flow and temperature using measuring instruments.

TEXT BOOKS:

1. Gupta. I.C., "Engineering Metrology", 3rd Edition Dhanpatrai Publications, 2005.
2. Jain R.K. "Engineering Metrology", 5th Edition, Khanna Publishers, 2018.
3. Manohar Mahajan, "A Textbook of Metrology", 4th edition Dhanpatrai Publications, 2021.

REFERENCES:

1. Alan S. Morris, "The essence of Measurement", 3rd Edition, Prentice Hall of India 1996.
2. Beckwith, Marangoni, Lienhard, "Mechanical Measurements", 4th Edition, Pearson Education, 2014.
3. Charles Reginald Shotbolt, "Metrology for Engineers", 5th Edition, Cengage Learning EMEA, 1990.

21ME306	**COMPUTER AIDED PRODUCT DEVELOPMENT** (Theory with Practical Course)	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To apply practical knowledge regarding conceptualization, design and development of a new product
- To use the basic concepts of product design, product features and its architecture
- To use basic knowledge in the common features a product has and how to incorporate them suitably in product.
- To discuss the purpose of inculcating basic design standards and design skills among the students.
- To apply basic features of product development

UNIT I INTRODUCTION **9**

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behavior analysis. Understanding customer need – prompting customer understanding – involve customer in development and managing requirements – Plan and establish product specifications.

UNIT II CONCEPT GENERATION AND SELECTION **9**

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

UNIT III PRODUCT ARCHITECTURE **9**

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

UNIT IV INDUSTRIAL DESIGN **9**

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools– Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – conceptualization – refinement – technology driven products – user – driven products – assessing the quality of industrial design.

UNIT V PRODUCT DEVELOPMENT **9**

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes –Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

LIST OF EXPERIMENTS: **15**

1. Introduction to Engineering Drawing standards
2. Introduction to Geometric Dimensioning
3. Introduction to Limits, Fits and Tolerances
4. Preparation of production drawings and reading of part and assembly drawings
5. CAD drawing of Plummer Block
6. CAD drawing of couplings

7. CAD drawing of screw jack

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate the concept of product development and its applications.

CO2: Apply concept evaluation process.

CO3: Demonstrate the suitable product architecture.

CO4: Discuss the product planning process based on the customer need.

CO5: Discuss product specification with cost, aesthetic and ergonomics aspects.

TEXT BOOKS:

1. Ulrich, Karl T and Steven D. Eppinger, “Product Design and Development”, 6^{th} Edition Irwin/McGraw-Hill, 2015.
2. N.Siddeshwar, P. Kanniah, V.V.S. Sastri, “Machine Drawing”, 3^{rd} Edition, Tata McGraw Hill, 2014.
3. Gopalakrishna K.R., “Machine Drawing”, 22^{nd} Edition, Subhas Stores Books Corner, Bangalore, 2013

REFERENCES:

1. David G. Ullman, “The Mechanical Design Process”, 4^{th} edition, Tata McGraw Hill , 2011
2. Orwin, Homewood, “Effective Product Design and Development”, 1^{st} Edition, Stephen Rosenthal, Business One, 1992.
3. Stuart Pugh, “Tool Design – Integrated Methods for successful Product Engineering”, 1^{st} Edition, Addison Wesley Publishing, 1991.

21ME307	**DESIGN OF TRANSMISSION SYSTEM** (Usage of P.S.G Design Data Book is permitted in the end semester examinations)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate the principles for designing the flexible elements in Transmission systems.
- To apply the design procedure for designing Spur and Helical gears
- To apply the design procedure for designing bevel and worm gears.
- To construct and calculate the multi-speed gear box.
- To illustrate the concepts for designing clutches and brakes.

UNIT I	DESIGN OF FLEXIBLE ELEMENTS	9

Introduction on transmission system - Design of Flat belt drive and Flat belt pulleys - Design of V belt drive - Design of roller chain drive - Design of wire ropes

UNIT II	SPUR AND HELICAL GEARS	9

Gear terminology - speed ratios and number of teeth-force analysis – stresses in gear teeth - dynamic effects – fatigue strength - Gear materials – Design of straight tooth spur & helical gears based on strength and wear considerations – Pressure angle in the normal and transverse plane- Equivalent number of teeth-forces for helical gears. - Crossed helical and Herringbone gear - Cross helical, Terminology-helix angles

UNIT III	BEVEL AND WORM GEARS	9

Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Design of pair of straight bevel gears. Worm Gear: Merits and demerits- terminology, materials-forces and stresses, efficiency, Design of the worm gear pair-Heat generation in worm gear drive

UNIT IV	DESIGN OF GEAR BOXES	9

Gear Box – methods for obtaining different spindle speeds – Requirements of a speed reducer gear box – preferred numbers - Standard step ratio - Rules for optimum gear box design - Preparation of ray diagram and kinematic arrangement – Design of multi-speed gearbox

UNIT V	CLUTCHES AND BRAKES	9

Clutches - Function of clutch – Classification – Friction materials – Design Single plate and Multi plate clutches - axial clutch - internal expanding rim clutches. Brakes – Classification - Design of Single Block, Double Blake brake – Design of Band and Block Brake - Internal and external expanding shoe brakes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply principles and procedure for the design of flexible Transmission elements.

CO2: Interpret the standard procedure for the design Spur and Helical Gears.

CO3: Interpret the standard procedure for the design Bevel and Worm Gears.

CO4: Demonstrate procedure for designing a gear box

CO5: Illustrate the concepts for designing clutches and brakes.

TEXT BOOKS:
1. Bhandari V.B, “Design of Machine Elements”, 4th Edition, Tata McGraw-Hill Education, New Delhi, 2017. 2. Richard G.Budynas and J.Keith Nisbett., “Shigley's Mechanical Engineering Design”, 10th Edition (SIE), Tata McGraw-Hill Education, New Delhi, 2017. 3. Alfred Hall, Halowenko, A and Laughlin, H., “Machine Design”, Tata McGraw-Hill BookCo.(Schaum“s Outline), 2010
REFERENCES:
1. Sundararajamoorthy T.V, Shanmugam .N, “Machine Design”, Anuradha Publications, Chennai, 2018 2. R.S.Khurmi, “A text book of Machine Design”, S.Chand & Co, New Delhi, 1st Edition 2015. 3. PSG College of Technology, “Design Data Book of Engineers”, Kalaikathir Achchagam, 2018.

21ME308	FINITE ELEMENT ANALYSIS (Theory with Practical Course)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To demonstrate the concepts of Mathematical Modeling of Engineering problems.
- To examine the One Dimensional structural and thermal elements.
- To appraise structural and thermal elements using Two Dimensional scalar variable equations
- To appraise planar stresses using Two Dimensional Vector variable equations
- To examine the Isoparametric elements for its displacement

UNIT I	INTRODUCTION	9

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Weighted Residual Methods – Variational Formulation of Boundary Value Problems–Ritz Technique – Basic concepts of the Finite Element Method.

UNIT II	ONE-DIMENSIONAL PROBLEMS	9

One Dimensional Second Order Equations – Discretization – Element types – Linear and Higher order Elements–Derivation of Shape functions and Stiffness matrices and force vectors-Assembly of Matrices-Solution of problems from solid mechanics and heat transfer.

UNIT III	TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS	9

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems – Thermal problems

UNIT IV	TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS	9

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

UNIT V	ISOPARAMETRIC FORMULATION	9

Natural co-ordinate systems–Isoparametric elements – Shape functions – One and two dimensions – Serendipity elements–Numerical integration and Gaussian quadrature

TOTAL: 45 PERIODS

PRACTICAL COURSE	15

LIST OF EXPERIMENTS:

1. Force and Stress analysis using link elements in Trusses, cables etc.
2. Stress and deflection analysis in beams with different support conditions
3. Stress analysis of flat plates.
4. Stress analysis of axisymmetric components
5. Thermal stress and heat transfer analysis of plates.
6. Thermal stress and heat transfer analysis of composite plates.
7. Modal analysis of Beams
8. Harmonic and transient analysis of simple beams

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:	Illustrate the Engineering problems using the concept of Engineering Model
CO2:	Solve the One Dimensional structural and thermal elements.
CO3:	Solve the Two Dimensional scalar variable equations structural and thermal elements
CO4:	Solve planar stresses using Two Dimensional Vector variable equations
CO5:	Demonstrate Isoparametric element, shape function and Gaussian quadrature.

TEXT BOOKS:

1. Reddy. J.N., “An Introduction to the Finite Element Method”, 3^{rd} Edition, Tata McGraw-Hill, 2005
2. Seshu, P, “Text Book of Finite Element Analysis”, 1^{st} Edition, Prentice-Hall of India Pvt. Ltd. New Delhi, 2007.
3. Rao, S.S., “The Finite Element Method in Engineering”, 3^{rd} Edition, Butterworth Heinemann, 2004

REFERENCES:

1. Logan, D.L., “A first course in Finite Element Method”, 1^{st} Edition, Thomson Asia Pvt. Ltd., 2002
2. Robert. D. Cook, David. S. Malkus, Michael. E. Plesha, Robert. J. Witt, “Concepts and Applications of Finite Element Analysis”, 4^{th} Edition, Wiley Student Edition, 2002.
3. Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 3^{rd} Edition, Prentice Hall College Div,1990
4. Bhatti Asghar M, "Fundamental Finite Element Analysis and Applications",1^{st} Edition, John Wiley & Sons, 2005(Indian Reprint 2013)

<table>
<tr><td rowspan="2">21ME309</td><td rowspan="2">MECHATRONICS and IoT
(Theory with Practical Course)</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
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COURSE OBJECTIVES:

- To apply knowledge about the elements and techniques involved in Mechatronics system.
- To demonstrate the architecture and operation of typical microprocessors and microcontrollers.
- To understand the concepts of Internet of Things and able to build IoT applications
- To apply knowledge gained about generic architecture of PLCs and its real-life industrial applications.
- To evaluate and select suitable actuators, sensors and controllers

UNIT I	**MECHATRONICS, SENSORS AND TRANSDUCER**	**9**

Introduction to Mechatronics – Systems – Need for Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics. Sensors and Transducers: Static and Dynamic Characteristics of Sensor, Potentiometers – LVDT – Capacitance sensors – Strain gauges – Eddy current sensor – Hall effect sensor – Temperature sensors(Bimetallic Strips,RTD,Thremistor) – Light sensors(Photo diode, photo transistor, Photo resister)-Optical Encoder

UNIT II	**MICROPROCESSOR AND MICROCONTROLLER**	**9**

Introduction – Architecture of 8085 – Pin Configuration – Addressing Modes –Instruction set– Block diagram of 8051 Microcontroller-Microprocessor vs. Microcontroller-Timing Diagram

UNIT III	**IOT AND PROGRAMMABLE PERIPHERAL INTERFACE**	**9**

Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT – Architecture of 8255- Pin Configuration- Interfacing Keyboard, LED display - Traffic light Control interface.

UNIT IV	**PROGRAMMABLE LOGIC CONTROLLER**	**9**

Introduction – Basic structure –Architecture of PLC- Input and output processing – Logic Gates– Mnemonics – Timers, counters and internal relays – Data handling – Selection of PLC

UNIT V	**ACTUATORS AND MECHATRONIC SYSTEM DESIGN**	**9**

Stepper and Servo motors – Construction – Working Principle – Advantages and Disadvantages. Design process-stages of design process – Traditional and Mechatronics design concepts – Case Studies of Mechatronics systems – Pick and place Robot – Automatic car park barrier.

LIST OF EXPERIMENTS:	**15**

1. Experiment with the various types of transducers.
2. Assembly language programming of 8085 – Addition – Subtraction
3. Stepper motor interface.
4. Design and develop traffic management system.
5. Speed control of DC motor.
6. Experiment on hydraulic, pneumatic and electro-pneumatic circuits.

7. Modelling and analysis of basic hydraulic, pneumatic and electrical circuits using Software.
8. Experiment on PLC and its applications.
9. Experiment the image processing technique.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Select various Sensors and Transducers in Mechatronics systems

CO2: Demonstrate 8085 Microprocessors and 8051 Micro controller.

CO3: Operate the fundamentals of IOT and Programmable Peripheral Interface.

CO4: Interpret programmable logic controller

CO5: Demonstrate various actuators and appraise mechatronics systems

TEXT BOOKS:

1. W.Bolton, "Mechatronics", 4th Edition, Prentice Hall, 2008.
2. Ramesh S Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", 5th Edition, Prentice Hall, 2008.
3. A. McEwen and H. Cassimally, "Designing the Internet of Things", 1st Edition, Wiley, 2013.

REFERENCES:

1. Devadas Shetty and Richard A. Kolk, "Mechatronics Systems Design", 4th Edition, PWS publishing company, 2007.
2. Krishna Kant, "Microprocessors & Microcontrollers", 3rd Edition, Prentice Hall of India, 2013
3. Michael B.Histand and Davis G.Alciatore, "Introduction to Mechatronics and Measurement systems", 4th Edition, McGraw Hill International edition, 2012.

21ME310	DESIGN THINKING AND PROTOTYPE DEVELOPMENT	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To apply the foundational knowledge to get hands on training in the fabrication of one or more components.
- To illustrate the various parts of the product.
- To relate the various operation and material selected for the product.
- To interpret the cost analysis of the product.
- To demonstrate the complete working model.

GUIDELINE FOR REVIEW AND EVALUATION

The students may be grouped into 2 to 4 and work under a project supervisor.

The device/system/component(s) to be fabricated may be decided in consultation with the supervisor and if possible with an industry.

A project report to be submitted by the group and the fabricated model, which will be reviewed and evaluated for internal assessment by a Committee constituted by the Head of the Department.

At the end of the semester examination the project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the fundamental concepts of design the product.

CO2: Demonstrate the various parts of the product.

CO3: Relate various operation and material selected for the product.

CO4: Interpret the cost analysis of the product.

CO5: Show the applications of the complete working model.

21EN301	PROFESSIONAL COMMUNICATION LABORATORY *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To demonstrate communication skills that can lead to improved interpersonal relationships.
- To plan to set and achieve goals with focus.
- To organize themselves in work life to face the professional set up with confidence.
- To interpret ideas and participate in group discussion with positive attitude.
- To develop their confidence and help learners to attend interviews successfully.

UNIT I	COMMUNICATION AND PROFESSIONAL ETIQUETTES	6
Importance and Types of Communication Verbal communication -Presentation skills- Non-Verbal communication - Personal Appearance, Posture, Gestures, Facial Expressions, Eye Contact and Space Distancing - Professional Etiquette		
UNIT II	**GOAL SETTING AND MOTIVATION**	**6**
Short term and Long term Goals- Strategies to set and achieve goals- Motivation		
UNIT III	**TIME AND STRESS MANAGEMENT**	**6**
Importance of Time - Time Management Skills - Sources of Stress - Managing Stress - Analysis of the Case Studies on time and stress management		
UNIT IV	**GROUP DISCUSSIONS AND POSITIVE ATTITUDE**	**6**
Group Discussions - Leadership Qualities - Decision Making - Problem Solving - Negotiation Skills - Positive Attitude		
UNIT V	**RESUME MAKING AND INTERVIEW SKILLS**	**6**
Preparing Resume - E - Resume - Covering Letter – Job Application through email - Career Portfolio - Types of Interviews - Mock Interviews		
	TOTAL: 30 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Demonstrate effective communication skills through presentations.

CO2: Utilize their knowledge of motivation in setting and achieving goals.

CO3: Examine time and stress management.

CO4: Formulate their ideas into an effective communication in formal contexts.

CO5: Develop a well-composed resume and face interviews confidently.

TEXTBOOKS:

1. Dhanavel S P, “English and Soft Skills”, 1st Edition, Orient BlackSwan Ltd, Hyderabad, 2012.
2. Dr. Tobin Porterfield & Bob Graham, “The 55 Soft Skills That Guide Employee and Organizational Success,” Mason – West Publishing House, 2018.
3. Prashant Sharma, “Soft Skills Personality Development for Life Success, “BPB Publications, New Delhi, January 2018.

REFERENCES:

1. M. Ashraf Rizvi, “Effective Technical Communication,” Tata McGraw Hill Education Pvt. Ltd. New Delhi, 2016.
2. Mohan Krishna & Meera Banerji, “Developing Communication Skills,” 1st Edition, Trinity Press, 2017.
3. N. Krishnaswami & T. Sriraman, “Creative English for Communication”, 3rd Edition, Laxmi Publications Private Limited, 2017.

21ME401	PROJECT WORK 1	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To develop knowledge to formulate a real-world problem.
- To apply the goal and evolve procedures
- To use different tools and techniques to arrive at a solution
- To relate the results analytically and experimentally
- To prepare a report and give a presentation

Student shall identify a minor problem related to the field of Mechanical Engineering and carry out a literature survey/case studies/data collection. Student is supposed to formulate Engineering solutions to the problem, methodology to test their hypothesis/solutions and validate it theoretically/practically, planned and executed within the stipulated time.

Observations, results and inference should be documented and presented as report in the prescribed format.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify an engineering problem using scientific tools

CO2: Analyse physical systems to address an engineering problem

CO3: Formulate objectives and timelines for executing a project

CO4: Apply multidisciplinary knowledge to develop sustainable solutions

CO5: Report solutions and their outcomes through documentation

21ME402	PROJECT WORK II	L	T	P	C
		0	0	20	10

COURSE OBJECTIVES:

- To use the knowledge to formulate a real-world problem.
- To demonstrate the goal and evolve procedures
- To use different tools and techniques to arrive at a solution
- To choose the results analytically and experimentally
- To prepare a report and give a presentation

Student shall identify a major/critical problem related to the field of Mechanical Engineering and carry out a literature survey/case studies/data collection. Student supposed to formulate Engineering solutions to set objectives, methodology to test their hypothesis/solutions and validate it theoretically/practically, planned and executed within the stipulated time.

Observations, results and inferences should be documented and presented as report in the prescribed format.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify an engineering problem using scientific tools

CO2: Analyse physical systems to address an engineering problem

CO3: Formulate objectives and timelines for executing a project

CO4: Apply multidisciplinary knowledge to develop sustainable solutions

CO5: Report solutions and their outcomes through documentation

VERTICAL 1: PRODUCT AND PROCESS DEVELOPMENT

21PME01	DESIGN CONCEPTS IN ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the concepts of design process.
- To explain the design ability of reliable products to satisfy the customer needs.
- To apply the appropriate design techniques.
- To illustrate the process of material selection principles and design.
- To apply the concepts used in design for reliability.

UNIT I	DESIGN PROCESS	9

Importance of design - The Design Process - Morphology of Design - Design Drawings - Computer Aided Engineering - Designing of Standards - Concurrent Engineering - Product Life Cycle - Technological Forecasting - Market Identification - Competition Benchmarking.

UNIT II	DESIGN FOR CUSTOMER NEEDS	9

Identification of customer needs - customer requirements - Quality Function Deployment - Product Design Specifications - Human Factors in Design – Ergonomics, Aesthetics and Societal consideration – Product liability – Patenting intellectual property – Legal and ethical domains – Codes of ethics - Ethical conflicts – Design for ecological - future trends in interaction of engineering with society.

UNIT III	DESIGN TECHNIQUES	9

Creativity and Problem Solving – Creativity methods-Theory of Inventive Problem Solving (TRIZ) – Conceptual decomposition - Generating design concepts - Axiomatic Design – Evaluation methods-Embodiment Design - Product Architecture - Configuration Design - Parametric Design - Role of models in design - Mathematical Modelling – Simulation – Geometric Modelling

UNIT IV	MATERIAL SELECTION PROCESSING IN DESIGN	9

Material Selection Process - Economics - Cost Vs Performance - Weighted Property Index - Value Analysis - Role of Processing in Design - Classification of Manufacturing Process - Design for Manufacture - Design for Assembly - Residual Stresses - Fatigue, Fracture and Failure.

UNIT V	PROBABILITY CONCEPTS IN DESIGN FOR RELIABILITY	9

Probability – Distributions – Test of Hypothesis – Design of Experiments – Reliability Theory – Design for Reliability – Robust Design – Failure Mode and Effect Analysis

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the principles of CAE/concurrent engineering/forecasting techniques for new product design and development

CO2: Describe the appropriate design strategies complying with established standards in devising systems for customer needs

CO3: Use the various design techniques through modelling/simulation and optimize design

CO4: Apply the appropriate material selection strategy for various design concepts.

CO5: Demonstrate the various design and analysis tools for improving the quality and reliability of products performance.

TEXT BOOKS:

1. Dieter, George E., Engineering Design - "A Materials and Processing Approach", 3rd Edition, McGraw Hill International Editions, Singapore, 2000.
2. Karl T. Ulrich and Steven D. Eppinger "Product Design and Development" 4th Edition, McGraw Hill Edition 2009.
3. Kevin Otto, and Kristin Wood, "Product Design – Techniques in Reverse Engineering and New Product Development", 1st Edition Pearson Education, 2000

REFERENCES:

1. Pahl, G, and Beitz, W.," Engineering Design – A systematic approach", 3rd Edition, English Springer 2007.
2. Suh, N.P., "The principles of Design", 1st Edition, Oxford University Press, NY. 1990.
3. Orwin, Homewood, "Effective Product Design and Development", 1st Edition, Stephen Rosenthal, Business One, 1992.

21PME02	PRODUCT LIFECYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the importance of product life cycle management.
- To illustrate the functions of product life cycle management.
- To use PLM software for various module in development of product.
- To demonstrate product life cycle concepts in industrial applications.
- To interpret PLM customization with CAD, SLM and ERP.

UNIT I	INTRODUCTION TO PRODUCT LIFECYCLE MANAGEMENT	9

Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management, Product Data Management, Collaborative Product Definition Management, Collaborative Product Commerce.

UNIT II	FUNCTIONS AND FEATURES OF PRODUCT DATA MANAGEMENT	9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration.

UNIT III	DETAILS OF MODULES IN APDM/PLM SOFTWARE	9

Collaborative Product Development, Mapping Requirements to specifications. Part Numbering, Engineering Vaulting, Product reuse, Engineering Change Management, Bill of Material and Process Consistency. Digital Mock up and Prototype development. Virtual testing and collateral.

UNIT IV	ROLE OF PLM IN INDUSTRIES	9

PLM selection and implementation - PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM

UNIT V	BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE	9

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Complete the history, concepts and terminology of PLM

CO2: Illustrate the functions and features of PLM/PDM

CO3: Discover the different modules offered in commercial PLM/PDM tools.

CO4: Demonstrate the PLM/PDM approaches for industrial applications.

CO5: Apply the integration of PLM/PDM with legacy data base & ERP systems

TEXT BOOKS:

1. Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, 3^{rd} Edition, Springer Publisher, 2008.
2. John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, 2^{nd} Edition, Springer Publisher, 2011.
3. Michael Grieves, “Product Life Cycle Management”, 2^{nd} edition, Tata McGraw Hill, 2006.

REFERENCES:

1. Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, 1^{st} Edition, Artech House Publishers, 2003.
2. John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, 1^{st} Edition, Springer Publisher, 2007.
3. ArieKarniel and Yoram Reich, Managing the Dynamics of New Product Development Processes: A New Product Lifecycle Management Paradigm, 1^{st} Edition, Springer, 2011.

<table>
<tr><td rowspan="2">21PME03</td><td rowspan="2" colspan="2">COMPUTER INTEGRATED MANUFACTURING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">• To demonstrate the basic concepts of CAD /CAM/CIM.
• To use the computers and software for preparing the process plan.
• To apply the group technology and cellular manufacturing concepts.
• To apply the concepts of FMS and AGV Systems.
• To demonstrate the basics of Industrial Robotics.</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION</td><td>9</td></tr>
<tr><td colspan="7">Brief introduction to CAD and CAM – Manufacturing Planning, Manufacturing Control- Introduction to CAD/CAM –CIM concepts – Computerized elements of CIM system – Types of production - Manufacturing models and Metrics – Mathematical models of Production Performance – Simple problems – Manufacturing Control – Simple Problems – Basic Elements of an Automated system – Levels of Automation</td></tr>
<tr><td>UNIT II</td><td colspan="5">PRODUCTION PLANNING AND CONTROL AND COMPUTERISED PROCESS PLANNING</td><td>9</td></tr>
<tr><td colspan="7">Process planning – Computer Aided Process Planning (CAPP) – Logical steps in Computer Aided Process Planning – Aggregate Production Planning and the Master Production Schedule – Material Requirement planning – Capacity Planning- Control Systems-Shop Floor Control- Automated data collection - bar codes, optical character recognition, vision or image processing, radio frequency identification, magnetic identification - Brief on Manufacturing Resource Planning-II (MRP-II)</td></tr>
<tr><td>UNIT III</td><td colspan="5">CELLULAR MANUFACTURING</td><td>9</td></tr>
<tr><td colspan="7">Group Technology (GT), Part Families – Parts Classification and coding – Simple Problems in Opitz Part Coding system – Production flow Analysis – Cellular Manufacturing – Composite part concept – Machine cell design and layout – Quantitative analysis in Cellular Manufacturing – Rank Order Clustering Method - Arranging Machines in a GT cell – Hollier Method – Simple Problems.</td></tr>
<tr><td>UNIT IV</td><td colspan="5">FLEXIBLE MANUFACTURING SYSTEM (FMS) AND AUTOMATED GUIDED VEHICLE SYSTEM (AGVS)</td><td>9</td></tr>
<tr><td colspan="7">Types of Flexibility - FMS – FMS Components – FMS Application & Benefits – FMS Planning and Control – Quantitative analysis in FMS – Simple Problems. Automated Guided Vehicle System (AGVS) – AGVS Application – Vehicle Guidance technology – Vehicle Management & Safety.</td></tr>
<tr><td>UNIT V</td><td colspan="5">INDUSTRIAL ROBOTICS</td><td>9</td></tr>
<tr><td colspan="7">Robot Anatomy and Related Attributes – Classification of Robots- Robot Control systems – End Effectors – Sensors in Robotics – Robot Accuracy and Repeatability - Industrial Robot Applications – Robot Part Programming – Robot Accuracy and Repeatability</td></tr>
</table>

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of the course, learners will be able to CO1: Describe the basis of Computer Integrated Manufacturing CO2: Apply the fundamentals of process and production planning CO3: Explain cellular manufacturing and group technology concepts CO4: Explain the concepts of FMS and AGV Systems CO5: Describe the working of Industrial Robotics in manufacturing systems
TEXT BOOKS:
1. Mikell.P. Groover "Automation, Production Systems and Computer Integrated manufacturing", 4th Edition, Pearson education ltd, 2016. 2. Radhakrishnan P, Subramanyan S. and Raju V., "CAD/CAM/CIM", 2nd Edition, New Age International (P) Ltd, New Delhi, 2018. 3. James A. Rehg, H. W. Kraebber, "Computer Integrated Manufacturing", 3rd Edition, Pearson, 2004.
REFERENCES:
1. Gideon Halevi and Roland Weill, "Principles of Process Planning – A Logical Approach" 1st Edition, Chapman & Hall, London, 1995. 2. Kant Vajpayee S, "Principles of Computer Integrated Manufacturing", 1st Edition, Prentice Hall India 1998. 3. Rao. P, N Tewari &T.K. Kundra, "Computer Aided Manufacturing", 2nd Edition, Tata McGraw Hill Publishing Company, 2017.

<table>
<tr><td rowspan="2">21PME04</td><td rowspan="2" colspan="2">ADDITIVE MANUFACTURING</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="7">COURSE OBJECTIVES:</td></tr>
<tr><td colspan="7">• To illustrate the potential of additive manufacturing in different industrial sectors.
• To demonstrate the need, advantages and limitations of additive manufacturing (AM)
• To demonstrate the processes used in additive manufacturing for a range of materials and applications
• To construct the role of additive manufacturing in the design process and its ability to support Design and manufacturing
• To relate the challenges associated with AM and its data-processing tools</td></tr>
<tr><td>UNIT I</td><td colspan="5">INTRODUCTION TO ADDITIVE MANUFACTURING</td><td>9</td></tr>
<tr><td colspan="7">Introduction to AM, AM evolution, Distinction between AM & CNC machining, Steps in AM, Classification of AM processes, Applications, Advantages of AM and Types of materials for AM. Impact of AM on Product Development - Virtual Prototyping - Rapid Tooling – RP to AM.</td></tr>
<tr><td>UNIT II</td><td colspan="5">REVERSE ENGINEERING AND CAD MODELLING</td><td>9</td></tr>
<tr><td colspan="7">Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements & formats, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM.</td></tr>
<tr><td>UNIT III</td><td colspan="5">LIQUID & SOLID-BASED ADDITIVE MANUFACTURING SYSTEMS</td><td>9</td></tr>
<tr><td colspan="7">Working Principles, details of processes, products, materials, advantages, limitations and applications - Stereo lithography Apparatus - Solid Ground Curing - Fused deposition Modelling - Laminated Object Manufacturing.</td></tr>
<tr><td>UNIT IV</td><td colspan="5">POWDER-BASED ADDITIVE MANUFACTURING SYSTEMS</td><td>9</td></tr>
<tr><td colspan="7">Selective Laser Sintering: Principle, process, Indirect and direct SLS- powder structures, Materials, post-processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping: Processes, materials, products, advantages, limitations and applications</td></tr>
<tr><td>UNIT V</td><td colspan="5">OTHER ADDITIVE MANUFACTURING SYSTEMS</td><td>9</td></tr>
<tr><td colspan="7">Three-dimensional Printing (3DP): Principle, basic process, types of printing, process capabilities, material system. Solid-based, Liquid-based and powder-based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing, Ballistic Particle Manufacturing and Selective Laser Melting.</td></tr>
<tr><td colspan="7" align="right">TOTAL: 45 PERIODS</td></tr>
<tr><td colspan="7">COURSE OUTCOMES:</td></tr>
<tr><td colspan="7">At the end of the course, learners will be able to
CO1: Demonstrate additive manufacturing and its role in product development
CO2: Apply the CAE processes in additive manufacturing
CO3: Apply the various liquid and solid-based additive manufacturing techniques</td></tr>
</table>

CO4: Illustrate the different powder-based additive manufacturing techniques

CO5: Summarize other additive manufacturing techniques

TEXT BOOKS:

1. Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, 2nd Edition, World Scientific Publishers, 2010.
2. Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, 1st Edition, Springer, 2010.
3. Amit Bandyopadhyay Susmita Bose, “Additive Manufacturing”, 2nd Edition, CRC Press, Taylor & Francis Group, 2020

REFERENCES:

1. Gebhardt, A., “Rapid prototyping”, 1st Edition, Hanser Gardener Publications, 2003.
2. Hilton, P.D. and Jacobs, P.F., “Rapid Tooling: Technologies and Industrial Applications”, 1st Edition, CRC press, 2005.
3. Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, 1st Edition, Springer, 2006.

21PME05	COMPOSITE MATERIALS IN PRODUCT DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Demonstrate the knowledge of composite materials and its types
- To Illustrate the difference between matrix and reinforcements
- To Summarize the fabrication techniques for polymer matrix composites
- To Summarize the fabrication techniques for metal matrix composites
- To Recognize the importance of novel composite materials in product development

UNIT I	INTRODUCTION TO COMPOSITES	9

Introduction: Definition, Classification of Composite materials based on structure, based on matrix, Advantages of composites, Applications of composites, Functional requirements of reinforcement and matrix.

UNIT II	REINFORCEMENTS AND INTERACTIONS	9

Types of reinforcements and their properties: Fibers: Carbon, Boron, Glass, Aramid, Al2O3, SiC - Role of interfaces: Wettability and Bonding, interface in Composites, Interactions and Types of bonding at the Interface, Tests for measuring Interfacial strength.

UNIT III	POLYMER MATRIX COMPOSITES	9

Fabrication of Polymeric Matrix Composites, hand layup processes – spray up processes – compression moulding – reinforced reaction injection moulding – resin transfer moulding – Pultrusion – Filament winding – Injection moulding. Laminated Composites

UNIT IV	METAL MATRIX COMPOSITES	9

Fabrication of Metal Matrix Composites: powder metallurgy process – diffusion bonding – stir casting – squeeze casting, spray process, Liquid infiltration In-situ reactions

UNIT V	COMPOSITES IN PRODUCT DEVELOPMENT	9

Properties of Composites - Mechanical Properties, Density, Elastic constants - Applications of composites in various domains - applications of PMC and MMC in aerospace, automotive industries – Composites in Additive Manufacturing

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Develop understanding of composite materials and its types
CO2: Comprehend knowledge on matrix, reinforcement and its interactions
CO3: Understand fundamentals and processing of polymer matrix composites
CO4: Understand fundamentals and processing of metal matrix composites
CO5: Identify the significance of composite materials in product development

TEXT BOOKS:

1. It Meng Low, Yu Dong, "Composite Materials - Manufacturing, Properties and Applications", 1st edition, Elsevier, 2021.

2. K. Srinivasan “Composite Material: Production Properties Testing”, 5^{th} edition, Narosa, 2020.
3. Mallick, P.K. and Newman, S., “Composite Materials Technology: Processes and Properties”, 4^{th} edition, Hansen Publisher, Munish, 1990

REFERENCES:

1. Issac M. Daniel and Ori Ishai, “Engineering Mechanics of Composite Materials”, 3^{rd} edition, Oxford University Press, 2006.
2. Mallick, P.K., “Fiber Reinforced Composites: Materials, Manufacturing and Design”, 4^{th} edition, Maneel Dekker Inc, 1993.
3. Halpin, J.C., “Primer on Composite Materials, Analysis”, 3^{rd} edition, Technomic Publishing Co., 1984.

21PME06	ERGONOMICS IN DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate the various concepts of ergonomics in the design of man – machine system.
- To use the basic knowledge in the application of ergonomic principles to design of industrial workplaces.
- To demonstrate the scope of occupational ergonomics.
- To demonstrate the environmental factor in design
- To explain the core concepts of ergonomics to evaluate and redesign the products.

UNIT I	INTRODUCTION	9

Concepts of human factors engineering and ergonomics – Man – machine system and design philosophy – Physical work – Heat stress – manual lifting – work posture – repetitive motion.

UNIT II	ANTHROPOMETRY	9

Physical dimensions of the human body as a working machine – Motion size relationships – Static and dynamic anthropometry – Anthropometric aids – Design principles – Using anthropometric measures for industrial design – Procedure for anthropometric design.

UNIT III	DESIGN OF SYSTEMS	9

Displays – Controls – Workplace – Seating – Work process – Duration and rest periods – Hand tool design – Design of visual displays – Design for shift work.

UNIT IV	ENVIRONMENTAL FACTORS IN DESIGN	9

Temperature – Humidity – Noise – Illumination –Vibration – Measurement of illumination and contrast – use of photometers – Recommended illumination levels. The ageing eye – Use of indirect (reflected) lighting – cost efficiency of illumination – special purpose lighting for inspection and quality control – Measurement of sound – Noise exposure and hearing loss – Hearing protectors – analysis and reduction of noise – Effects of Noise on performance

UNIT V	WORK PHYSIOLOGY	9

Provision of energy for muscular work – Role of oxygen physical exertion – Measurement of energy expenditure Respiration – Pulse rate and blood pressure during physical work – Physical work capacity and its evaluation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the various concepts of human factors engineering

CO2: Demonstrate the anthropometry principles and measures.

CO3: Sketch the tasks and workstations to fit employees.

CO4: Demonstrate the design consideration of the surroundings

CO5: Interpret the concepts of work physiology.

TEXT BOOKS:

1. Kroemer, K.H.E., “Fitting the Human: Introduction to Ergonomics”, 7th Edition, CRC Press, 2017. 2. Martin Helander, “A guide to the ergonomics of manufacturing”, 4th Edition, East West press, 2007. 3. Freivalds, A., “Neibel’s Methods, Standards and Work Design”, 13th Edition, McGraw Hill.2013
REFERENCES:
1. Bridger, R.S. “Introduction to Ergonomics”, 1st Edition, McGraw Hill, 1995. 2. Micormic, J. “Human factors in Engineering and Design”, 2nd Edition, McGraw Hill, 1992. 3. Wilson,J.R.Corlect EN, “Evaluation of Human work”, A. practical Ergonomcis methodology, 1st Edition, Taylor and Francis, 1990. 4. Shackel, B.Richardson S, “Human Factors for Information usability”, Cambridge University, 1st Edition, Cambridge University Press, 1991.

21PME07	DESIGN FOR MANUFACTURING AND ASSEMBLY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate the design principle for economical production.
- To explain the importance of form design in manufacture.
- To illustrate various machining parameter for assembly.
- To demonstrate the casting concepts for DFMA
- To interpret the knowledge of compliance analysis on assembly and environment design

UNIT I	INTRODUCTION	9

General design principles for manufacturability: strength and mechanical factors, mechanisms selection, evaluation method, Process capability: Feature tolerances, Geometric tolerances, Assembly limits, Datum features, and Tolerance stacks.

UNIT II	FACTORS INFLUENCING FORM DESIGN	9

Working principle, Material, Manufacture, Design- Possible solutions, Materials choice, Influence of materials on form design, form design of Welded members, forgings and castings

UNIT III	COMPONENT DESIGN-I	9

Machining Consideration: Design features to facilitate machining: drills, milling cutters, keyways, Doweling procedures, counter sunk screws, Reduction of machined area, simplification by separation, simplification by amalgamation, Design for machinability, Design for economy, Design for clampability, Design for accessibility, Design for assembly

UNIT IV	COMPONENT DESIGN-II	9

Casting Consideration: Redesign of castings based on parting line considerations, Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design, Modifying the design, group technology, Computer Applications for DFMA

UNIT V	DESIGN FOR THE ENVIRONMENT	9

Introduction, Environmental objectives, Global issues, Regional and local issues, Basic DFE methods, Design guide lines, Example application, Lifecycle assessment, Basic method, Environmentally responsible product assessment, Weighted sum assessment method, Lifecycle assessment method, Techniques to reduce environmental impact, Design to minimize material usage, Design for disassembly, Design for recyclability, Design for remanufacture, Design for energy efficiency, Design to regulations and standards

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the appropriate design for economical production.

CO2: Demonstrate the factors influencing form design.

CO3:	Interpret various machining operation for economical production and assembly.
CO4:	Use the casting concepts to design component for DFMA.
CO5:	Use the compliance analysis for design of assembly and environment.

TEXT BOOKS:

1. Geoffry Boothroyd, Peter Dewhurst and W. A. Knight, “Product design for manufacture and assembly”, 3rd Edition, CRC Press,
2. George E Deiter, “Engineering Design”, 4th Edition, McGraw-Hill International, 2002.
3. Kevin Otto and Kristin Wood, ”Production Design”,5th edition, Person Education,

REFERENCES:

1. A. K. Chitale and R.C. Gupt ‘‘Product design and Manufacturing”, 3rd Edition, prentice-Hall of India, New Delhi, 2003
2. Surender Kumar, Goutham Sutradhar, ‘‘Design and Manufacturing”, 3rd Edition, Oxford & IBH Publishing co, Pvt Ltd, 1998.
3. Graedel T. Allen B, “Design for the Environment”, 5th Edition, Angle Wood Cliff, Prentice Hall. Reason Pub.1996

VERTICAL 2: DIGITAL AND GREEN MANUFACTURING

21PME08	NON-TRADITIONAL MACHINING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To relate the need for unconventional machining processes and its classification
- To explain various thermal energy and electrical energy based unconventional machining processes
- To classify various chemical and electro-chemical energy based non-traditional machining processes
- To choose various nano abrasives based unconventional machining processes
- To show various recent trends based unconventional machining processes

UNIT I	INTRODUCTION AND MECHANICAL ENERGY BASED PROCESSES	9

Unconventional machining Process – Need – classification – merits, demerits and applications. Abrasive Jet Machining – Water Jet Machining – Abrasive Water Jet Machining - Ultrasonic Machining. (AJM, WJM, AWJM and USM). Working Principles – equipment used – Process parameters – MRR- Applications.

UNIT II	THERMAL AND ELECTRICAL ENERGY BASED PROCESSES	9

Electric Discharge Machining (EDM) – Wire cut EDM – Working Principle-equipment-Process Parameters-Surface Finish and MRR- electrode / Tool – Power and control Circuits-Tool Wear – Dielectric – Flushing –– Applications. Laser Beam machining and drilling, (LBM), plasma, Arc machining (PAM) and Electron Beam Machining (EBM). Principles – Equipment –Types – Beam control techniques – Applications.

UNIT III	CHEMICAL AND ELECTRO-CHEMICAL ENERGY BASED PROCESSES	9

Chemical machining and Electro-Chemical machining (CHM and ECM)- Etchants – Maskant - techniques of applying maskants - Process Parameters – Surface finish and MRR-Applications. Principles of ECM- equipment-Surface Roughness and MRR Electrical circuit-Process Parameters-ECG and ECH - Applications.

UNIT IV	ADVANCED NANO FINISHING PROCESSES	9

Abrasive flow machining, chemo-mechanical polishing, magnetic abrasive finishing, magneto rheological finishing, magneto rheological abrasive flow finishing their working principles, equipment, effect of process parameters, applications, advantages and limitations.

UNIT V	RECENT TRENDS IN NON-TRADITIONAL MACHINING PROCESSES	9

Recent developments in non-traditional machining processes, their working principles, equipment, effect of process parameters, applications, advantages and limitations. Comparison of non-traditional machining processes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1: Explain the mechanical energy based processes and its classification.

CO2: Identify the various thermal energy and electrical energy based processes.

CO3: Demonstrate the various chemical and electro-chemical energy based processes.

CO4: Choose various advanced nano finishing processes.

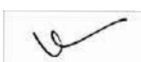
CO5: Identify the recent trends in non-traditional machining processes.

TEXT BOOKS:

1. Vijay. K. Jain "Advanced Machining Processes" 2nd Edition, Allied Publishers Pvt. Ltd., New Delhi, 2007
2. Pandey P.C. and Shan H.S. "Modern Machining Processes" 3rd Edition, Tata McGraw-Hill, New Delhi, 2007.
3. Paul De Garmo, J.T.Black, and Ronald. A.Kohser, "Material and Processes in Manufacturing" Prentice Hall of India Pvt. Ltd., 8th Edition, New Delhi, 2001.

REFERENCES:

1. Benedict. G.F. "Nontraditional Manufacturing Processes", 1st Edition, Marcel Dekker Inc., New York, 1987.
2. Mc Geough, "Advanced Methods of Machining", 2nd Edition, Chapman and Hall, London, 1998.
3. M. K. Singh, "Unconventional Machining processes", New Age International Publishers, 1st Edition, 2010.



21PME09	CASTING AND WELDING PROCESSES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the quality test methods conducted on welded and cast components.
- To demonstrate the metallurgical aspects during the solidification of metal and alloys.
- To relate the challenges associated with various casting and moulding processes in manufacturing.
- To explain the behaviour of materials during welding, and the effect of process parameters in welding
- To demonstrate the various joining process used in manufacturing.

UNIT I	INTRODUCTION TO FOUNDRY CASTING	9

Introduction: Definition, Classification of manufacturing processes. Metals cast in the foundry - classification, factors that determine the selection of a casting alloy. Patterns: Definition, classification, materials for pattern, pattern allowances. Sand moulding: Types of base sand, requirements. Binder, Additives definition, need and types; preparation of sand moulds. Moulding machines- Jolt type, squeeze type and Sand slinger. Types of moulding process, Cores: Definition, need, types. Method of making cores, Concept of gating and risers, Functions and types.

UNIT II	MELTING & METAL MOLD CASTING METHODS	9

Melting furnaces: Classification of furnaces, Gas fired pit furnace, Resistance furnace, Coreless induction furnace, electric arc furnace, constructional features & working principle of cupola furnace. Casting using metal moulds: Gravity die casting, pressure die casting, centrifugal casting, squeeze casting, slush casting, thixocasting, and continuous casting processes.

UNIT III	SOLIDIFICATION & NON-FERROUS FOUNDRY CASTING	9

Solidification: Definition, nucleation, solidification variables. Directional solidification-need and methods. Degasification in liquid metals-sources of gas, degasification methods. Fettling and cleaning of castings: Basic steps involved. Sand Casting defects- causes, features and remedies.
Advantages & limitations of casting process. Nonferrous foundry casting: Aluminium castings - advantages, limitations, melting of Aluminium using lift-out crucible furnace. Hardeners used, drowsing, gas absorption, fluxing and flushing, grain refining, pouring temperature. Stir casting set-up, procedure, uses, advantages and limitations.

UNIT IV	WELDING PROCESSES	9

Welding process: Definition, Principles, classification, application, advantages & limitations of welding. Arc welding: Principle, Metal arc welding (MAW), Flux Shielded Metal Arc Welding (FSMAW), Inert Gas Welding (TIG & MIG) Submerged Arc Welding (SAW) and Atomic Hydrogen Welding (AHW). Special types of welding: Resistance welding principles, Seam welding, Butt welding, Spot welding and Projection welding. Friction welding, Explosive welding, Thermit welding, Laser welding and Electron beam welding.

UNIT V	METALLURGICAL ASPECTS IN WELDING, SOLDERING, AND BRAZING	9

Structure of welds, Formation of different zones during welding, Heat Affected Zone (HAZ), Parameters affecting HAZ. Effect of carbon content on structure and properties of steel, Shrinkage in welds& Residual stresses. Concept of electrodes, filler rod and fluxes. Welding defects- detection, causes & remedy. Soldering, brazing, gas welding: Soldering, Brazing, Gas Welding: Principle, oxy-Acetylene welding, oxyhydrogen welding, air-acetylene welding, Gas cutting, powder cutting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply casting process with knowledge of foundry and moulding machines.

CO2: Illustrate the various casting furnaces and different mould casting methods.

CO3: Describe the Solidification process and Casting of Non-Ferrous Metals.

CO4: Explain the different welding processes used in manufacturing

CO5: Illustrate the metallurgical aspects in welding, soldering and brazing process

TEXT BOOKS:

1. Anup Goel, "Metal Casting and Welding: Processes and Applications", Technical Publications, 1st edition, 2020
2. Richard W. Heine, Carl R. Loper Jr., Philip C. Rosenthal, "Principles of metal casting", Tata McGraw Hill Education Private Limited, 1st edition, 1976
3. Serope Kalpakjian, Steuen. R Sechmid, "Manufacturing Technology", 5th Edition, Pearson Education Asia, 2006

REFERENCES:

1. Dr. K. Radhakrishna, "Manufacturing Process-I", Sapna Book House, 5th Revised Edition 2009.
2. P.N.Rao, "Manufacturing Technology - Foundry, Forming and Welding", 3rd Edition, Tata McGraw Hill, 2003.
3. Roy A Lindberg, "Process and Materials of Manufacturing", 4th Edition, Pearson Edu. 2006
4. G.S. Sawhney, "Manufacturing Science", Vol I: Forming, Casting, Welding, 1st edition, Wiley, 2019

21PME10	NON DESTRUCTIVE TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the overview of Non Destructive testing methods.
- To demonstrate the various surface NDE methods.
- To Use thermography and eddy current testing for NDE.
- To Use ultrasonic testing and acoustic emission concepts in NDE.
- To apply radiography testing method for evaluation.

UNIT I	**OVERVIEW OF NDT**	**9**

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterisation. Relative merits and limitations, Various physical characteristics of materials and their applications in NDT., Visual inspection – Unaided and aided

UNIT II	**SURFACE NDE METHODS**	**9**

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetisation methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III	**THERMOGRAPHY AND EDDY CURRENT TESTING (ET)**	**9**

Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV	**ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)**	**9**

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique – Principle, AE parameters, Applications

UNIT V	**RADIOGRAPHY (RT)**	**9**

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrameters, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the fundamental concepts of NDT

CO2: Demonstrate the different methods of NDE

CO3: Use the concept of Thermography and Eddy current testing

CO4: Demonstrate the concept of Ultrasonic Testing and Acoustic Emission

CO5: Illustrate the concept of Radiography

TEXT BOOKS:

1. Baldev Raj, T.Jayakumar, M.Thavasimuthu "Practical Non-Destructive Testing", 1st Edition, Narosa Publishing House, , 2014.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised Edition, New Age International Publishers, 2010
3. Paul E Mix, "Introduction to Non-destructive testing: a training guide", 2nd Edition, Wiley, New Jersey, 2005

REFERENCES:

1. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
2. ASNT, American Society for Non Destructive Testing, Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing.
3. Charles, J. Hellier, "Handbook of Nondestructive evaluation", 1st Edition, McGraw Hill, New York 2001.

21PME11	SURFACE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To experiment with failure micro mechanisms occurring for different service conditions.
- To illustrate the micro mechanism failure to optimize surface engineered microstructures.
- To illustrate appropriate testing approaches to evaluate service performance.
- To experiment with real life surface failure problems and determine the correct surface engineering solution by applying contact mechanics.
- To relate complex data and propose appropriate engineering solutions

UNIT I	FUNDAMENTALS OF SURFACE ENGINEERING	7

Introduction: Engineering components, surface dependent properties and failures, importance and scope of surface engineering; Surface and surface energy: Structure and types of interfaces, surface energy and related equations; Surface engineering: classification, definition, scope and general principles

UNIT II	CONVENTIONAL SURFACE ENGINEERING PRACTICES	12

Solid material removal: Cleaning, pickling, etching, grinding, polishing, buffing / puffing; Solid material addition: Electrodeposition / plating, Aluminizing, calorizing, diffusional coatings; Surface modification using liquid/molten bath: Cyaniding, liquid carburizing; Surface modification using gaseous medium: Nitriding carbonitriding

UNIT III	ADVANCED SURFACE ENGINEERING PRACTICES	12

Surface engineering by energy beams: General classification, scope and principles, types and intensity/energy deposition profile; Laser assisted microstructural modification, Ion beam assisted microstructure and compositional modification; Surface engineering by spray techniques: Flame spray and HVOF. Surface coatings and surface modifications: Evaporation - Sputter deposition of thin films & coatings - PVD coating processes, CVD and PECVD.

UNIT IV	CHARACTERIZATION OF COATINGS AND SURFACES	7

Measurement of coatings thickness; porosity & adhesion of surface coatings; Measurement of residual stress & stability; Surface microscopy & topography by scanning probe microscopy; Spectroscopic analysis of modified surfaces

UNIT V	FUNCTIONAL COATINGS AND APPLICATIONS	7

Functional and nano-structured coatings and their applications in photovoltaics, bio- and chemical sensors; Surface passivation of semiconductors & effect on electrical properties; Surface engineering of polymers and composites; Thin film technology for multilayers & superlattices for electronic, optical and magnetic devices; Modelling.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the fundamental surface engineering techniques.

CO2: Demonstrate the conventional surface engineered structures.

CO3: Relate the advanced practices in surface engineering. CO4: Experiment with characterization of coatings and surfaces. CO5: Demonstrate the functional coatings and applications.
TEXT BOOKS:
1. Devis, J.R., "Surface Engineering for Corrosion & Wear Resistance", 1st Edition, CRC Press, 2001 2. M. Ohring, “The Materials Science of Thin Films”, 2nd Edition, Academic Press Inc, 2001. 3. Peter Martin, " Introduction to Surface Engineering and Functionally Engineered Materials", 1st Edition, John Willey, 2011
REFERENCES:
1. K.G. Budinski, “Surface Engineering a Wear Resistances”, 1st Edition, Prentice Hall, Englewood Cliffs, 1988. 2. M.G. Fontana, “Corrosion Engineering (classification of Corrosion)”, Mc. Graw Hill, 1st Edition, 1987. 3. John O. Milewski, “Additive Manufacturing of Metals”, Springer, 2017.

21PME12	INDUSTRIAL AUTOMATION SYSYTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the basics of automation and its basic concepts
- To use the concepts of group technology
- To apply the concepts of flexible manufacturing system
- To explain the Industrial Robotics and Mechatronics System
- To demonstrate the knowledge of automated machinery and economy

UNIT I	INTRODUCTION	9

Automation and types, Automated Manufacturing System, Reasons for Automating, the USA Principle, Strategies for automation and process improvement, automation migration strategies, levels of automations, Types of Automations.

UNIT II	GROUP TECHNOLOGY	9

Part family, Part classification and coding, production flow analysis – OPITZ classification system, cellular manufacturing, quantitative analysis in cellular manufacturing. Rank Order Clustering Technique (ROC), Holier Method –I, II, Single Linkage Cluster Analysis Technique (SLCA). Application of group technology

UNIT III	FLEXIBLE MANUFACTURING SYSTEM	9

Types of flexibility, types of FMS, FMS components, FMS Components-Workstations, Material Handling and Storage Systems, Computer Control System, Human Recourses, FMS Applications and Benefits., Quantitative analysis of FMS, Sizing the FMS, System performance measure. Automated Material Handling & Storage: Functions, Types, Analysis of material handling equipment, Design of Conveyor & AGV systems. Problems. Development for total material handling system.

UNIT IV	INDUSTRIAL ROBOTICS AND MECHATRONICS SYSTEM	9

Introduction, Robot Anatomy and Related Attributes, Robot Control Systems, End Effectors, Sensors in Robotics, Industrial Robot Applications, Robot Programming overview. Transducers, Sensors and Actuators: Classification, Principle of Operation, Selection Criteria, Signal Conditioning, Calibration

UNIT V	AUTOMATED MACHINERY AND AUTOMATED ECONOMY	9

Introductions, Automated transfer machine, automated transfer line, auto-storage and retrieval system, automated guided vehicles, automated material handling system, automated inspection system and CMM.

Plant Economy, feasibility of automation on economical sense, effect of automation on economy, feasibility of automation in Indian market, Scope of automation in Indian industries, Break Even point analysis for automation

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use the application of automated systems integration using CIM

CO2: Apply the automation by applying Group Technology concepts.

CO3: Demonstrate the concepts of FMS in automation.

CO4:	Apply the working of different sensors and actuator and find application for industrial automation
CO5:	Show the scope of Automation in Industries
TEXT BOOKS:	
1.	Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover, 3rd Edition, P.H.I. 2015.
2.	Frank Lamb, "Industrial Automation", 1st Edition , Mc Graw Hill, 2013.
3.	Tien-Chien Chang, Richard A. Wysk and Hsu-Pin Wang, "Computer Aided Manufacturing", 1st Edition , Pearson 2011.
REFERENCES:	
1.	Er. A. K. Gupta and S. K. Arora, "Industrial Automation and Robotics", University Science Press, 1st Edition ,Laxmi Publishing Pvt. Ltd, 2011.
2.	R. K. Mittal and I. J. Nagrath, "Robotics and Control", 1st Edition , McGraw Hill Education (India) Private Limited, 2015.
3.	Ronald L Krutz, "Industrial Automation and Control System Security Principles", 2nd Edition , International Society of Automation, 2012.

21PME13	GREEN SUPPLY CHAIN MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the foundational knowledge associated with the green supply chain.
- To illustrate the implication of today's most pressing environmental issues.
- To relate the various green supply chain practices can actually save money, increases efficiency and reduce delivery time.
- To interpret the Closed-loop Supply Chain in green manufacturing.
- To demonstrate the practices in Green Logistics and Transportation.

UNIT I	INTRODUCTION	9

Introduction – Traditional Supply Chain and Green Supply Chain – Environmental Concern and Supply Chain – Closed-loop Supply Chain – Corporate Environmental Management – Green Supply Chain (GSCM): Definition, Basic Concepts – GSCM Practices.

UNIT II	ECO-DESIGN	9

Design for the Environment (DFE) or Eco-Design – Eco-Design and Supplier Relationships – Definitions of Eco-Design – Tools of Product Eco-Design – Involving suppliers in product ecodesign: Drivers, Challenges and Successful factors.

UNIT III	GREEN PURCHASING	9

Green Procurement and Purchasing – Definitions of green purchasing – Drivers of green purchasing – Green purchasing strategies – Green purchasing performance measurement –Green Supplier Development and Collaboration.

UNIT IV	GREEN MANUFACTURING	9

Green Manufacturing or Production: Evolution, Definitions – 4Re's: recycling, remanufacturing, reuse and reduction – Closed-loop Manufacturing – Life Cycle Analysis (LCA) – Lean Manufacturing for Green Manufacturing or Production.

UNIT V	GREEN LOGISTICS AND TRANSPORTATION	9

Green Logistics and Transportation – Definitions of Green Logistics – Critical drivers of Green Logistics – Green transportation and logistics practices – Environmental impacts of transportation and logistics – Closing the Loop:

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the fundamental concepts of Green Supply Chain.

CO2: Demonstrate the Eco design

CO3: Relate Green Procurement and Purchasing

CO4: Interpret Closed-loop Supply Chain.

CO5: Show the applications of Green Logistics and Transportation

TEXT BOOKS:

1. Joseph Sarkis, Yijie Dou, "Green Supply Chain Management: A Concise Introduction", 1st Edition, Routledge, 2017
2. Charisios Achillas, Dionysis D. Bochtis, Dimitrios Aidonis, Dimitris Folinas, "Green Supply

Chain Management”, 1^{st} Edition, Routledge, 2018.

3. D. Simchi-Levi, P. Kaminsky, E. Simchi-Levi, and Ravi Shankar, “Designing and Managing the Supply Chain concepts, Strategies and Case studies”, 3^{rd} Edition, Tata McGraw Hill, New Delhi 2017.

REFERENCES:

1. Hsiao-Fan Wang, Surendra M. Gupta, “Green Supply Chain Management: Product Life Cycle Approach”, 1^{st} Edition, McGraw Hill publishing, 2011
2. Stuart Emmett, Vivek Sood, “Green Supply Chains: An Action Manifes by Stuart Emmett”, 1^{st} Edition, Wiley publications, 2010
3. Alan Harrison and Remko van Hoek, “Logistics Management and Strategy”, 5^{th} Edition, Pearson, 2014.

21OPH01	**Modern Materials Characterization Techniques** (*Common to all B.E. / B.Tech. Programmes*)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To establish a sound grasp of knowledge on analyzing crystal structure
- To prepare the students to understand the basics of thermal analysis.
- To understand the concept of various electron microscopes.
- To discuss students with different spectroscopic techniques.
- To interpret knowledge on electrical characterization of materials.

UNIT I	X-RAY DIFFRACTION	9

Elastic and inelastic scattering - Bragg's law - basic powder diffraction - generation of X-rays - characteristic X ray spectrum - Moseley's law - methods to remove Kb radiation – detectors - factors affecting the intensity of diffraction peaks - phase identification using XRD.

UNIT II	THERMAL ANALYSIS	9

Introduction – Thermo gravimetric analysis (TGA) – Instrumentation – determination of weight loss and decomposition products – differential thermal analysis (DTA) – cooling curves – differential scanning calorimetry (DSC) – Instrumentation – specific heat capacity measurements – determination of thermo mechanical parameters.

UNIT III	ELECTRON MICROSCOPY	9

Scanning electron microscope (SEM) – field emission scanning electron microscope (FESEM) – Energy dispersive X-ray analysis (EDAX) – high resolution transmission electron microscope (HRTEM): working, principle and instrumentation – sample preparation – scanning probe microscopy – atomic force microscopy: principle, working and instrumentation.

UNIT IV	SPECTROSCOPY	9

Principles and instrumentation for UV-Vis-IR, FTIR spectroscopy, Raman spectroscopy, electron spin resonance (ESR) – nuclear magnetic resonance (NMR), electron spectroscopy for chemical analysis (ESMA) -proton induced X-ray emission spectroscopy (PIXE).

UNIT V	ELECTRICAL CHARACTERIZATION	9

Two probe and four probe methods – Vander Pauw method – Hall probe and measurement – scattering mechanism – C-V, I-V characteristics – Schottky barrier capacitance – impurity concentration –electrochemical C-V profiling- limitations.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Comprehend the X-ray diffraction to identify the phase present in the analyzed crystal system.

CO2: Understand the importance of thermal analysis.

CO3: Express the knowledge in scanning electron microscope and transmission electron microscope.

CO4: Demonstrate a strong foundational knowledge in spectroscopy.

CO5: Understand the importance of electrical characterization.

TEXT BOOKS:

1. Elton N. Kaufmann, “Characterization of Materials”, Volume 1 & 2, Willey –Interscience, 2003.
2. E. Newbury, Patrick Echlin& Joseph Goldstein, “Scanning Electron Microscopy and X-Ray Microanalysis: A Text for Biologists, Materials Scientists, and Geologists (English)”, Springer 2011.
3. R.F. Egerton, “Physical Principles of Electron Microscopy-An Introduction to TEM, SEM and AEM”, Second edition, Springer, 2016.
4. Colin. N. Banwell, Elaine M. Cash, “Fundamentals of Molecular Spectroscopy”, 4th Edition, Tata McGraw Hill, Indian Edition, 2017.

REFERENCES:

1. B.D. Cullity, “Elements of X-ray Diffraction”, Addison-Wesley Publishing Company, Inc., 2013.
2. B.L. Sharma, R. K. Purohit, “Semiconductor Heterojunctions”, Pergamon, 2014.
3. Bert Voigtlander, “Atomic Force Microscopy”, 2nd Edition, Springer, 2019.
4. Joseph. I. Goldstein, Dale E. Newbury, Joseph R. Micheal, Nicholas W. M. Rictchie, John Henry J. Scott, David C. joy, Budhika G. Mendis, “Scanning Electron Microscopy and X-ray Microanalysis”, Willey, 2018.

VERTICAL 3: CLEAN AND GREEN ENERGY TECHNOLOGIES

21PME14	RENEWABLE ENERGY TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the solar radiation and its environmental impact to power.
- To illustrate the various collectors used for storing solar energy.
- To illustrate the various applications in solar energy.
- To demonstrate the wind energy and biomass and its economic aspects.
- To illustrate geothermal energy with other energy sources.

UNIT I	PRINCIPLES OF SOLAR RADIATION	9

Role and potential of new and renewable source, the solar energy option, Environmental impact of solar power, physics of the sun, the solar constant, extra-terrestrial and terrestrial solar radiation, solar radiation on titled surface, instruments for measuring solar radiation and sun shine, solar radiation data

UNIT II	SOLAR ENERGY COLLECTION	9

Flat plate and concentrating collectors, classification of concentrating collectors, orientation and thermal analysis, advanced collectors.

UNIT III	SOLAR ENERGY STORAGE AND APPLICATIONS	9

Methods of Sensible heat, latent heat and stratified storage systems. Solar applications - heating/cooling technique, solar ponds, photovoltaic energy conversion, solar distillation and drying.

UNIT IV	WIND ENERGY AND BIOMASS	9

Sources and potentials, horizontal and vertical axis windmills, performance characteristics, Betz criteria - biomass: Principles of Bioconversion, Anaerobic/aerobic digestion, types of biogas digesters, gas yield, combustion characteristics of biogas, utilization for cooking, I.C. Engine operation and economic aspects.

UNIT V	GEOTHERMAL ENERGY	9

Resources, types of wells, methods of harnessing the energy, potential in India. Ocean energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy: Potential and conversion techniques and their economics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Discuss the physics of solar radiation.

CO2: Demonstrate the solar energy collectors and methodologies of storing solar energy.

CO3: Demonstrate the application of solar energy in a useful way.

CO4: Illustrate wind energy and biomass with its economic aspects.

CO5: Illustrate the other forms of energy sources like wind, biogas and geothermal energies.

TEXT BOOKS:

1. Rai G.D. "Non-Conventional Energy Sources", 2nd Edition, Khanna Publishers, 2015.

2. Twidell & Wier, “Renewable Energy Resources”, 3rd Edition, CRC Press (Taylor & Francis), 2015.
3. Kothari D.P, Singhal ., K.C., “Renewable energy sources and emerging technologies”, 2nd Edition, P.H.I, New Delhi, 2011

REFERENCES:

1. Tiwari and Ghosal, “Renewable energy resources”, 1st Edition, Narosa Publishing House, 2004
2. Ramesh R & Kumar K.U , “Renewable Energy Technologies”, 1st edition, Narosa Publishing House, 2004
3. Mittal K M, “Non-Conventional Energy Systems”, 1st Edition, Wheeler Publishing Co. Ltd, New Delhi, 2003

21PME15	BIOENERGY CONVERSION TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To use the energy conversion technologies related to biomass
- To demonstrate the properties of biomass and its energy products
- To illustrate the feasibility of power production from biomass sources
- To use of the biochemical conversion technologies
- To demonstrate the separation of various elements

UNIT I	INTRODUCTION	9

Biomass as energy source – Sources – Biomass conversion processes – Biological – Thermal – Chemical – Hybrid conversions – Application of biomass conversion products – Biomass properties for conversion process – Physical properties : Particle size, distribution, heat capacity and thermal conductivity – Thermal properties : Proximate,

UNIT II	TORREFACTION	9

Torrefaction – products obtained – properties of torrified biomass – Physical and chemical – composition changes – torrefaction as pre-treatment process – Pyrolysis – types – effects of process parameters – Product characterization techniques – oxidation stability – Bio-oil up gradation – applications – Liquefaction – direct and indirect methods – advanced liquefaction techniques.

UNIT III	BIOMASS GASIFICATION	9

Biomass gasification – chemistry – types of gasifiers – gasifier design : TDR, throughput, A/F ratio and equivalence ratio calculations – advanced gasification – fluidized bed gasifier – component design – cold fluidization tests – Electrical power production – Biomass combustion – types of combustors – Co-combustion and Co-firing – applications – Eutectic point of biomass ash.

UNIT IV	BIOCHEMICAL CONVERSION TECHNOLOGIES	9

Stirred Tank Reactors; Batch Fermentation and Microbial Growth; Continuous Fermentation and Kinetics; Aeration and Oxygen Transfer

UNIT V	BIOMASS SEPARATION	9

Centrifugation/Filtration for Biomass Separation; Distillation (bioethanol and biodiesel production); Membrane Processes (Ultrafiltration, microfiltration, Pervaporation (alcohol/water separations); Adsorptive Separations (zeolites and chromatography)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the properties of biomass and energy conversion process

CO2: Explain the characteristics of products obtained from biomass pyrolysis

CO3: Relate the basics of biomass gasification with gasifier design

CO4: Assess the potential of electrical power production from biomass

CO5: Interpret the separation of gases.

TEXT BOOKS:

1. Sergio C. Capareda "Introduction to Biomass Energy Conversions", CRC Press, 2^{nd} edition Taylor and Francis Group, 2019.
2. Sergio C. Capareda "Introduction to Renewable Energy Conversions", CRC Press, 1^{st} edition Taylor and Francis Group, 2019.
3. Anju Dahiya, "Bioenergy: Biomass to Biofuels", Academic press, 3^{rd} edition Elsevier Publication, 2014.

REFERENCES:

1. Erik Dahlquist, "Biomass as Energy Source: Resources, systems and applications", Sustainable Energy Developments series, CRC Press, 1^{st} edition Taylor and Francis Group, 2012.
2. D.P.Kothari, K.C Singal and Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", 1^{st} edition PHI Learning Private Ltd, New Delhi, 2011.
3. Godfrey Boyle, "Renewable Energy power for a sustainable future", 3^{rd} Edition, Oxford University Press, 2012

21PME16	ENERGY STORAGE DEVICES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the various types of energy storage.
- To describe the various applications of energy storage systems.
- To discuss the importance of energy storage.
- To summarize the knowledge of fuel cell and its applications.
- To explain the areas of energy storage systems and its applications in contemporary systems.

UNIT I	INTRODUCTION TO ENERGY STORAGE SYSTEMS	9

Necessity of energy storage – types of energy storage – comparison of energy storage technologies – Applications

UNIT II	THERMAL ENERGY STORAGE SYSTEMS	9

Thermal storage – Types – Modelling of thermal storage units – Simple water and rock bed storage system – pressurized water storage system – Modelling of phase change storage system – Simple units, packed bed storage units - Modelling using porous medium approach, Use of Transys

UNIT III	ELECTRO CHEMICAL ENERGY CONVERSION SYSTEMS	9

Electro-chemical energy conversion and storage: Introduction to batteries, elements and operation of electrochemical cells, theoretical cell voltage and capacity, losses in cells; Battery classification, factors effecting battery performance, batteries for PV system.

UNIT IV	FUEL CELL AND ITS APPLICATIONS	9

Fuel Cell – History of Fuel cell, Principles of Electrochemical storage – Types – Hydrogen oxygen cells, Hydrogen air cell, Hydrocarbon air cell, alkaline fuel cell, detailed analysis – advantage and drawback of each type.

UNIT V	APPLICATION OF ENERGY STORAGE SYSTEMS	9

Some areas of application of energy storage: Food preservation; Waste heat Recovery; Solar energy storage; Greenhouse heating; Power plant applications; Drying and heating for process industries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Describe the basic principles to study about energy storage systems.

CO2: Discuss the performance parameters of various thermal energy storage systems.

CO3: Explain the various electro chemical energy conversion systems and its drawbacks.

CO4: Summarize the various fuel cell and its types.

CO5: Discuss the concept of energy storage systems for commercial applications.

TEXT BOOKS:

1. James Larminie and Andrew Dicks, “Fuel cell systems Explained”, 1st edition,Wiley publications, 2003.
2. Ru-shiliu, Leizhang, Xueliang sun, “Electrochemical technologies for energy storage and

conversion", 3^{rd} edition,Wiley publications, 2012.

3. Johannes Jensen & Bent Sorensen, "Fundamentals of Energy Storage", 3^{rd} edition,John Wiley & Sons, 1984

REFERENCES:

1. Ibrahim Dincer and Mark A. Rosen, Thermal Energy Storage Systems and Applications, 3^{rd} edition John Wiley & Sons 2002
2. Rai G.D. "Non-Conventional Energy Sources", 2nd edition Khanna Publishers, 2015.
3. D.P.Kothari, K.C Singal and Rakesh Ranjan "Renewable Energy Sources and Emerging Technologies", 2^{nd} edition PHI Learning Private Ltd, New Delhi, 2011.

21PME17	SOLAR ENERGY TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn and study the solar radiation and various solar collectors
- To study the various solar thermal energy technologies and their applications
- To learn about various solar PV cell materials and conversion techniques
- To learn various Solar SPV systems designs and their applications
- To know about various solar passive building techniques for cooling and heating

UNIT I	SOLAR RADIATION AND MEASUREMENT	9

Energy from Sun – Solar Constant –Sun earth relationship – Spectral distribution of Extraterrestrial Radiation – Variation of Extraterrestrial Radiation – Solar angles–Sun path diagrams– Solar Time and its equation –Air mass ratio – Radiation reaching Earth's surface – Measurement and estimation on horizontal and tilted surfaces –Measurement devices for Solar Radiation

UNIT II	SOLAR COLLECTORS	9

Flat plate collector thermal analysis – Testing methods-Evacuated tubular collectors –Concentrating collectors – Classification- Design and performance parameters-Tracking systems- Compound parabolic concentrators – Parabolictrough concentrators-Concentrators with point focus-Heliostats– performance of the collectors

UNIT III	SOLAR PV FUNDAMENTALS	9

Semiconductor – properties – energy levels – basic equations of semiconductor devices physics. Solar cells – p-n junction: homo and hetro junctions – metal-semiconductor interface – dark and illumination characteristics – figure of merits of solar cell – efficiency limits – variation of efficiency with b and-gap and temperature-efficiency measurements-high efficiency cells–Solar thermoPhotovoltaic..

UNIT IV	SPV SYSTEM DESIGN AND APPLICATIONS	9

Solar cell array system analysis and performance prediction- Shadow analysis: reliability – solar cell array design concepts – PV system design – design process and optimization – detailed array design-storage autonomy-voltage regulation-maximum tracking-centralized and decentralized SPV systems-standalone-hybrid and grid connected system-System installation - Operation and maintenances – field experience – PV market analysis and economics of SPV systems.

UNIT V	SOLAR PASSIVE ARCHITECTURE	9

Thermal comfort – bioclimatic classification – passive heating concepts: direct heat gain – indirect heat gain – isolated gain and sun spaces- passive cooling concepts: evaporative cooling-Radiative cooling-application of wind, water and earth for cooling; shading-paints and cavity Walls for co

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to CO1: Illustrate solar radiation and its measurement CO2: Identify various solar thermal energy technologies and their applications CO3: Compare various solar PV cell materials and interpret factors influencing of conversion efficiency CO4: Infer various SPV systems designs and their applications CO5: Evaluate various solar passive building techniques for cooling and heating applications
TEXT BOOK
1. Chetan Singh Solanki, Solar Photo voltatics – Fundamentals, Technologies and Applications, 3rd PHI Learning Private limited, 2015. 2. John A.Duffie, William A.Beckman, Solar Engineering of Thermal Processes, 5th Edition, John Wiley & Sons, 2020. 3. Lovegrove K.,Stein W., Concentrating Solar Power Technology, Wood head Publishing Series in Energy, Elsevier, 1st Edition,2012
REFERENCES:
1. Solar Energy International, Photovoltaic–Design and Installation Manual, 1st Edition, New Society Publishers, 2004. 2. Sukhatme SP, Naya kJK, Solar Energy–Principle of Thermal Storage and collection, 4th Edition, Tata McGraw Hill, 2017. 3. Garg H P, Prakash J, Solar Energy – Fundamentals and Applications, 1st Edition, Tata McGraw Hill,2017.

21PME18	ENERGY CONSERVATION IN INDUSTRIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss the types of fuels used in Industries and their characteristics
- To explain the techniques adopted for performance evaluation of thermal utilities
- To describe the working principle employed in VCRS and VAM systems
- To summarize technical parameters considered in electricity billing and the losses associated with a motor.
- To explain the techniques available for energy conservation in electrical utilities

UNIT I	INTRODUCTION	9

Introduction: Energy –Power –Past & Present Scenario Of World; National Energy Consumption Data –Environmental Aspects Associated With Energy Utilization –..

UNIT II	ENERGY CONSERVATION IN THERMAL UTILITIES	9

Thermal Systems: Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters –Efficiency Computation and Encon Measures. Steam: Distribution & Usage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT III	ENERGY CONSERVATION IN OHER UTILITIES	9

Energy Conservation In Major Utilities: Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration And Air Conditioning Systems –Cooling Towers –D.G. Sets..

UNIT IV	ENERGY AUDITING	9

Energy Auditing: Need, Types, Methodology And Barriers. Role Of Energy Managers. Instruments For Energy Auditing

UNIT V	ENERGY ECONOMICS	9

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concepts

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the stoichiometric air for fuel and suggest measures for efficient combustion

CO2: Describe the cause for underperformance of thermal utilities and suggest suitable remedial measures

CO3: Summarize the factors affecting the COP of a VCR and VAR system

CO4: Describe the performance of induction motors and transformers

CO5: Exaplin energy conservation avenues of thermal and electrical utilities

TEXT BOOKS:

1. L.C.Witte, P.S.Schmidt, D.R.Brown, “Industrial Energy Management and Utilization” 1st edition,Hemisphere Publication, Washington, 1987.
2. Eastop.T.D & Croft D.R, Energy Efficiency for Engineers and Technologists, 1st edition,Logman Scientific &Technical, ISBN-0-582-03184, 1990.
3. Barney L. Capehart, Wayne C. Turner and William J. Kennedy, “Guide to Energy

Management”, 7th Edition, The Fairmont Press Inc., 2012.

REFERENCES:

1. W.C.turner, “Energy Management Handbook”Wiley,1st edition,NewYork,1982
2. W.R. Murphy and G. McKay “Energy Management” 1st edition Butter worths, London1987
3. Energy Manager Training Manual (4Volumes) available at http://www.emea.org/gbook1.asp,a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India. 2004.

21PME19	EQUIPMENT FOR POLLUTION CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain knowledge and understanding of causes and effects of air pollution and their controlling mechanisms.
- To describe knowledge on the principle and design of control of Indoor.
- To discuss a design of control of Particulate Contaminants
- To demonstrate a model for controlling Gaseous Contaminants
- To summarize knowledge in air pollutant and its emerging trends. .

UNIT I	INTRODUCTION	9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards

UNIT II	METEOROLOGY	9

Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

UNIT III	CONTROL OF PARTICULATE CONTAMINANTS	9

Factors affecting Selection of Control Equipment – Gas Particle Interaction – Working principle, Design and performance equations of Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations.

UNIT IV	CONTROL OF GASEOUS CONTAMINANTS	9

Factors affecting Selection of Control Equipment – Working principle, Design and performance equations of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations.

UNIT V	INDOOR AIR QUALITY MANAGEMENT	9

Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness- Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize knowledge and understanding of causes and effects of air pollution and their controlling mechanisms.

CO2: Explain knowledge on the principle and design of control of Indoor.

CO3:Demonstrate a design of control of Particulate Contaminants

CO4:Discuss a model for controlling Gaseous Contaminants

CO5:Explain the knowledge in air pollutant and its emerging trends

TEXT BOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, “Air Pollution Control Engineering”, Tokyo, 3rd Edition, springer science + science media LLC,2004.
2. Noel de Nevers, “Air Pollution Control Engineering”, 3rd Edition, Waveland press, Inc 2017.
3. Anjaneyulu. Y, “Air Pollution and Control Technologies”, 1st Edition, Allied Publishers (P) Ltd., India 2002.

REFERENCES:

1. David H.F. Liu, Bela G. Liptak, “Air Pollution”, 3rd Edition, Lweis Publishers, 2000.
2. Arthur C. Stern, “Air Pollution (Vol.I – Vol.VIII)”, 1st edition, Academic Press, 2006.
3. Wayne T.Davis, “Air Pollution Engineering Manual”, 3rd Edition John Wiley and Sons, Inc, 2000.

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21PME20	ENVIRONMENT SUSTAINABILITY AND IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss the need, methodology, documentation and usefulness of environmental impact assessment
- To explain the knowledge related to the broad field of environmental risk assessment, important processes that control contaminant transport
- To demonstrate the environmental impact assessment documentation process.
- To summarize the environment management plan, ethical and quality aspects of environmental impact assessment.
- To discuss the hazard identification and management technique.

UNIT I	INTRODUCTION	8

Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping - setting – analysis – mitigation. Cross sectorial issues and terms of reference in EIA – Public Participation in EIA-EIA Consultant Accreditation.

UNIT II	IMPACT INDENTIFICATION AND PREDICTION	10

Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for impact prediction – Assessment of impacts – air – water – soil – noise – biological –– Cumulative Impact Assessment

UNIT III	SOCIAL IMPACT ASSESSMENT AND EIA DOCUMENTATION	8

Social impact assessment - Relationship between social impacts and change in community and institutional arrangements. Individual and family level impacts. Communities in transition Documentation of EIA findings – planning – organization of information and visual display materials.

UNIT IV	ENVIRONMENTAL MANAGEMENT PLAN	7

EIA Report preparation. Environmental Management Plan - preparation, implementation and review – Mitigation and Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies

UNIT V	ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT	12

Environmental risk assessment framework-Hazard identification -Dose Response Evaluation – Exposure Assessment – Exposure Factors, Tools for Environmental Risk Assessment– HAZOP and FEMA methods – Event tree and fault tree analysis – Multimedia and multipath way exposure modeling of contaminant- Risk Characterization Risk communication - Emergency Preparedness Plans –Design of risk management programs

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Describe the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.

CO2: Explain the cost benefit analysis of environmental impact assessment

CO3: Discuss the concept of environmental impact assessment documentation for proper findings.

CO4: Summarize the environment management plan.

CO5: Explain the methods of risk assessment and management.

TEXT BOOKS:

1. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification, Assessment and Control, 4^{th} Edition, Butterworth Heineman, 2012.
2. Lawrence, D.P., Environmental Impact Assessment – Practical solutions to recurrent problems, 3^{rd} edition,Wiley-Interscience, New Jersey. 2003
3. Kolluru Rao, Bartell Steven, Pitblado R and Stricoff "Risk Assessment and Management Handbook",3^{rd}edition, McGraw Hill Inc., New York, 1996.

REFERENCES:

1. Canter, L.W., "Environmental Impact Assessment", and McGraw Hill, 1^{st} edition, New York. 1996
2. Cutter, S.L., "Environmental Risk and Hazards", 2^{nd}edition,Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
3. Raghavan K. V., Khan A, "Methodologies in Hazard Identification and Risk Assessment, 1^{st} Edition, Institution of Chemical Engineers by CLRI, 1997.

VERTICAL 4 - LOGISTICS AND SUPPLY CHAIN MANAGEMENT

21PME21	LOGISTICS IN MANUFACTURING, SUPPLY CHAIN AND DISTRIBUTION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the foundational knowledge in logistics.
- To relate the various logistics strategies.
- To illustrate operations in supply chain.
- To interpret the functions of distribution.
- To demonstrate the planning in Distribution flows.

UNIT I	INTRODUCTION LOGISTICS	9

Introduction – Scope of logistics in business, Logistics and Supply Chain Management, Core and support activities of logistics; Logistical integration hierarchy; Integrated Logistics; Operating objectives; Barriers internal integration; Logistical performance cycles; Supply chain relationships – Channel participants, Channel structure, Basic functions, Risk, power and leadership.

UNIT II	LOGISTICS SYSTEM DESIGN	9

Logistics reengineering, Logistical environmental assessment, Time based logistics, Anticipatory and Response based strategies, Alternative strategies, Logistical operational arrangements, Time based control techniques; Integration theory – Location structure, Transportation economies, Inventory economies, Formulating logistics strategy.

UNIT III	CONCEPTS OF SUPPLY CHAIN	9

Service and manufacturing supply chain dynamics - Evolution of supply chain management - Multiple views and flows - Service supply chains -Manufacturing supply chains - Measures of supply chain performance - Bullwhip effect.

UNIT IV	DISTRIBUTION	9

Role of Distribution in Supply chain, Distribution channels – Functions, resources, Operations in Distribution, Designing Distribution network models - its features - advantages and disadvantages

UNIT V	PLANNING	9

Distribution network planning, Distribution network decisions, Distribution requirement planning (DRP)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate the various functions of logistics

CO2:	Explain the various types of logistics strategies
CO3:	Apply the operations in supply chain to increase the productivity
CO4:	Explain the importance of distribution in supply chain.
CO5:	Show the applications of planning in Distribution

TEXT BOOKS:

1. Sunil Chopra, Peter Meindl, "Supply Chain Management: Strategy, Planning, and Operation", 6th edition, Pearson, 2014.
2. Raghuram and N. Rangaraj, "Logistics and Supply chain Management Cases and Concepts", 1st Edition, Macmillan Business Books, 2000.
3. John J. Coyle, Edward J. Bardi and C. John Langley Jr., "The Management of Business Logistics - A supply chain Perspective", 10th Edition, Thomson Business Information, 2016.

REFERENCES:

1. Paul Schönsleben, "Integral Logistics Management: Planning and Control of Comprehensive Supply", 2nd Edition, CRC Press Company, 2016.
2. David Frederick Ross, "Distribution Planning and Control: Managing in the Era of Supply Chain last edition", Springer, 2015.
3. Shaw, "G-P Forges Strong Customer Bonds Using Supply Chain Expertise, Innovative Marketing," Pulp & Paper, October 77:10 (2003), 26-30.

21PME22	MATERIALS MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the significance of Materials Management
- To demonstrate meaning of ABC Analysis.
- To illustrate characteristics of coding System.
- To interpret the functions of Purchase Department
- To demonstrate objectives of Negotiation.

UNIT I	MATERIALS MANAGEMENT: AN INTRODUCTION	9

Introduction, Meaning and Scope of Materials Management , Objectives of Materials Management Significance of Materials Management, Materials Management in Other Areas of Management Functions -Materials Management and Design/Development, Materials Management and Production , Materials Management and Sales , Materials Management and Finance & Accounting

UNIT II	ABC ANALYSIS	9

Meaning of ABC Analysis, Objective of ABC Analysis, Advantages of ABC Analysis, Limitations of ABC Analysis and Simple Numerical of ABC Analysis

UNIT III	CODIFICATION AND STANDARDIZATION	9

Basis of Codification - Codification by Group Classification and characteristics of a Good Coding System, Types of Coding, Standardization and Its Benefit.

UNIT IV	PURCHASING MANAGEMENT	9

Introduction, Meaning of Purchase Management, objectives of scientific purchasing, functions of Purchasing department- Responsibilities of the Purchase department and Duties of Purchasing Department, Purchase Parameters, Kardex System, Purchasing Policy and Procedure.

UNIT V	NEGOTIATION	9

Introduction, meaning of Negotiation, objectives of Negotiation, Techniques of Negotiation
Negotiator - Qualities of a Good Negotiator, Tactics and Strategies in Negotiation - Factors Influencing Tactics, Preparation for Negotiation, Phases of Negotiation Request for Quotation (RFQ)

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the various the Functions of Purchase Department

CO2: Relate various meaning of ABC Analysis.

CO3: Relate the characteristics of coding System and its benefits.
CO4: Interpret the functions and responsibilities of Purchase Department.
CO5: Explain the objectives of Negotiation and its factors.

TEXT BOOKS:

1. Stephen N. Chapman, Tony Arnold. J R, “Introduction to Materials Management” 8^{th} Edition, Pearson, 2007.
2. Gopalkrishanan. P, Sundaresan. M, “Materials Management: An Integrated Approach”. 1^{st} Edition, PHI Learning Pvt. Ltd, 2004.
3. J K. Shridhar Bhat, “Production and Materials Management”, 1^{st} Edition, Himalaya Publishing House, 2008

REFERENCES:

1. Chary. S.N, “Production and Operations Management”, 6^{th} Edition, Tata McGraw Hill, 2019
2. Evrim Ursavas Guldogan, “Port Operations and Container Terminal Management: with applications”, 6^{th} Edition, Springer, 2011.
3. Arnold, Champman and Ramakrishnan, “Introduction to Materials Management”, 5^{th} Edition, Pearson Education, 2007.

21PME23	ENTERPRISE RESOURCE PLANNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To show the basic concepts of ERP
- To illustrate ERP implementation in organization
- To use various ERP modules
- To discover the market potential of ERP
- To apply ERP concepts in real time case studies

UNIT I	MRP AND INTRODUCTION TO ERP	9

Introduction - overview of MRP I and MRP II, capacity requirements planning, history of ERP, evolution of ERP, comparison of ERP with traditional systems, benefits of ERP, need for ERP, overview of modules in ERP.

UNIT II	ERP IMPLEMENTATION	9

Traditional approach to information system design, new approach to system development; ERP Implementation: Requirement analysis, alternatives, life cycle, implementation methodology; Selection of an ERP package for suitability for manufacturing, hidden costs; Case studies.

UNIT III	BUSINESS MODULES IN ERP	9

Accounts, production planning, human resources, plant maintenance, materials management, quality management, sales and distribution, ware house and supply chain; Case studies.

UNIT IV	ERP MARKET	9

Market place, dynamics, SAP R3, SAP HANA Baan Company, Oracle Corporation, People Soft, JD Edwards World Solutions Co, System Software Associates, Inc. (SSA); QAD; A Comparative Assessment and Selection of ERP Packages and Modules.

UNIT V	ERP CASE STUDIES	9

HRM, finance and costing, production planning, materials management, sales and distribution, integration of modules.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1: To illustrate basic concepts of ERP and MRP.
CO2 : To demonstrate the ERP implementation process
CO3 : Categorize the ERP modules based on its application.
CO4 :To show the real world utilization of various ERP Packages

CO5 :To illustrate ERP with real time problems

TEXT BOOKS:

1. Vinod Kumar Garg and Venkitakrishnan N K, “Enterprise Resource Planning Concepts and Practice”, 1^{st} Edition, PHI, 2010.
2. Alexis Leon, "ERP Demystified", 2^{nd} Edition, Tata McGraw Hill, India, 2008.
3. Joseph A Brady, Ellen F Monk, Bret Wagner, “Concepts in Enterprise Resource Planning”, 2^{nd} Edition, Thompson Course Technology, 2010.

REFERENCES:

1. Rahul V. Altekar, “Enterprise Resource Planning”, 4^{th} Edition Tata McGraw Hill, 2010.
2. David L OLSON, "Managerial Issues of ERP Systems", 1^{st} Edition, Tata-McGraw Hill, India, 2004.
3. Mary Summer, “Enterprise Resource Planning”, 2^{nd} Edition, Pearson Education, 2005.

21PME24	WAREHOUSING AUTOMATION AND CONTAINER LOGISTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the foundational knowledge in warehousing receiving and issuing.
- To relate the various warehouse types.
- To illustrate operations in warehouse.
- To apply the foundational knowledge in container management.
- To illustrate operations in containers.

UNIT I	RECEIVING AND ISSUING	9

Receiving- Logistics support for Inward Transportation, Unloading, Inspection, Acceptance and Recording; Storing: Space allocation, Facilitation to stocking, Guarding & Recording; Risk bearing- Processing- Grading and branding – Disinfecting services.

Issuing: Order preparation, Picking, Dispatching/ Delivery & Recording Handling, Transportation & Storage of ISO Containers– Utility and Advantages of warehouses- Problems and issues in receiving processes.

UNIT II	WAREHOUSE TYPES	9

Warehouse Types: Own Warehouses- Hired Warehouses- Private Warehouses- Public Warehouses- Government Warehouses- Bonded Warehouses- Co-operative Warehouses- Distribution Warehouses- Fulfilment/ Consolidation Warehouses .Warehouses Providing Value Added Services- Cross Docking and Trans-loading Warehouses- Break Bulk Warehouses- Storage Warehouses- Refrigerated Warehouses Characteristics of ideal warehouses- Warehouse Layout- Principles and Facilities Types.

UNIT III	OPERATIONS IN WAREHOUSE	9

Internal Operations: Measures and metrics of warehouse operations- Logistics in the warehouse- Localization of materials in a warehouse- Identification and classification of Materials and products in the warehouse- Managing the material/products turns in warehouse (FIFO/LIFO) – Problems and issues in shipment processes. Warehousing Equipment: Material Handling equipment and Systems Safety Matting, Industrial Safety Equipment- Storage types and storage unit management

UNIT IV	MULTIMODAL TRANSPORT	9

Container, Types of containers- Multimodal Transport- Advantages- Freight Rate Structure & Shipping Regulations, Principal factors impacting ocean freight rates- International Commercial Terms- Multimodal Transport Network System- Advanced system in Container management - Sea Freight Container details- Customs connection & Multimodal Transport in International Trade Maritime Frauds. Container crimes. ICT in Multimodal transport.

UNIT V	CONTAINER TERMINOLOGY	9

Container characteristics- ISO standards- Types and purpose- Container terminology-Container integrity and security. Container packing. Container seals and securing-Techniques-Container ownership and management- Owning vs. Leasing- Storage, maintenance and repair. Container ship types, sizes and characteristics-Layout and design of a modern Containership- Lack of deck obstructions, speed. The economics of container ship operations owning vs. Chartering – Operating costs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the various functions of Warehouse.

CO2: Relate various types of warehouses and their advantages

CO3: Relate the metrics of warehouse operations.

CO4: Apply the various functions in containers.

CO5: Show the various applications procedures in containers.

TEXT BOOKS:

1. David J. Piasecki, “Inventory Accuracy: People, Processes, & Technology”, 1st Edition, OPS publication, 2003.
2. Jeroen.P. Van Den Berg, “Integral Warehouse Management: Management”, 1st Edition, Create space Independent Pub 2007.
3. Max Muller “Essentials of Inventory Management”, 3rd Edition, AMACOM, 2009.

REFERENCES:

1. Dr. Hariharan K. V, “Container & Multimodal Transport Management”, 1st Edition, Shroff Publishers and Distributors Pvt. Ltd, 2002.
2. Kap Hwan Kim, Hans-Otto Günther, “Container Terminals and Cargo Systems: Design, Operations Management, and Logistics Control Issues”, 1st Edition, Springer, 2010.
3. Urgen Sorgen Frei, “Port Business”, 2nd Edition, BoD Books, 2000.

21PME25	MATERIAL HANDLING EQUIPMENT, REPAIR AND MAINTENANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To choose the material handling system for various engineering application
- To prepare the various material handling equipment and systems for the case
- To construct suitable system for the industrial requirement
- To apply the knowledge of maintenance procedures for material handling devices.
- To construct maintenance management system for based on requirement.

UNIT I PRINCIPLES OF MATERIAL HANDLING 9

Classifications of the materials handling equipment, their characteristics and application, principles, packaging and storage of materials, operation analysis and study of travel diagrams and flow process charts. Preparation of a new proposal for an integrated materials handling system. Protective devices handling of fluids and multiphase systems. Handling of refrigerated cargo.

UNIT II VARIOUS MATERIAL HANDLING EQUIPMENT AND SYSTEMS 9

Theory and construction of the various parts of Mechanical Handling devices, wire ropes and chains, hooks, shackles, grabs, ladles and lifting electromagnets, sheaves, sprockets and drums, runners and rails, buffers and limit switches.

UNIT III DESIGN OF MATERIAL HANDLING EQUIPMENT 9

Design of simple mechanical handling devices, viz., screw jacks, pulley blocks, winches, hoists and capstans, wind lasses. Need, Comparison with conventional systems, Equipment like industrial robots and automatically guided vehicles

UNIT IV REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT 9

Repair methods for beds, slideways, spindles, gears, lead screws and bearings – Failure analysis – Failures and their development – Logical fault location methods – Sequential fault location.

UNIT V MAINTENANCE FOR MATERIAL HANDLING EQUIPMENT 9

Repair methods for Material handling equipment - Equipment records –Job order systems - Use of computers in maintenance.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1: Illustrate the material handling system for the application
CO2: Choose the various material handling equipment and systems
CO3: Construct suitable mechanical handling system for the requirement

CO4: Discover the repair methods for material handling devices CO5: Prepare maintenance management system for industrial case studies
TEXT BOOKS:
1. James Apple, Material Handling System Design, 1st Edition, John Wiley, 2009 2. Siddhartha Ray, Introduction to Materials Handling, 2nd Edition, New Age International Pvt Ltd Publishers, 2017 3. Venkataraman .K "Maintenance Engineering and Management", 1st Edition, PHI Learning, Pvt Ltd., 2007.
REFERENCES:
1. Immer J. R., Material Handling, 1st Edition, Tata McGraw Hill Publication, 1953 2. Materials Handling Equipment - N. Rudenco, MIR Publisher, 2nd Revised Edition, 1997. 3. Srivastava S.K., "Industrial Maintenance Management", S. Chand and Co., 2nd Edition 2002.

21PME26	PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the process planning concepts for selecting proper equipment and tools.
- To explain the various process planning activities.
- To prepare the cost estimation for various products after process planning.
- To calculate the product cost of job done by various manufacturing methods.
- To manipulate the machining time for various operations carried out in different machines.

UNIT I	INTRODUCTION TO PROCESS PLANNING	10

Introduction- methods of process planning-Drawing interpretation-Material evaluation – steps in process selection-.Production equipment and tooling selection.

UNIT II	PROCESS PLANNING ACTIVITIES	10

Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods - Set of documents for process planning-Economics of process planning- case studies.

UNIT III	INTRODUCTION TO COST ESTIMATION	8

Importance of costing and estimation –methods of costing-elements of cost estimation –Types of estimates – Estimating procedure- Estimation labour cost, material cost- allocation of overhead charges- Calculation of depreciation cost.

UNIT IV	PRODUCTION COST ESTIMATION	8

Estimation of Different Types of Jobs - Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop.

UNIT V	MACHINING TIME CALCULATION	9

Estimation of Machining Time - Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations ,Drilling and Boring - Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the process planning concepts and appropriate selection of equipment and tools for various industrial products.

CO2: Interpret the process planning activity chart.

CO3: calculate the various types of cost in the development of product.

CO4: Manipulate the costs of forging, welding and casting process to make or buy the product.

CO5: Calculate the machining time for various machining operations.

TEXT BOOKS:

1. Peter scallan, “Process planning, Design/Manufacture Interface”, 1^{st} edition, Elsevier science technology Books, 2003.
2. Panneerselvam. R and Sivasankaran. P, “Process Planning and Cost Estimation”, 1^{st} edition, PHI Learning, 2015.
3. T.R. Banga and S.C. Sharma “A Text-Book of Mechanical Estimating & Costing”, 17^{th} Edition, Khanna Publishers, New Delhi, 2018.

REFERENCES:

1. Khanna. R.B, "Production and operations management", 2^{nd} Edition, PHI Learning, 2015.
2. Adithan.M, “Process Planning and Cost Estimation”, 2^{nd} Edition, New Age International Publisher, 2013.
3. Chary S. N., “Production & Operations Management”, 5^{th} edition , Tata McGraw Hill, 2012

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<tr><td rowspan="2">21PME27</td><td rowspan="2">PRODUCTION PLANNING AND CONTROL</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
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COURSE OBJECTIVES:

- To demonstrate concepts of production planning and control.
- To apply the principles of work study.
- To apply the principles of product planning and process planning.
- To prepare the various production scheduling and dispatching techniques.
- To explain the recent trends of PPC.

UNIT I	**INTRODUCTION**	**9**

Objectives and benefits of planning and control-Functions of production control - Types of Production – job- batch and continuous-Product development and design-Marketing aspect - Functional aspects-Operational aspect-Durability and dependability aspect- Aesthetic aspect. Profit consideration-Standardization, Simplification & Specialization.

UNIT II	**WORK STUDY**	**9**

Method study, Basic procedure – Selection-Recording of process - Critical analysis, Development - Implementation - Micro motion and memo motion study - Work measurement - Techniques of work measurement - Time study – Performance rating – Activity sampling - Production study - Work sampling - Synthesis from standard data - Predetermined motion time standards.

UNIT III	**PRODUCT PLANNING AND PROCESSPLANNING**	**9**

Product planning - Extending the original product information - Value analysis - Problems in lack of product planning - Process planning and routing-Pre requisite information needed for process planning - Steps in process planning - Quantity determination in batch production - Machine capacity, Line balancing-Analysis of process capabilities in a multi-product system.

UNIT IV	**PRODUCTION SCHEDULING**	**9**

Production Control Systems - Loading and scheduling - Master scheduling - Scheduling rules - Gantt charts -Perpetual loading - Basic scheduling problems - Flow production scheduling - Batch production scheduling - Product sequencing - Material requirement planning – Dispatching - Progress reporting and expediting -Manufacturing lead time - Master production schedule along with lead time and MRP

UNIT V	INVENTORY CONTROL AND RECENT TRENDS IN PPC	9

Inventory control - Purpose of holding stock - Effect of demand on inventories – Ordering procedures. Two bin system - Periodic review system – Fixed order quantity system - Ordering cycle system - Determination of economic order quantity and economic lot size - ABC analysis - Recorder procedure - Elements of JIT - Fundamentals of MRP II and ERP**.**

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the various components and function of production planning and control.

CO2: Apply the principles of work study and time study activities.

CO3: Use the principles of product planning and process planning.

CO4: Prepare various production scheduling and dispatching techniques.

CO5: Describe the recent trends like Manufacturing Requirement Planning (MRP-II) & Enterprise Resource Planning (ERP).

TEXT BOOKS:

1. Martand Telsang, "Industrial Engineering and Production Management", 3rd Edition, S. Chand, 2018.
2. Panneerselvam, R., "Production and Operations Management", 3rd Edition, Prentice Hall of India, New Delhi,2012
3. Chary S. N., "Production & Operations Management", 5th Edition, Tata McGraw Hill, 2012.

REFERENCES:

1. Samuel Eilon, "Elements of Production Planning and Control", 3rd Edition, , Macmillan 2007.
2. Elwood S. Buffa and Rakesh K. Sarin, "Modern Production / Operations Management", 8th Edition, John Wiley and Sons, 2011.
3. Jain K. C, Aggarwal L. N., "Production Planning Control and Industrial Management", 6th Edition, Khanna Publishers, 2004.

VERTICAL 5: THERMAL POWER PROCESSES AND EQUIPMENT

21PME28	THERMAL POWER ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the concepts of thermodynamics law.
- To demonstrate various air standard cycles.
- To illustrate the function of thermal power plant.
- To apply various process of waste heat recovery systems.
- To interpret various types of Cogeneration.

UNIT I	FUNDAMENTAL OF THERMODYNAMICS	9

Heat and work transfer, definition and comparison, sign convention. Displacement work and other modes of work. P-V diagram. Zeroth law of thermodynamics – concept of temperature and thermal equilibrium– relationship between temperature scales –new temperature scales. First law of thermodynamics. Heat Reservoir, source and sink. Heat Engine, Refrigerator, Heat pump. Statements of second law and its corollaries.

UNIT II	AIR STANDARD CYCLES	9

Air Standard Cycles - Otto, Diesel, Dual, Brayton – Cycle Analysis, Performance and Comparison – Rankine, reheat and regenerative cycle

UNIT III	THERMAL POWER PLANT AND ITS PARTS	9

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment.

UNIT IV	WASTE HEAT RECOVERY SYSTEMS	9

Source and utilisation of residual heat. Heat pipes, Heat pumps, Recuperative and Regenerative heat exchangers-parallel flow- counter flow and cross flow heat exchangers. Economic Aspects. Advantages and limitations of heat recovery systems

UNIT V	COGENERATION	9

Cogeneration Principles, Types – Topping and Bottoming cycles - Advantages and limitations - Cycle Analysis, Applications of Cogeneration in Sugar, Paper, Steel and Glass industries. Economics of Cogeneration

TOTAL: 45 PERIODS

COURSE OUTCOMES:

CO1: Solve the concepts of thermodynamics law

CO2: Interpret the air standard cycles.

CO3: Analyze the function of thermal power plant

CO4: Analyze the process of waste heat recovery systems

CO5: Calculate the various types of Cogeneration

TEXT BOOKS:

1. Kothandaraman.C.P, Domkundwar. S,Domkundwar. A.V., “A course in thermal

Engineering", 5^{th} Edition, Dhanpat Rai & sons , 2016

2. Rajput. R. K., “Thermal Engineering” 6^{th} Edition, S.Chand Publishers, 2017.
3. Rudramoorthy, R, “Thermal Engineering”, 3^{rd} Edition, Tata McGraw-Hill, New Delhi,2003

REFERENCES:

1. Ganesan V. “Internal Combustion Engines” , 3^{rd} Edition, Tata Mcgraw-Hill 2012
2. Ramalingam. K.K., "Thermal Engineering", 4^{th} Edition, Scitech Publications Pvt. Ltd., 2009.
3. Sarkar, B.K, “Thermal Engineering” 6^{th} Edition, Tata McGraw-Hill Publishers, 2007.

21PME29	AUTOMOBILE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the construction and working principle of various parts of an automobile.
- To demonstrate the engine auxiliary system.
- To demonstrate the transmission systems in vehicle.
- To show the steering, brakes and suspension systems.
- To show assembling and dismantling of engine parts and transmission system.

UNIT I	VEHICLE STRUCTURE AND ENGINES	9

Types of automobiles, vehicle construction and different layouts, chassis, frame and body, Vehicle aerodynamics - IC engines –components- functions and materials, Variable Valve Timing.

UNIT II	ENGINE AUXILIARY SYSTEMS	9

Electronically controlled gasoline injection system for SI engines, Electronically controlled diesel injection system (Unit injector system, Rotary distributor type), Electronic ignition system (Transistorized coil ignition system, capacitive discharge ignition system), Turbo chargers (WGT, VGT), Engine emission control by three way catalytic converter system, Emission norms (Euro and BS).

UNIT III	TRANSMISSION SYSTEMS	9

Clutch-types and construction, gear boxes- manual and automatic, gear shift mechanisms, Over drive, transfer box, fluid flywheel, torque converter, propeller shaft, slip joints, universal joints, Differential and rear axle, Hotchkiss Drive and Torque Tube Drive

UNIT IV	STEERING, BRAKES AND SUSPENSION SYSTEMS	9

Steering geometry and types of steering gear box-Power Steering, Types of Front Axle, Types of Suspension Systems, Pneumatic and Hydraulic Braking Systems, Antilock Braking System (ABS), electronic brake force distribution (EBD) and Traction Control.

UNIT V	RECENT TRENDS IN AUTOMOTIVE SYSTEMS	9

Multi Point Fuel Injection, Common Rail Diesel Injection, Automatic Transmission, Continuously variable transmission - GDA Engine and HVT engine Electric and Hybrid Vehicles, Fuel Cell.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the construction and working principle of various parts of an automobile.
CO2: Discuss the engine auxiliary system.
CO3: Demonstrate the transmission systems in vehicle.
CO4: Discuss the steering, brakes and suspension systems.
CO5: Demonstrate assembling and dismantling of engine parts and transmission system.

TEXT BOOKS:
1. Ganesan, V., Internal Combustion Engines, 3rd Edition, Tata McGraw-Hill, New Delhi, 2012. 2. Kirpal Singh, Automobile Engineering- Vol. I and II, 4th Edition, Standard Publishers, New Delhi, 2011. 3. Ramalingam. K .K, Automobile Engineering, 6th Edition, Scitech publications,2011
REFERENCES:
1. Kamaraju Ramakrishna, Automobile Engineering, 5th Edition, PHI Learning pvt. Ltd., New delhi2012. 2. Mathur M.L. and Sharma. 'A Course in Internal Combustion Engines', 2nd Edition R.P. Dhanpat Rai Publications, 2009. 3. K. M. Gupta, Automobile Engineering- Vol I and II, 1st Edition,Umesh Publications, 2007

21PME30	ADVANCED INTERNAL COMBUSTION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate various functions of SI engines.
- To demonstrate various functions of CI engines.
- To explain the pollution formations and their control
- To demonstrate various alternate fuels and their properties.
- To illustrate various recent development in IC engines.

UNIT I	SPARK IGNITION ENGINES	9

Mixture requirements – Fuel injection systems – Monopoint, Multipoint & Direct injection - Stages of combustion – Normal and Abnormal combustion – Knock - Factors affecting knock – Combustion chambers

UNIT II	COMPRESSION IGNITION ENGINES	9

Diesel Fuel Injection Systems - Stages of combustion – Knocking – Factors affecting knock – Direct and Indirect injection systems – Combustion chambers – Fuel Spray behavior – Spray structure and spray penetration – Air motion - Introduction to Turbocharging.

UNIT III	POLLUTANT FORMATION AND CONTROL	9

Pollutant – Sources – Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter – Methods of controlling Emissions – Catalytic converters, Selective Catalytic Reduction and Particulate Traps – Methods of measurement – Emission norms and Driving cycles.

UNIT IV	ALTERNATIVE FUELS	9

Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel - Properties, Suitability, Merits and Demerits - Engine Modifications.

UNIT V	RECENT TRENDS	9

Air assisted Combustion, Homogeneous charge compression ignition engines – Variable Geometry turbochargers – Common Rail Direct Injection Systems - Hybrid Electric Vehicles – NOx Adsorbers - On-board Diagnostics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate various functions of SI engines.

CO2: Illustrate various functions of CI engines.

CO3: Illustrate the pollution formations and their control

CO4: Explain various alternate fuels and their properties

CO5: Demonstrate various recent development in IC engines.

TEXT BOOKS:

1. Ramalingam. K.K., "Internal Combustion Engine Fundamentals", 6^{th} Edition, SciTech

Publications, 2002.
2. Ganesan, "Internal Combustion Engines", 2^{nd} Edition, TMH, 2002.
3. John Heywood, “Internal Combustion engines”,3^{rd} Edition, McGraw Hill, 1988.

REFERENCES:

1. Mathur. R.B. and R.P. Sharma, "Internal Combustion Engines" 4^{th} Edition,Dhanpat Rai & Sons 2007.
2. Duffy Smith, "Auto Fuel Systems", 2^{nd} Edition, The Good Heart Willcox Company, Inc., 1987.
3. Eric Chowenitz, "Automobile Electronics", 4^{th} Edition, SAE Publications, 1995

21PME31	REFRIGERATION AND AIR CONDITIONING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the principles of operations in different Refrigeration & Air conditioning systems
- To discuss vapour compression refrigeration system
- To demonstrate the various refrigeration system
- To solve psychrometric process and systems
- To describe knowledge on design aspects of Refrigeration & Air conditioning systems

UNIT I	INTRODUCTION	9

Introduction to Refrigeration - Unit of Refrigeration and C.O.P.– Ideal cycles- Refrigerants Desirable properties – Classification - Nomenclature - ODP & GWP.

UNIT II	VAPOUR COMPRESSION REFRIGERATION SYSTEM	9

Vapour compression cycle: p-h and T-s diagrams - deviations from theoretical cycle – sub cooling and super heating- effects of condenser and evaporator pressure on COP- multi pressure system - low temperature refrigeration - Cascade systems – problems. Equipment's: Type of Compressors, Condensers, Expansion devices, Evaporators.

UNIT III	OTHER REFRIGERATION SYSTEMS	9

Working principles of Vapour absorption systems and adsorption cooling systems – Steam jet refrigeration- Ejector refrigeration systems- Thermoelectric refrigeration- Air refrigeration - Magnetic - Vortex and Pulse tube refrigeration systems.

UNIT IV	PSYCHROMETRIC PROPERTIES AND PROCESSES	9

Properties of moist Air-Gibbs Dalton law, Specific humidity, Dew point temperature, Degree of saturation, Relative humidity, Enthalpy, Humid specific heat, Wet bulb temperature Thermodynamic wet bulb temperature, Psychrometric chart; Psychrometric of air-conditioning processes, mixing of air streams.

UNIT V	AIR CONDITIONING SYSTEMS AND LOAD ESTIMATION	9

Air conditioning loads: Outside and inside design conditions; Heat transfer through structure, Solar radiation, Electrical appliances, Infiltration and ventilation, internal heat load; Apparatus selection; fresh air load, human comfort & IAQ principles, effective temperature & chart, calculation of summer & winter air conditioning load; Classifications, Layout of plants; Air distribution system; Filters; Air Conditioning Systems with Controls: Temperature, Pressure and Humidity sensors, Actuators & Safety controls.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the different properties of the refrigerants

CO2: Demonstrate the concepts of vapor compression refrigeration system.

CO3: Demonstrate the concepts of various refrigeration systems. CO4: Manipulate the psychrometric properties and processes. CO5: Demonstrate the load estimation of air conditioning system
TEXT BOOKS:
1. Arora, C.P., "Refrigeration and Air Conditioning", 3rd edition, McGraw Hill, New Delhi, 2010. 2. Manohar Prasad, "Refrigeration and Air Conditioning", 3rd Edition, New age international (P) limited, New Delhi, 2021. 3. R.S.Khurmi & J.K Gupta, "Refrigeration and Air Conditioning" Revised Edition, S. Chand Publication, 2019
REFERENCES:
1. Stoecker, W.F. and Jones J. W., "Refrigeration and Air Conditioning", 2nd Edition, McGraw Hill, New Delhi. 2. P.L.Ballaney, ". Refrigeration and Air Conditioning" Khanna publishers,1st Edition, New Delhi, 1972. 3. Andrew D. Althouse, Carl h. Turnquist and Alfred F. Bracciano, "Modern Refrigeration and Air Conditioning" 2nd Edition, The goodheart-willcox company, INC, 2012

21PME32	GAS DYNAMICS AND JET PROPULSION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the concept of isentropic condition for solving the problems in variable flow ducts.
- To calculate heat transfer and friction in constant area ducts.
- To apply the normal and oblique shock concept for finding various parameters.
- To apply basic knowledge in jet propulsion.
- To demonstrate the basic principle of cryogenics and rocket propulsion

UNIT I — BASIC CONCEPTS AND ISENTROPIC FLOWS — 9

Energy and momentum equations of compressible fluid flows – Stagnation states, Mach waves and Mach cone – Effect of Mach number on compressibility – Isentropic flow through variable ducts – Nozzle and Diffusers.

UNIT II — FLOW THROUGH DUCTS — 9

Flows through constant area ducts with heat transfer (Rayleigh flow) and Friction (Fanno flow) – variation of flow properties.

UNIT III — NORMAL AND OBLIQUE SHOCKS — 9

Governing equations – Variation of flow parameters across the normal and oblique shocks – Prandtl – Meyer relations – Applications.

UNIT IV — JET PROPULSION — 9

Theory of jet propulsion – Thrust equation – Thrust power and propulsive efficiency – Operating principle, cycle analysis and use of stagnation state performance of ram jet, turbojet, turbofan and turbo prop engines.

UNIT V — SPACE PROPULSION — 9

Types of rocket engines – Propellants-feeding systems – Ignition and combustion – Theory of rocket propulsion – Performance study – Staging – Terminal and characteristic velocity – Applications – space flights-Basics of cryogenics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret the concept of compressible flows in variable area ducts.

CO2: Apply the concept of compressible flows in constant area ducts.

CO3: Examine the effect of compression and expansion waves in compressible flow.

CO4: Use the concept of gas dynamics in Jet Propulsion.

CO5: Apply the concept of gas dynamics in Space Propulsion

TEXT BOOKS:

1. Anderson, J.D., "Modern Compressible flow", 3rd Edition, McGraw Hill, 2012.
2. Yahya, S.M. "Fundamentals of Compressible Flow", 3rd Edition, New Age International

(P) Limited, New Delhi, 2002.
3. Sutton. G.P., "Rocket Propulsion Elements", 5^{th} Edition, John Wiley, New York, 2010.

REFERENCES:

1. Cohen. H., G.E.C. Rogers and Saravanamutto, "Gas Turbine Theory",1^{st} Edition Longman Group Ltd.,1980
2. Ganesan. V., "Gas Turbines", 3^{rd} Edition, Tata McGraw Hill Publishing Co., New Delhi, 2010.
3. Shapiro. A.H.," Dynamics and Thermodynamics of Compressible fluid Flow", 2^{nd} Edition, John Wiley, New York, 1953.
4. Zucrow. N.J., "Principles of Jet Propulsion and Gas Turbines", 1st Edition, John Wiley, New York, 1970.

		L	T	P	C
21PME33	**POWER PLANT ENGINEERING**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To demonstrate the overview of thermal power plants
- To illustrate diesel, gas turbine and combined cycle power plants.
- To interpret nuclear power plant
- To interpret various renewable energies
- To calculate the power tariff and load factors

UNIT I	**COAL BASED THERMAL POWER PLANTS**	**10**

Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

UNIT II	**DIESEL, GAS TURBINE AND COMBINED CYCLE POWER PLANTS**	**10**

Otto, Diesel, Dual & Brayton Cycle - Analysis & Optimization. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

UNIT III	**NUCLEAR POWER PLANTS**	**7**

Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

UNIT IV	**POWER FROM RENEWABLE ENERGY**	**10**

Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

UNIT V	**ENERGY, ECONOMIC AND ENVIRONMENTAL ISSUES OF POWER PLANTS**	**8**

Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Examine the function and the parts of the coal based Thermal Power plant.

CO2: Demonstrate the power plants based on gas power cycles.

CO3: Examine the Nuclear Reactors in Nuclear power plant.

CO4: Illustrate power from Renewable energy sources.

CO5: Report the energy, economic and Environmental issues of power plant.

TEXT BOOKS:
1. Nag. P.K., "Power Plant Engineering", 3rd Edition, Tata McGraw – Hill Publishing Company Ltd., 2008 2. El-Wakil. M.M., "Power Plant Technology", 1st Edition Tata McGraw – Hill Publishing Company Ltd., 2010. 3. Arora and Domkundwar, “Power plant engineering” 8th Edition, Dhanpat rai & co. pvt. Ltd. 2016
REFERENCES:
1. Black & Veatch, Springer, "Power Plant Engineering", 1st Edition,1996. 2. Thomas C. Elliott, Kao Chen and Robert C. Swanekamp, "Power Plant Engineering", Second Edition, Standard Handbook of McGraw – Hill, 1998. 3. Godfrey Boyle, "Renewable energy", Open University, Oxford University Press in association with the Open University, 2004.

21OCH02	MATERIALS CHEMISTRY *(Common to all B.E / B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the working principles of adhesives and lubricants.
- To realize the characteristics of explosives and propellants.
- To recognize the significant applications of glasses and abrasives.
- To apprehend the importance of smart materials.
- To summarize the applications of sensor materials.

UNIT-I	ADHESIVES AND LUBRICANTS	9

Adhesives-Introduction and classification - bonding process of adhesives- physical and chemical factors influencing adhesive action -development of adhesive strength-**lubricants**-classification - mechanism of lubrication- properties of lubricating oils-viscosity- redwood viscometer method-flash and fire point-determination -cloud and pour point-determination –oiliness.

UNIT-II	EXPLOSIVES AND PROPELLANTS	9

Explosives-Introduction and classification –characteristics- precautions during storage- blasting fuses – preparation of important explosives (TNT, GTN and RDX) - uses of explosives- -**Rocket Propellants**– classification, essential characteristics of rocket propellant.

UNIT III	GLASSES AND ABRASIVES	9

Glasses-Introduction- manufacture of glass- special types of glasses (safety glasses, optical glasses, toughened glasses and laminated glasses) - **Abrasives** -classification - characteristics and applications – manufacture of abrasive paper and cloth.

UNIT IV	SMART MATERIALS	9

Introduction to smart materials – properties – components – classification – piezoelectric materials – electrostrictive materials – magnetostrictive materials – rheological materials – thermo responsive materials – electrochromic materials – fullerenes – biomimetic materials – smart gels – shape memory alloys – industrial applications.

UNIT V	SENSOR MATERIAL	9

Introduction to sensor material - classification and physico –chemical properties of sensor-sensing mechanism-chemical and electrochemical sensors for environmental pollution monitoring-sensor-characterisation, calibration sensor reliability, aging test-failure mechanisms and their evaluation and stability study-biosensor instrumentation- transducers-industrial applications.

45 PERIODS

COURSE OUTCOMES : At the end of the course, learners will be able to

CO 1: Understand the working principle of adhesives and lubricants.
CO 2: Identify the characteristics of explosives and propellants.
CO 3: Apprehend the applications glasses and abrasives.
CO 4: Interpret the characteristics of smart materials and relevant applications.
CO 5: Relate the importance of sensor materials.

Text Book:

1. Jain and Jain, A Text book of Engineering Chemistry, Dhanpat Rai Publishing Company, New Delhi, 17th Edition, 2019.
2. Malini.S, Anantha Raju K.S, Chemistry of Engineering Materials, CBS Publishers & Distributors pvt ltd, New Delhi,1st Edition,2022.
3. Rajendran V, Materials Science, McGraw Hill Publishing Company limited, New Delhi, 3rd Edition, 2017.

Reference Books:

1 .S.S. Dara and S.S. Umare, A Text Book of Engineering Chemistry, S Chand Publishers and Company limited, New Delhi, 6th Edition, 2019.
2.Harry. R. Allcock, Introduction to Materials Chemistry, Wiley publication, U.S, 2nd Edition, 2019.
3.C.V. Agarwal, C. Parameswara Murthy, Andra Naidu, BS Publications, Hyderabad, 9th Edition, 2018.

VERTICAL 6: INDUSTRIAL SYSTEM ENGINEERING

21PME34	PRINCIPLES OF MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To predict the importance of knowledge in management
- To demonstrate the process of planning in an organization.
- To illustrate functions of an industry.
- To use different motivational techniques and leadership skills in the organization.
- To use the various controlling techniques and tools in the organization.

UNIT I INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS 9

Definition of Management – Science or Art – Manager Vs. Entrepreneur - types of managers - managerial roles and skills – Evolution of Management – Scientific, human relations , system and contingency approaches – Types of Business organization - Sole proprietorship, partnership, company-public and private sector enterprises - Organization culture and Environment – Current trends and issues in Management.

UNIT II PLANNING 9

Nature and purpose of planning – planning process – types of planning – objectives – setting objectives – policies – Planning premises – Strategic Management – Planning Tools and Techniques – Decision making steps and

UNIT III ORGANISING 9

Nature and purpose – Formal and informal organization – organization chart – organization structure – types – Line and staff authority – departmentalization – delegation of authority – centralization and decentralization – Job Design - Human Resource Management – HR Planning, Recruitment, selection, Training and Development, Performance Management , Career planning and management.

UNIT IV DIRECTING 9

Foundations of individual and group behaviour – motivation – motivation theories – motivational techniques – job satisfaction – job enrichment – leadership – types and theories of leadership – communication – process of communication – barrier in communication – effective communication – communication and IT.

UNIT V CONTROLLING 9

System and process of controlling – budgetary and non-budgetary control techniques – use of computers and IT in Management control – Productivity problems and management – control and performance – direct and preventive control – reporting.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the foundational knowledge in management.

CO2: Relate the various planning.

CO3: Illustrate various functions of organization.

CO4: Interpret the functions of motivation.

CO5: Demonstrate the practices in budget and reporting.

TEXT BOOKS:

1. JAF Stoner, Freeman R.E and Daniel R Gilbert "Management", 6th Edition, Pearson Education, 2004.
2. Stephen P. Robbins & Mary Coulter, "Management", 10th Edition, Prentice Hall (India) Pvt. Ltd., 2009.
3. Stephen A. Robbins & David A. Decenzo & Mary Coulter, "Fundamentals of Management", 7th Edition, Pearson Education, 2011.

REFERENCES:

1. Robert Kreitner & Mamata Mohapatra, "Management", 1st Edition, Biztrantra, 2008.
2. Harold Koontz & Heinz Weihrich, "Essentials of Management", 1st Edition, Tata McGraw Hill, 1998.
3. Tripathy PC & Reddy PN, "Principles of Management", 1st Edition, Tata McGraw Hill, 1999

21PME35	TOTAL QUALITY MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the foundational knowledge in Total Quality Management.
- To relate the various TQM Principles.
- To illustrate various TQM Tools and Techniques I.
- To interpret the functions of TQM Tools and Techniques II.
- To demonstrate the practices in Quality Management System.

UNIT I	INTRODUCTION	9

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Customer focus - Customer orientation, Customer Satisfaction, Customer complaints, Customer retention.

UNIT II	TQM PRINCIPLES	9

Leadership - Quality Statements, Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier Partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III	TQM TOOLS AND TECHNIQUES I	9

The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types.

UNIT IV	TQM TOOLS AND TECHNIQUES II	9

Quality Circles - Cost of Quality - Quality Function Deployment (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures

UNIT V	QUALITY MANAGEMENT SYSTEM	9

Introduction—Benefits of ISO Registration—ISO 9000 Series of Standards—Sector-Specific Standards—AS 9100, TS16949 and TL 9000-- ISO 9001 Requirements—Implementation—Documentation—Internal Audits—Registration.

ENVIRONMENTAL MANAGEMENT SYSTEM: Introduction—ISO 14000 Series Standards—Concepts of ISO 14001—Requirements of ISO 14001— Benefits of EMS.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the quality management philosophies and Framework.

CO2: Demonstrate the need of customer expectations, employee involvement and Supplier Partnership.

CO3: Illustrate TQM tools and Techniques to improve the product and process Quality

CO4: Use the modern tools to improve quality of the product.

CO5: Explain the Management Standards and certification process.

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre, Hemant Urdhwareshe and Rashmi Urdhwareshe, “Total Quality Management”, Revised 3^{rd} Edition, Pearson Education Asia, Indian Reprint, 2013.
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8^{th} Edition, Cengage Learning, 2012.
3. Oakland J S, “TQM - Text with Cases”, 3^{rd} Edition, Butterworth - Heinemann Ltd., Oxford, 2012.

REFERENCES:

1. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", 1^{st} Edition,PrenticeHall (India) Pvt. Ltd., 2006.
2. Suganthi.L and Anand Samuel, "Total Quality Management", 2^{nd} Edition, Prentice Hall (India) Pvt. Ltd.,2006.
3. Ramachandran S, “Total Quality Management”, 3^{rd} Edition, Air Walk Publications, 2014.
4. ISO9001-2015 standards

21PME36	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To use various Lean Manufacturing tools
- To execute various lean tools for improving production
- To show the concepts to reduce the process time
- To implement the process of Six Sigma
- To use the suitable Lean Tools for various cases

UNIT I	INTRODUCTION TO LEAN MANUFACTURING	9

Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT II	CELLULAR MANUFACTURING, JIT, TPM	9

Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT III	SET UP TIME REDUCTION, TQM, 5S, VSM	9

Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

UNIT IV	SIX SIGMA	9

Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation.

UNIT V	CASE STUDIES	9

Various case studies of implementation of lean manufacturing at industries.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply various Lean Manufacturing tools to eliminate wastes.

CO2: Apply various lean manufacturing tools for productivity improvements.

CO3: Demonstrate the concepts to reduce the process time

CO4: Apply the process of Six Sigma in industries.

CO5: Use the suitable Lean Tools for the identified cases and justify

TEXT BOOKS:

1. Ronald G. Askin & Jeffrey B. Goldberg, "Design and Analysis of Lean Production Systems", 1st Edition, John Wiley & Sons, 2003.
2. D. Reinertsen, "The Principles of Product Development Flow", 1st Edition, Second Generation Lean Product Development, Celeritas Publishing, 2009.
3. M. Rother, J. Shook, "Learning to See , Lean" 1st Edition, Enterprise Institute, 2009.

REFERENCES:

1. Mikell Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", 4th edition, Pearson, 2014.
2. Rother M. and Shook J, "Learning to See: Value Stream Mapping to Add Value and

Eliminate MUDA", Lean Enterprise Institute, 1st Edition, 1999.

3. J.K. Liker, "The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer", 1st Edition, McGraw Hill, 2004.

21PME37	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply safety ideas to impart basic safety skills.
- To relate the concepts of safety analysis and its control measures.
- To discover the occupational health hazards and its risk in workplace.
- To interpret the safety, Health and Environmental regulations.
- To relate safety management system and apply in industrial case studies.

UNIT I — OPERATIONAL SAFETY — 9

Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – hot bending pipes – safety in welding and cutting, Cold – metal operation – safety in machine shop – cold bending and chamfering of pipes metal cutting – shot blasting, grinding, painting – power press and other machines. Management of toxic gases and chemicals – industrial fires and prevention – road safety – highway and urban safety – safety of sewage disposal and cleaning – control of environmental pollution – managing emergencies in industries – planning security and risk assessments, on – site and off site. Control of major industrial hazards.

UNIT II — SAFETY APPRAISAL AND ANALYSIS — 9

Human side of safety – personal protective equipment – causes and cost of accidents. Accidents prevention program – specific hazard control strategies – HAZOP training and development of employees – first aid – fire fight devices – accident reporting, investigation. Measurement of safety performance, accident reporting and investigation – plant safety inspection, job safety analysis – safety permit procedures. Product safety – plant safety rules and procedures – safety sampling – safety inventory systems. Determining the cost effectiveness of safety measurement.

UNIT III — OCCUPATIONAL HEALTH — 9

Concept and spectrum of health functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickel, chromium and manganese toxicity – gas poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT IV — SAFETY AND HEALTH REGULATIONS — 9

Safety and health standards – industrial hygiene – occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules 123a, history of legislations related to safety – pressure vessel act – Indian boiler act – the environmental protection act – electricity act – explosive act.

UNIT V — SAFETY MANAGEMENT — 9

Evaluation of modern safety concepts – safety management functions – safety organization, safety department- safety committee, safety audit – performance measurements and motivation – employee participation in safety - safety and productivity.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret operational safety in industrial process

CO2: Calculate safety risk by executing safety appraisal using HAZOP

CO3: Discover the occupational health hazards presents in the workplace

CO4: Relate the safety and health regulations in workplace

CO5: Choose safety system to run an industry with utmost safety precautions

TEXT BOOKS:

1. John V Grimaldi, Safety Management, Richard D. Irwin; 5^{th} Edition, 2003
2. Krishnan N.V, “Safety in Industry”, 1^{st} Edition, Jaico Publisher House, 1996
3. Deshmukh L M , “Industrial Safety Management”, 2^{nd} Edition, McGraw Hill Education India, 2017

REFERENCES:

1. John.V .Grimaldi and Rollin. H Simonds, “Safety Management”, 1^{st} Edition, All India traveller book seller, New Delhi – 1989
2. Singh, U.K and Dewan, J.M., “Safety, Security and Risk Management”, 1^{st} Edition, APH publishing company, New Delhi, 1996
3. Occupational Safety Manual, NIOSH, 1985

21PME38	INDUSTRY 4.0	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the basic concepts of Industry 4.0
- To relate the concepts of evolution of Industry 4.0
- To construct the concepts of IIOT
- To discover the real time application of Industry 4.0
- To prepare the Business opportunities and challenges in Industry 4.0

UNIT I	**INTRODUCTION TO INDUSTRY 4.0**	**9**

The Various Industrial Revolutions - Digitalisation and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - The Journey so far: Developments in USA, Europe, China and other countries - Comparison of Industry 4.0 Factory and Today's Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation.

UNIT II	**ROAD TO INDUSTRY 4.0**	**9**

Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics

UNIT III	**IIOT**	**9**

Fourth Revolution – Sustainability assessment of Manufacturing Industry – Lean Production system – Smart and connected business perspective – smart factories – cyber-physical systems – collaboration platform and PLM

UNIT IV	**APPLICATIONS**	**9**

Inventory Management and Quality Control – Plant security and safety – Facility management – oil, chemical and Pharmaceutical Industry – Milk processing and packaging industries

UNIT V	**BUSINESS ISSUES IN INDUSTRY 4.0**	**9**

Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era – Strategies for competing in an Industry 4.0 world

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1: Show the basics of Industrial Revolution
CO2: Interpret the basic concepts of Industry 4.0
CO3: Relate the Concepts of Industrial IOT in various sectors
CO4: Demonstrate the applications of Industrial IOT
CO5: Solve the Business issues in Industry 4.0

TEXT BOOKS:

1. The Fourth Industrial Revolution‖ by Klaus Schwab, World Economic Forum 2nd Edition
2. Arsheep Bahga and Vijay Madisetti, "Internet of Things: A Hands-On Approach", 8th Edition, University Press.
3. NOC: "Introduction to Industry 4.0 and Industrial Internet of Things" 3rd Edition

REFERENCES:

1. Jean-Claude André, "Industry 4.0", 3rd Edition, Wiley- ISTE, 2019.
2. Diego Galar Pascual, Pasquale Daponte, Uday Kumar, "Handbook of Industry 4.0 and SMART Systems", 2nd Edition, Taylor and Francis, 2020.
3. Miller M, "The internet of things: How smart TVs, smart cars, smart homes, and smart cities are changing the world", 3rd Edition, Pearson Education, 2015.

21PME39	PROFESSIONAL ETHICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the importance of Human Values.
- To relate the various theories related to ethical behaviour.
- To illustrate various role and responsibility in technological development through experimentation.
- To explain the functions of professionals rights.
- To demonstrate the practices in Global Issues.

UNIT I	HUMAN VALUES	9

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II	ENGINEERING ETHICS	9

Senses of _Engineering Ethics – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg‘s theory – Gilligan‘s theory – Consensus and Controversy – Models of professional roles – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

UNIT III	ENGINEERING AS SOCIAL EXPERIMENTATION	9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV	SAFETY, RESPONSIBILITIES AND RIGHTS	9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

UNIT V	GLOBAL ISSUES	9

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development - Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors - Moral Leadership –Code of Conduct – Corporate Social Responsibility.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the foundational knowledge in Human Values.

CO2: Relate the various Engineering Ethics.

CO3: Illustrate various Engineering as Social Experimentation.

CO4: Interpret the functions of Safety, Responsibilities and Rights.

CO5: Apply the knowledge of human values and social values to contemporary ethical values and global issues.

TEXT BOOKS:

1. Mike W. Martin and Roland Schinzinger, "Ethics in Engineering", 4^{th} Edition, Tata McGraw Hill, New Delhi, 2017. 2. Govindarajan M, Natarajan S, Senthil Kumar V. S, "Engineering Ethics", 1^{st} Edition, Prentice Hall of India, New Delhi, 2004. 3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", 1^{st} Edition, Oxford University Press, Oxford, 2001.
REFERENCES:
1. Charles B. Fleddermann, "Engineering Ethics", 2^{nd} Edition, Pearson Prentice Hall, New Jersey, 2004. 2. John R Boatright, "Ethics and the Conduct of Business", 1^{st} Edition, Pearson Education, New Delhi, 2003. 3. Laura P. Hartman and Joe Desjardins, "Business Ethics: Decision Making for Personal Integrity and Social Responsibility", 1^{st} Edition, Mc Graw Hill education, India Pvt. Ltd., New Delhi, 2013

21PME40	ENTREPRENEURSHIP DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop basic entrepreneurial skills.
- To demonstrate strengthen entrepreneurial motivation
- To illustrate the business efficiently and effectively
- To relate financing and accounting
- To support the entrepreneurs policy

UNIT I	ENTREPRENEURSHIP	9

Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Entrepreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth

UNIT II	MOTIVATION	9

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III	BUSINESS	9

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies

UNIT IV	FINANCING AND ACCOUNTING	9

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V	SUPPORT TO ENTREPRENEURS	9

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures - Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the entrepreneurial skills and factors

CO2: Illustrate the need of motivation for Entrepreneur

CO3: Describe the requirement to run the business efficiently and effectively

CO4: Estimate the sources of Finance and Loan

CO5: Express to support the entrepreneurs policy

TEXT BOOKS:

1. Khanka. S.S., “Entrepreneurial Development” S.Chand & Co. Ltd., Ram Nagar, New Delhi,
2. Donald F Kuratko, “Entrepreneurship – Theory, Process and Practice”, 9th Edition, Cengage
3. Hisrich R D, Peters M P, “Entrepreneurship” 8th Edition, Tata McGraw-Hill, 2013.

REFERENCES:

1. Mathew J Manimala, "Entrepreneurship theory at cross roads: paradigms and praxis” 2nd Edition, Dream tech, 2005.

2. Rajeev Roy, "Entrepreneurship" 2nd Edition, Oxford University Press, 2011.
3. EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

21PME41	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To solve Linear Programming techniques.
- To solve about the transportation models and network models
- To solve about Assignment models and Inventory control
- To solve basic Project management techniques
- To solve Game theory problems and queuing models

UNIT I	CONCEPTS OF OPERATIONS RESEARCH AND LINEAR PROGRAMMING TECHNIQUES	9

Operations research and decision making, types of mathematical models and their construction; Formulation of linear programming problem, applications and limitations: Graphical method, Simplex method, Big–M method, Two–phase method.

UNIT II	TRANSPORTATION MODELS AND NETWORK MODELS	9

Least cost method, North West corner rule, Vogel's approximation method, Modified distribution method optimization models, degeneracy in transportation model, unbalanced and maximization models.

UNIT III	ASSIGNMENT MODELS AND INVENTORY CONTROL	9

Assignment models: Hungarian algorithm, unbalanced assignment problems, maximization case in assignment problems, traveling salesman problem. Inventory models with penalty, shortage and quantity discount, safety stock, inventory models with probability, lead time, demand, multi item deterministic model.

UNIT IV	PROJECT MANAGEMENT BY CPM AND PERT	9

Constructing project network, network computations in CPM and PERT, cost crashing, resource levelling.

UNIT V	GAME THEORYAND QUEUING MODELS	9

Game theory: Theory of games, competitive games, rules for game theory, mixed strategies, two person zero sum game, n person zero sum game, graphical method. ; Queuing models: The M/M/1 queue, The M/M/m queue, batch arrival queuing system, queues with breakdowns

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Construct the LPP and solve by Graphical method

CO2: Solve the Transportation and Network models

CO3: Solve the Assignment and Inventory models

CO4: Construct the project network using CPM and PERT

CO5: Solve by using Game theory and Queuing models

TEXT BOOKS:

1. Hillier and Libeberman, "Operations Research", 3rd Edition, Holden Day, 2005
2. Taha H.A., "Operations Research", 6th Edition, Prentice Hall of India, 2003.
3. Tulsian and Pasdey V., "Quantitative Techniques", 4th Edition, Pearson Asia, 2002.

REFERENCES:

1. Bazara M.J., Jarvis and Sherali H., "Linear Programming and Network Flows", 4th Edition, John Wiley, 2009.
2. Budnick F.S., "Principles of Operations Research for Management", 3rd Edition, Richard D Irwin, 1990.
3. Philip D.T. and Ravindran A., "Operations Research", 2nd Edition, John Wiley, 1992.
4. Shennoy G.V. and Srivastava U.K., "Operation Research for Management", 4th Edition, Wiley Eastern, 1994.

VELAMMAL

COLLEGE OF ENGINEERING AND TECHNOLOGY, MADURAI – 625 009

(Autonomous)

(Accredited by NAAC with 'A' Grade and by NBA for 5 UG Programmes)

(Approved by AICTE and affiliated to Anna University, Chennai)

DEPARTMENT OF INFORMATION TECHNOLOGY

B.Tech. INFORMATION TECHNOLOGY

CURRICULUM and SYLLABUS

(I to VIII Semesters)

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY, MADURAI-625 009

(Autonomous)

REGULATIONS - 2021

B.Tech. INFORMATION TECHNOLOGY (CBCS)

CURRICULUM FOR SEMESTERS I TO VIII

SEMESTER–I

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21IP101	Induction Programme *(Common to all B.E./B.Tech. Programmes)*	-	0	0	0	0
		THEORY					
2.	21EN101	Professional English – I *(Common to all B.E./B.Tech. Programmes)*	HS	3	2	0	4
3.	21MA101	Matrices and Calculus *(Common to all B.E./B.Tech. Programmes)*	BS	3	2	0	4
4.	21PH101	Engineering Physics *(Common to all B.E./B.Tech. Programmes)*	BS	3	0	0	3
5.	21CH101	Engineering Chemistry *(Common to all B.E./B.Tech. Programmes)*	BS	3	0	0	3
6.	21CS101	Problem Solving and Python Programming *(Common to all B.E./B.Tech. Programmes)*	ES	3	0	0	3
7.		Cambridge Course*	EE	1	0	0	1
		PRACTICAL COURSES					
8.	21CS102	Problem Solving and Python Programming Laboratory *(Common to all B.E./B.Tech. Programmes)*	ES	0	0	4	2
9.	21PC101	Physics and Chemistry Laboratory *(Common to all B.E./B.Tech. Programmes)*	BS	0	0	4	2
		Total Credits					**22**

***Naan Mudhalvan Scheme Course**

SEMESTER- II

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21EN102	English – II *(Common to all B.E./B.Tech. Programmes)*	HS	3	0	0	3
2.	21MA103	Sampling Techniques and Numerical Methods *(Common to B.E. CSE,ECE & B.Tech.IT)*	BS	3	2	0	4
3.	21PH103	Physics for Information Science *(Common to B. E. CSE /B.Tech. IT)*	BS	3	0	0	3
4.	21ME101	Engineering Graphics *(Common to all B.E/B.Tech Programmes)*	ES	2	0	2	3
5.	21CS103	Programming in C *(Common to B. E. CSE /B.Tech. IT)*	PC	3	0	0	3
6.	21CH103	Environmental Science *(Common to all B.E./B.Tech. Programmes)*	BS	2	0	0	2
7.	21EE104	Basic Electrical and Electronics Engineering for Information Science *(Common to B.E. CSE / B.Tech.IT)*	ES	3	0	0	3
		PRACTICAL COURSES					
8.	21EM101	Engineering Practices Laboratory *(Common to all B.E/B.Tech Programmes)*	ES	0	0	4	2
9.	21CS104	Programming in C Laboratory *(Common to B. E. CSE /B.Tech. IT)*	PC	0	0	4	2
		Total Credits					**25**

SEMESTER- III

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21MA203	Discrete Mathematics *(Common to B. E. CSE /B.Tech. IT)*	BS	3	2	0	4
2.	21EC201	Digital Principles and System Design *(Common to B.E. (CSE & ECE) /B.Tech.(IT))*	PC	3	0	0	3
3.	21CS201	Computer Organization and Architecture *(Common to B. E. CSE /B.Tech. IT)*	PC	3	0	0	3
4.	21CS202	Data Structures *(Common to B. E. CSE /B.Tech. IT)*	PC	3	0	0	3
5.	21CS203	Object Oriented Programming *(Common to B. E. CSE /B.Tech. IT)*	PC	3	0	0	3
6.	21EC213	Analog and Digital Communication	PC	3	0	0	3
7.		Microsoft Office Fundamentals*	EE	1	0	0	1
		PRACTICAL COURSES					
8.	21EC212	Digital Systems Laboratory *(Common to B.E. (CSE & ECE) /B.Tech.(IT))*	PC	0	0	4	2
9.	21CS204	Data Structures Laboratory *(Common to B. E. CSE /B.Tech. IT)*	PC	0	0	4	2
10.	21CS205	Object Oriented Programming Laboratory *(Common to B. E. CSE /B.Tech. IT)*	PC	0	0	4	2
		Total Credits					**26**

***Naan Mudhalvan Scheme Course**

SEMESTER- IV

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1.	21MA205	Stochastic Process and its Applications *(Common to B. E. CSE /B.Tech. IT)*	BS	3	2	0	4
2.	21CS206	Database Management Systems *(Common to B. E. CSE /B.Tech. IT)*	PC	3	0	0	3
3.	21CS207	Design and Analysis of Algorithm *(Common to B. E. CSE /B.Tech. IT)*	PC	3	0	0	3
4.	21CS208	Operating Systems *(Common to B. E. CSE /B.Tech. IT)*	PC	3	0	0	3
5.	21IT201	Computer Networks	PC	3	0	0	3
6.	21IT202	Design Thinking and Product Innovation	EE	2	0	0	1
PRACTICAL COURSES							
7.	21CS210	Database Management Systems Laboratory *(Common to B. E. CSE /B.Tech. IT)*	PC	0	0	4	2
8.	21CS211	Operating Systems Laboratory *(Common to B. E. CSE /B.Tech. IT)*	PC	0	0	4	2
Total Credits							**21**

SEMESTER- V

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
THEORY							
1.	21IT301	Foundations of Data Science	PC	3	0	0	3
2.	21IT302	Principles of Cloud Computing	PC	3	0	0	3
3.	21PXXXX	Professional Elective – I	PE	-	-	-	3
4.	21PXXXX	Professional Elective – II	PE	-	-	-	3
5.	21OCITXX	One Credit Course	EE	1	0	0	1
6.	21MCC01	Constitution of India	MC	1	0	0	0
7.		Naan Mudhalvan Scheme Course*	EE	2	0	0	2*
THEORY WITH PRACTICAL COURSES							
8.	21IT303	Software Engineering	PC	3	0	2	4
PRACTICAL COURSES							
9.	21IT304	FOSS and Cloud Laboratory	PC	0	0	4	2
10.		Internship#	EE	0	0	0	1
Total Credits							**20**

* Big Data / Full Stack / Cloud Essential / AR VR Development / Machine Learning with application to object recognition

Two weeks Internships

SEMESTER- VI

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21IT305	Mobile Computing	PC	3	0	0	3
2.	21IT306	Fundamentals of Artificial Intelligence	PC	3	0	0	3
3.	21PXXXX	Professional Elective – III	PE	-	-	-	3
4.	21PXXXX	Professional Elective – IV	PE	-	-	-	3
5.	21OXXXX	Open Elective – I	OE	3	0	0	3
6.	21OXXXX	Open Elective – II	OE	3	0	0	3
7.	21MCC02	Essence of Indian Traditional Knowledge	MC	1	0	0	0
8.		Naan Mudhalvan Scheme Course *	EE	2	0	0	2*
		THEORY WITH PRACTICAL COURSE					
9.	21IT307	Internet of Things	PC	3	0	2	4
		PRACTICAL COURSES					
10.	21EN301	Professional Communication Laboratory	HS	0	0	2	1
		Total Credits					**23**

* Big Data / Full Stack / Cloud Essential / AR VR Development / Machine Learning with application to object recognition

SEMESTER- VII

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21IT401	Big Data Engineering	PC	3	0	0	3
2.	21IT402	Software Project Management	PC	3	0	0	3
3.	21OXXXX	Open Elective – III	OE	3	0	0	3
4.	21OXXXX	Open Elective – IV	OE	3	0	0	3
5.		Naan Mudhalvan Scheme Course*	EE	2	0	0	2*
		PRACTICAL COURSE					
6.	21IT403	Project Work-I	EE	0	0	4	2
		Total Credits					**14**

* Big Data / Full Stack / Cloud Essential / AR VR Development / Machine Learning with application to object recognition

SEMESTER- VIII

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21PXXXX	Professional Elective – V	PE	-	-	-	3
2.	21PXXXX	Professional Elective – VI	PE	-	-	-	3
		PRACTICAL COURSE					
3.	21IT404	Project Work-II	EE	0	0	20	10
		Total Credits					**16**

Total Credits: 167

SEMESTER-WISE CREDIT DISTRIBUTION

	I SEM	II SEM	III SEM	IV SEM	V SEM	VI SEM	VII SEM	VIII SEM	Total Credits
HS	4	3				1			8
BS	12	9	4	4					29
ES	5	8							13
PC		5	21	16	12	10	6		70
PE					6	6		6	18
OE						6	6		12
EE	1*		1*	1	2+2*	2*	2+2*	10	17
MC/ Non Credit					*	*			
Total	22	25	26	21	20	23	14	16	**167**

S.No	Topic
1.	Humanities and Social Sciences including Management (HS)
2.	Basic Sciences (BS)
3.	Engineering Sciences including Workshop, Drawing, Basics of Civil / Electrical / Mechanical / Computer etc. (ES)
4.	Professional Core Courses (PC)
5.	Professional Electives : Courses relevant to chosen specialization / branch (PE)
6.	Open Electives: Electives from other Technical and / or emerging Courses (OE)
7.	Project Work, Seminar and Internship in Industry – Employability Enhancement Courses (EE)
8.	Mandatory Courses (MC)
9.	Open Elective (OE)

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL 1: DATA SCIENCE

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PCS01	Data Science and Big Data Analytics	PE	2	0	2	3
2.	21PCS02	Exploratory Data Analysis	PE	2	0	2	3
3.	21PCS03	Neural Networks and Deep Learning	PE	2	0	2	3
4.	21PCS04	Information Recommender Systems	PE	2	0	2	3
5.	21PCS05	Computer Vision Algorithms and Applications	PE	2	0	2	3
6.	21PCS06	Image and Video Analytics	PE	2	0	2	3
7.	21PCS07	Text and Speech Analysis	PE	2	0	2	3
8.	21PCS08	Essentials of Business Analytics	PE	2	0	2	3

VERTICAL 2: FULL STACK DEVELOPEMENT

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PCS09	Principles of Programming Languages	PE	2	0	2	3
2.	21PCS10	Web Technology and Design	PE	2	0	2	3
3.	21PCS11	Cloud Services Management	PE	2	0	2	3
4.	21PCS12	Android App Development	PE	2	0	2	3
5.	21PCS13	Web Application Security	PE	2	0	2	3
6.	21PCS14	Software Testing and Automation	PE	2	0	2	3
7.	21PCS15	Introduction to Dev-Ops	PE	2	0	2	3
8.	21PCS16	Python Application Programming Interface Development	PE	2	0	2	3

VERTICAL 3: DATA CENTRE TECHNOLOGIES

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PCS17	Data Ware housing Concepts and Implementation	PE	2	0	2	3
2.	21PCS18	Data Storage Technologies	PE	2	0	2	3
3.	21PCS19	Software Defined Networks	PE	2	0	2	3
4.	21PCS20	Cloud Computing and Virtualization	PE	2	0	2	3
5.	21PCS21	Information Storage and Management	PE	3	0	0	3
6.	21PCS22	Stream Processing Framework	PE	2	0	2	3
7.	21PCS23	Fog and Edge Computing	PE	3	0	0	3
8.	21PCS24	Cloud Data Centre Network Architectures	PE	2	0	2	3

VERTICAL 4: CYBER SECURITY AND DATA PRIVACY

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PIT01	Cryptographic Techniques	PE	3	0	0	3
2.	21PIT02	Paradigms of Network Security	PE	2	0	2	3
3.	21PIT03	Engineering Secure Software Systems	PE	3	0	0	3
4.	21PIT04	Digital and Mobile Forensics	PE	3	0	0	3
5.	21PIT05	Ethical Hacking Exploit Development	PE	2	0	2	3
6.	21PIT06	Social Network Security	PE	3	0	0	3
7.	21PIT07	Security and Privacy in Cloud	PE	3	0	0	3
8.	21PIT08	Cryptocurrency and Blockchain Technologies	PE	2	0	2	3

VERTICAL 5: CREATIVE MEDIA

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PIT09	Multimedia and Animation	PE	2	0	2	3
2.	21PIT10	Multimedia Data Compression and Storage	PE	3	0	0	3
3.	21PIT11	UI and UX Design	PE	2	0	2	3
4.	21PIT12	Video Processing and Analytics	PE	3	0	0	3
5.	21PIT13	Techniques for Visual Effects	PE	3	0	0	3
6.	21PIT14	Game Design and Development	PE	2	0	2	3
7.	21PIT15	Concepts of Augmented Reality and Virtual Reality	PE	3	0	0	3
8.	21PIT16	Strategies of Digital Marketing	PE	3	0	0	3

VERTICAL 6: PROGRESSIVE TECHNOLOGIES

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PIT17	Techniques of Robotic Process Automation	PE	3	0	0	3
2.	21PIT18	Cyber security Essentials	PE	3	0	0	3
3.	21PIT19	3D Printing and Design	PE	3	0	0	3
4.	21PIT20	Embedded System Design	PE	2	0	2	3
5.	21PIT21	Principles of Quantum Computing	PE	3	0	0	3
6.	21PIT22	Autonomous Ground Vehicle Systems	PE	3	0	0	3
7.	21PIT23	E-Learning Techniques	PE	3	0	0	3
8.	21PIT24	Next Generation Networks	PE	3	0	0	3

VERTICAL 7: COGNITIVE COMPUTING

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21PCS25	Ethics and Artificial Intelligence	PE	3	0	0	3
2.	21PCS26	Introduction to Knowledge Engineering	PE	2	0	2	3
3.	21PCS27	Principles of Soft Computing	PE	2	0	2	3
4.	21PCS28	Optimization Techniques and Applications	PE	2	0	2	3
5.	21OMA01	Graph Theory and its Applications	PE	3	0	0	3
6.	21PCS29	Introduction to Game Theory	PE	2	0	2	3
7.	21PCS30	Cognitive Science Theory and Applications	PE	2	0	2	3
8.	21PCS31	Statistical Natural Language Processing	PE	2	0	2	3

VERTICAL 8: EMERGING TECHNOLOGIES (OPEN ELECTIVES I & II FOR EEE, CIVIL AND MECH PROGRAMMES)

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21OIT01	Fundamentals of Augmented Reality and Virtual Reality	OE	3	0	0	3
2.	21OIT02	Fundamentals of Robotic Process Automation	OE	3	0	0	3
3.	21OIT03	Deep Learning Techniques	OE	3	0	0	3
4.	21PIT18	Cyber security Essentials	OE	3	0	0	3
5.	21OIT04	Fundamentals of Block chain	OE	3	0	0	3
6.	21OIT05	Game Development for Novice	OE	3	0	0	3
7.	21OIT06	Introduction to 3D Printing and Design	OE	3	0	0	3
8.	21OIT07	Fundamentals of Machine Learning	OE	3	0	0	3
9.	21OIT08	Internet of Things concepts and Applications	OE	3	0	0	3
10.	21IT301	Foundations of Data Science	PC	3	0	0	3

ONE CREDIT COURSES

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21OCIT01	Automation Tool	EE	0	0	2	1
2.	21OCIT02	Azure Cloud Essentials	EE	0	0	2	1
3.	21OCIT03	Mongo DB Basics	EE	0	0	2	1

SEMESTER – I

21IP101	INDUCTION PROGRAMME (Common to all B.E./ B.Tech. programmes)	L	T	P	C
		0	0	0	0

PRE-REQUISITE:

Ability to understand the high frequency every day or job-related language and write simple connected text on topics which are familiar or of personal interest.

OBJECTIVES:

- This course aims at making students comfortable to the new environment and create a holistic outlook, and to create a desire to work for national needs and beyond.

12

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:
"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfill his/her responsibility as an engineer, as a citizen and as a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character. "

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and therefore there shall be no tests / assessments during this programme.

Hence, the purpose of this programme is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

	TOTAL: 12 PERIODS

REFERENCES:

Guide to Induction program from AICTE

21EN101	PROFESSIONAL ENGLISH-1 (Common to all B.E./B.TECH. Programmes)	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To develop learners skills in listening and responding effectively.
- To apply basic grammar for better communication.
- To employ reading passages for understanding vocabulary.
- To construct logical sentences and participate in pair presentation, extempore.
- To organize ideas for various compositions in writing.

UNIT I	INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION	15

Listening – Listening for general information - Specific details - Conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form; **Speaking** - Self Introduction; Introducing a friend; Conversation - Politeness strategies; Telephone conversation; Leave a voicemail; Leave a message with another person; asking for information to fill details in a form; **Reading** - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails; **Writing** - Writing emails / letters introducing oneself; **Grammar** - Present Tense (simple, continuous); Question types: Wh/ Yes or No/ and Tags **Vocabulary** - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).

UNIT II	NARRATION AND SUMMATION	15

Listening - Listening to podcast, anecdotes / stories / event narration; documentaries and interviews with celebrities; **Speaking** - Narrating personal experiences / events; Interviewing a celebrity; Reporting / and summarizing of documentaries / podcasts/ interviews; **Reading** - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs; **Writing** - Guided writing - Paragraph writing Short Report on an event (field trip etc.); **Grammar** - Past tense (Simple, continuous); Subject-Verb Agreement; and Prepositions; **Vocabulary** - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.

UNIT III	DESCRIPTION OF A PROCESS / PRODUCT	15

Listening - Listen to a product and process descriptions; a classroom lecture; and advertisements about a products; **Speaking** - Picture description; Giving instruction to use the product; Presenting a product; and Summarizing a lecture; **Reading** - Reading advertisements, gadget reviews; user manuals; **Writing** - Writing definitions; instructions; and Product /Process description; **Grammar** - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect, Present and past perfect continuous tenses; **Vocabulary** - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words)

UNIT IV	CLASSIFICATION AND RECOMMENDATIONS	15

Listening - Listening to TED Talks; Scientific lectures; and educational videos; **Speaking** – Small Talk; Mini presentations and making recommendations; **Reading** - Newspaper articles; Journal reports - Non Verbal Communication (tables, pie charts etc,) **Writing** - Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode) **Grammar** - Articles; Pronouns - Possessive & Relative pronouns; **Vocabulary** - Collocations; Fixed / Semi fixed expressions

UNIT V	EXPRESSIONS	15

Listening - Listening to debates/ discussions; different viewpoints on an issue; and panel discussions; **Speaking** - Group discussions, Debates, and Expressing opinions through Simulations & Role-play; **Reading** - Reading editorials; and Opinion Blogs; **Writing** - Essay Writing (Descriptive or narrative); **Grammar** - Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences; **Vocabulary** - Cause & Effect Expressions - Content vs. Function words.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Listen and comprehend complex academic texts.

CO2: Read and infer the denotative and connotative meanings of technical texts.

CO3: Write definitions, descriptions, narrations and essays on various topics.

CO4: Speak fluently and accurately in formal and informal communicative contexts.

CO5: Express their opinions effectively in both oral and written medium of communication.

TEXT BOOKS:

1. Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University. English for Science & Technology. Cambridge University Press, 2021.
2. Board of Editors, Department of English, Anna University. English for Engineers & Technologists. Orient Blackswan Private Ltd, 2020.
3. Board of Editors, Department of English, Anna University. Using English Orient Blackswan Private Ltd, 2017.

REFERENCES:

1. Meenakshi Raman & Sangeeta Sharma. Technical Communication – Principles And Practices Oxford University Press, New Delhi, 2016.
2. Lakshminarayanan K.R. A Course Book On Technical English. SciTech Publications (India) Pvt. Ltd., 2012.
3. Ayesha Viswamohan. English For Technical Communication (With CD). McGraw Hill,Education, ISBN: 0070264244. 2008.
4. Kulbhusan Kumar, RS Salaria, Effective Communication Skill. Khanna Publishing House. First Edition, 2018.
5. Dr. V. Chellammal. Learning to Communicate. Allied Publishing House, New Delhi, 2003.

21MA101	MATRICES AND CALCULUS *(Common to all B.E. / B.Tech. Programmes)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To explain the students about differential calculus.
- To demonstrate the functions of several variables technique to solve problems in many engineering branches.
- To demonstrate the various techniques of integration.
- To prepare the student to use mathematical tools in evaluating multiple integrals and their applications.

UNIT I	MATRICES	12

Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.

UNIT II	DIFFERENTIAL CALCULUS	12

Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.

UNIT III	FUNCTIONS OF SEVERAL VARIABLES	12

Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.

UNIT IV	INTEGRAL CALCULUS	12

Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.

UNIT V	MULTIPLE INTEGRALS	12

Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use the matrix algebra methods for solving engineering problems.

CO2: Apply differential calculus tools in solving various application problems.
CO3: Make use of differential calculus ideas on several variable functions.
CO4: Identify suitable methods of integration in solving practical problems.
CO5: Solve practical problems of areas, volumes using multiple integrals.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
3. James Stewart, "Calculus: Early Transcendentals", 8thEdition, Cengage Learning, New Delhi, 2015.

REFERENCES:

1. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", 7thEdition, Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 2009.
2. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", 5th Edition, Narosa Publications, New Delhi, 2016.
3. Ramana. B.V., "Higher Engineering Mathematics", 6th Edition, McGraw Hill Education Pvt. Ltd, New Delhi, 2010.
4. Thomas. G. B., Hass. J and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

21PH101	ENGINEERING PHYSICS *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the students effectively to achieve an understanding of mechanics.
- To infer the students to gain knowledge of electromagnetic waves and its applications.
- To explain the basics of oscillations, optics and lasers.
- To outline the importance of quantum physics.
- To relate the students towards the applications of quantum mechanics.

UNIT I	MECHANICS	9

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum– double pendulum –Introduction to nonlinear oscillations.

UNIT II	ELECTROMAGNETIC WAVES	9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.

UNIT III	OSCILLATIONS, OPTICS AND LASERS	9

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave – sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference– Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV	BASIC QUANTUM MECHANICS	9

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in an infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.

UNIT V	APPLIED QUANTUM MECHANICS	9

The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the importance of mechanics.

CO2: Extend their knowledge in electromagnetic waves.

CO3: Illustrate a strong foundational knowledge in oscillations, optics and lasers.

CO4: Interpret the importance of quantum physics.

CO5: Summarize quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow,"An Introduction to Mechanics",First Edition, McGraw Hill Education, 2017.
2. E.M.Purcell and D.J.Morin, "Electricity and Magnetism", Third Edition, Cambridge UniversityPress, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", SeventhEdition, McGraw-Hill, 2017.

REFERENCES

1. R.Wolfson. "Essential University Physics",Volume 1 & 2. , First Edition (Indian Edition) Pearson Education,2009.
2. Paul A. Tipler, "Physics"- Volume 1 & 2, First Edition (Indian Edition), CBS Publishers & Distributors, 2004.
3. K.Thyagarajan and A.Ghatak. "Lasers: Fundamentals and Applications", Second Edition, Laxmi Publications,(Indian Edition), 2019.
4. D.Halliday, R.Resnick and J.Walker,"Principles of Physics", 10th Edition(Indian Edition), Wiley, 2015.
5. N.Garcia, A.Damask and S.Schwarz,"Physics for Computer Science Students",First Edition, Springer Verlag, 2012.

21CH101	**ENGINEERING CHEMISTRY** *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I	WATER AND ITS TREATMENT	9

Water: Sources and impurities, **Water quality parameters:** Definition and significance of-colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination).**Desalination of brackish water**: Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming &foaming. **Treatment of boiler feed water**: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II	NANOCHEMISTRY	9

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials**: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. **Applications** of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III	PHASE RULE AND COMPOSITES	9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.
Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). **Properties and applications of**: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. **Hybrid composites** - definition and examples.

UNIT IV	FUELS AND COMBUSTION	9

Fuels: Introduction: Classification of fuels; **Coal and coke**: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:** Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Power alcohol and biodiesel.**

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; **Ignition temperature**: spontaneous ignition temperature, Explosive range; **Flue gas analysis** - ORSAT Method. **CO_2 emission and carbon foot print.**

UNIT V	ENERGY SOURCES AND STORAGE DEVICES	9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. **Solar energy conversion:** Principle, working and applications of solar cells; **Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H_2-O_2 fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO 1: Infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO 2: Identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO 3: Apply the knowledge of phase rule and composites for material selection requirements.

CO 4: Recommend suitable fuels for engineering processes and applications.

CO 5: Recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", 1st Edition, Tata McGraw-Hill Publishing Company Ltd, NewDelhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", 12th Edition, S. Chand Publishing, , 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B.B. Rath and James Murday, "Text book of nanoscience and nanotechnology", 1st Edition, Universities Press-II M Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" 2nd Edition, McGraw Hill Education (India) Private Limited, 2017.
3. Friedrich Emich, "Engineering Chemistry", 1st Edition, Scientific International PVT,

LTD, New Delhi, 2014.
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", 2nd Edition, Cambridge University Press, Delhi, 2019
5. O.V. Roussak and H.D. Gesser, "Applied Chemistry-A Text Book for Engineers and Technologists", 2nd Edition, Springer Science Business Media, New York, 2013.

21CS101	PROBLEM SOLVING AND PYTHON PROGRAMMING *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

UNIT-I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.

UNIT-II	DATA TYPES, EXPRESSIONS, STATEMENTS	9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT-III	CONTROL FLOW, FUNCTIONS, STRINGS	9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-else-if-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT-IV	LISTS, TUPLES, DICTIONARIES	9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT-V	FILES, MODULES, PACKAGES	9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of design approaches to solve computational problems.

CO2: Develop and execute basic Python programs using expressions and input/output statements.

CO3: Utilize strings, functions and control statements to develop real world problems.

CO4: Construct programs using Python data types like lists, tuples and dictionaries.

CO5: Prepare a Python application by incorporating files and exceptions.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher,"Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
3. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc- Graw Hill, 2018.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", 1st Edition, Pearson Education, 2021.
2. G Venkatesh and MadhavanMukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1stEdition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", 3rdEdition, MITPress, 2021.
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.

21CS102	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY *(Common to all B.E./B.Tech Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.,)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples. (Items present in a library/Components of a car/ Materials required for construction of a building –operations of list & tuples)
5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.,- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy. Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.,

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Develop algorithmic solutions to simple computational Problems

CO2: Illustrate and execute basic Python programs using simple statements.

CO3: Build program for scientific problems using strings, functions and control statements.

CO4: Utilize compound data types lists, tuples and dictionaries for real-time applications. CO5: Experiment the python packages, files and exceptions for developing software applications

21PC101	PHYSICS AND CHEMISTRY LABORATORY *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY

COURSE OBJECTIVES:

- To explain the proper use of various kinds of physics laboratory equipment.
- To extend how data can be collected, presented and interpreted in a clear and concise manner.
- To infer problem solving skills related to physics principles and interpretation of experimental data.
- To summarize error in experimental measurements and techniques used to minimize such error.
- To translate the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS: (Any 7 Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – Determination of the velocity of sound and compressibility of liquids.
10. Post office box - Determination of Band gap of a semiconductor.
11. Photoelectric effect.
12. Michelson Interferometer.
13. Melde's string experiment.
14. Experiment with lattice dynamics kit.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:.Explain the functioning of various physics laboratory equipment

CO2: Relate the graphical models to analyze laboratory data

CO3: Interpret mathematical models as a medium for quantitative reasoning and describing physical reality.

CO4: Explain Access, process and analyze scientific information.

CO5:Translate students to solve problems individually and collaboratively

REFERENCES:

1. "Physics Laboratory Manual", Department of Physics, Velammal College of Engineering & Technology, Madurai (2021).
2. P. Mani, "Physics Laboratory", Dhanam Publications, 2021.

CHEMISTRY LABORATORY

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters such as acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electro analytical techniques such as pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles.
- To analyze the quality of coal sample using proximate analysis.

LIST OF EXPERIMENTS: (Any 7 Experiments)

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using the primary standard.
2. Determination of types and amount of alkalinity in water sample.
3. Determination of total, temporary& permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate. (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium/ potassium present in water using flame photometer.
13. Preparation of nano particles (TiO_2/ ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickelin steel.
15. Proximate analysis of Coal.

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: To analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.

CO2: To determine the amount of metal ions through volumetric and spectroscopic techniques.

CO3: To analyse and determine the composition of alloys.

CO4: To learn simple method of synthesis of nanoparticles.

CO5: To quantitatively analyse the impurities in solution by electro analytical techniques.

REFERENCES :

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, "Vogel's Textbook of Quantitative Chemical Analysis" 2009.

SEMESTER – II

21EN102	ENGLISH-II (Common to all B.E./B.TECH. Programmes)	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- To prepare and write convincing job applications and effective reports.
- To demonstrate their speaking skills to make technical presentations and participate in group discussions.
- To apply their Listening skill which will help them comprehend lectures and talks in their areas of specialization
- To choose appropriate soft skills to suit the situation.

UNIT I	INTRODUCTION TO TECHNICAL ENGLISH	9

Listening - Factual and Academic speeches; **Speaking** - Asking for and giving directions - **Reading** - Technical texts from - Newspapers /websites; **Writing** - Statements - Definitions - issue based writing instructions - Checklists - Recommendations; **Vocabulary Development**- technical vocabulary; **Grammar** - Error spotting - Compound words; **Soft skills** - Leadership Skills.

UNIT II	READING AND STUDY SKILLS	9

Listening - Listening to longer technical talks and completing exercises based on them; **Speaking** - Describing a general process; **Reading** - Reading longer technical texts - Identifying the various transitions in a text - Paragraphing; **Writing** - Interpreting charts, graphs; **Vocabulary Development** - Vocabulary used in formal letters/emails and reports **Grammar** - Impersonal passive voice, numerical adjectives - **Soft skills** - Teamwork

UNIT III	TECHNICAL WRITING AND GRAMMAR	9

Listening - Listening to classroom lectures, talks on engineering /technology; **Speaking** - introduction to technical presentations; **Reading** - longer texts both general and technical, practice in speed reading; **Writing** - Describing a technical process; **Vocabulary Development** - Sequence words - Misspelled words; **Grammar** - Embedded sentences ; **Soft skills** - Decision making

UNIT IV	JOB APPLICATIONS	9

Listening - Listening to documentaries and making notes. **Speaking** - Mechanics of presentations; **Reading** - Reading for detailed comprehension; **Writing** - Email etiquette - job application - Cover Letter - Resume preparation(via email and hard copy) - Analytical essay writing - **Vocabulary Development** - finding suitable synonyms - paraphrasing; **Grammar** - clauses - If conditionals - **Soft skills** - Time Management

UNIT V	GROUP DISCUSSION AND REPORT WRITING	9

Listening - TED talks; **Speaking** - Participating in a group discussion - **Reading** - Reading and understanding technical articles; **Writing** - Writing reports - Survey report, accident report and minutes of a meeting - **Vocabulary Development** - Verbal analogies; **Grammar** - reported speech; **Soft skills** - Conflict Resolution.

	TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able to:

CO1: Interpret by reading information in technical texts.

CO2: Choose appropriate language to write convincing job applications, resume and reports.

CO3: Formulate the technical ideas effectively in spoken and written forms.

CO4: Analyze and understand spoken language in lectures and talks.

CO5: Demonstrate basic soft skills in life.

TEXT BOOKS:

1. Board of Editors, Fluency in English-A Course book for Undergraduate Engineers and Technologist. Orient Blackswan Pvt Ltd, Hyderabad: 2018
2. Jawahar, Jewelcy & Rathna.P. Communicative English Workbook. VRB Publishers Pvt Ltd. Chennai. 2018.
3. Board of Editors, Department of English, Anna University, Chennai. Mindscapes-English for Technologists and Engineers. Orient Black Swan Pvt Ltd, Chennai, 2012.

REFERENCES:

1. Verma, Shalini. Technical Communication for Engineers. Vikas Publishing House Pvt Ltd. New Delhi. 2015
2. Raman, Meenakshi & Sharma, Sangeeta. Technical Communication English Skills for Engineers. Oxford University Press. 2008.
3. Rizvi, Ashraf.M. Effective Technical Communication. MC Graw Hill Education Pvt Ltd. New Delhi. 2016.

21MA103	SAMPLING TECHNIQUES AND NUMERICAL METHODS *(Common to B.E. CSE,ECE & B.Tech.IT)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To describe the necessary basic concepts in probability
- To explain the concept of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To use the basic concepts of classification of design of experiments.
- To choose the method for solving algebraic and transcendental equations using numerical techniques.
- To discuss the numerical techniques of interpolation in various intervals and numerical techniques of differentiation and integration which plays an important role in engineering and technology disciplines.

UNIT I	PROBABILITY	12
Introduction-Sample Spaces and Events-Axioms of Probability-Interpretations and Properties of Probabilities-Conditional Probabilities-Baye's theorem- Independence.		
UNIT II	**TESTING OF HYPOTHESIS**	**12**
Large sample test based on Normal distribution for single mean and difference of means – Tests based on t, $\chi 2$ and F distributions for testing means and variances – Contingency table (Test for Independency) – Goodness of fit.		
UNIT III	**DESIGN OF EXPERIMENTS**	**12**
Introduction, aim, basic designs of experiments, one way and two way classifications - Completely randomized design – Randomized block design – Latin square design.		
UNIT IV	**SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS**	**12**
Newton Raphson method –Method of False position- pivoting – Gauss Jordan methods – Iterative method: Gauss Seidel – Matrix inversion by Gauss Jordan method – Eigen values of a matrix by power method.		
UNIT V	**INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION**	**12**
Lagrange's and Newton's divided difference interpolations – Newton's forward and backward difference interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's 1/3 rules, $3/8^{th}$ rule.		
	TOTAL: 60 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the concepts of Probability in Engineering problems.

CO2: Explain the test of hypothesis for small and large samples by using various test like t-test, F-test, Z-test and $\chi 2$ test.

CO3: Apply the basic concepts of classifications of design of experiments.

CO4: Solve the system of equations and the eigen value problems using iterative procedure.

CO5: Calculate the value of an unknown function at any interpolated point of the given tabulated values.

TEXT BOOKS:

1. JAY.L. Devore, "Probability and Statistics for Engineering and the Science",9th Edition, Cengage Learning, 2021.
2. Johnson. R.A., and Irwin Miller, John Freund, "Miller and Freund's Probability and Statistics for Engineers", 12th Edition, Pearson Education, Asia, 2011.
3. Gerald. C.F., and Wheatley. P.O. "Applied Numerical Analysis", 7th Edition, Pearson Education, Asia, New Delhi, 2008.

REFERENCES:

1. Walpole. R.E., Myers. R.H., Myers. S.L., and Ye. K., "Probability and Statistics for Engineers and Scientists", 8thEdition, Pearson Education, Asia, 2007.
2. Spiegel. M.R., Schiller. J., and Srinivasan. R.A., "Schaum's Outlines on Probability and Statistics", 3rdEdition, Tata McGraw Hill , 2012.
3. Chapra. S.C., and Canale. R.P, "Numerical Methods for Engineers", 5thEdition, Tata McGraw Hill, New Delhi, 2007.
4. Grewal. B.S., and Grewal. J.S., "Numerical Methods in Engineering and Science", 9th Edition, Khanna Publishers, New Delhi, 2007.

21PH103	PHYSICS FOR INFORMATION SCIENCE *(Common to B. E. CSE & B. Tech. IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the importance in studying electrical properties of materials.
- To extend the students knowledge in semiconductor physics.
- To illustrate knowledge on magnetic properties of materials.
- To summarize different optical properties of materials, optical displays and applications.
- To translate an idea of significance of nano structures, quantum confinement, ensuing nano device applications and quantum computing.

UNIT I	ELECTRICAL PROPERTIES OF MATERIALS	9

Classical free electron theory - Expression for electrical conductivity - Thermal conductivity, expression - Wiedemann-Franz law - Success and failures -Electrons in metals - Particle in a three dimensional box -Degenerate states - Fermi- Dirac statistics - Density of energy states - Electron effective mass -Concept of hole.

UNIT II	SEMICONDUCTOR PHYSICS	9

Intrinsic Semiconductors - Energy band diagram -Direct and indirect band gap semiconductors - Carrier concentration in intrinsic semiconductors - extrinsic semiconductors - Carrier concentration in n-type &p-type semiconductors - Variation of carrier concentration with temperature -Variation of Fermi level with temperature and impurity concentration - Carrier transport in Semiconductor: random motion, drift, mobility and diffusion - Hall effect and devices -Ohmic contacts - Schottky diode.

UNIT III	MAGNETIC PROPERTIES OF MATERIALS	9

Magnetic dipole moment -Atomic magnetic moments- Magnetic permeability and susceptibility - Magnetic material classification: diamagnetism -Paramagnetism -Ferromagnetism - Antiferromagnetism -Ferrimagnetism - Ferromagnetism: origin and exchange interactionsaturation magnetization and Curie temperature - Domain Theory- M versus H behaviour - Hard and soft magnetic materials -Examples and uses- Magnetic principle in computer data storage -Magnetic hard disc (GMR sensor).

UNIT IV	OPTICAL PROPERTIES OF MATERIALS	9

Classification of optical materials - carrier generation and recombination processes - Absorption emission and scattering of light in metals, insulators and semiconductors (concepts only) - photo current in a P-N diode - solar cell - LED - Organic LED - Laser diodes - Optical data storage techniques.

UNIT V	NANODEVICES AND QUANTUM COMPUTING	9

Introduction - Quantum confinement -Quantum structures: quantum wells, wires and dots -Band gap of nanomaterials. Tunneling - Single electron phenomena: Coulomb blockade - Resonant- tunneling diode - single electron transistor - quantum cellular automata - Quantum system for information processing - quantum states - classical bits - quantum bits or qubits - CNOT gate - multiple qubits - quantum gates - advantage of quantum computing over classical computing (qualitative).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Demonstrate the classical and quantum electron theories, and energy band structures.

CO2: Infer knowledge on basics of semiconductor physics and its applications in various devices.

CO3: Summarize magnetic properties of materials and their applications in data storage.

CO4: Extend the functioning of optical materials for optoelectronics

CO5: Translate the basics of quantum structures towards quantum computing.

TEXT BOOKS:

1. Jasprit Singh, "Semiconductor Devices Basic Principles", 1st edition, Wiley (Indian Edition), 2007.
2. S.O. Kasap,"Principles of Electronic Materials and Devices", 4th edition, McGraw-Hill Education (Indian Edition), 2020.
3. Parag K. Lala, "Quantum Computing: A Beginner's Introduction", 1st edition, McGraw-Hill Education (Indian Edition), 2020.

REFERENCES

1. Charles Kittel, "Introduction to Solid State Physics", 8th edition, Wiley, 2019.
2. Y.B.Band and Y.Avishai, "Quantum Mechanics with Applications to Nanotechnology and Information Science", 1st edition, Academic Press, 2013.
3. V.V.Mitin, V.A. Kochelap and M.A.Stroscio, "Introduction to Nanoelectronics", 1st edition, Cambridge Univ.Press, 2008.
4. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson Education (Indian Edition) 2009.
5. B.Rogers, J.Adams and S.Pennathur,"Nanotechnology: Understanding Small Systems", 3rd edition, CRC Press, 2014.

21ME101	**ENGINEERING GRAPHICS** *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To sketch the projection of points, lines and planes.
- To sketch the projection of simple solids
- To sketchthe projection of sectioned solids and development of lateral surfaces
- To sketch the isometric and perspective views of simple solids.
- To sketch theorthographic projection of various objects free handly.

UNIT I	PROJECTIONS OF POINTS, LINES AND PLANE SURFACE	12

Importance of graphics in engineering applications – Use of drafting instruments - Lettering and dimensioning.
Introduction to Orthographic projections - Principles -Principal planes-First angle projection. Projection of points located in all quadrants. Projection of straight lines inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.

Projection of planes (regular polygonal and circular surfaces) inclined to both the principal planes by rotating object method. (Not for Examination)

UNIT II	PROJECTION OF SOLIDS	12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT III	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT IV	ISOMETRIC AND PERSPECTIVE PROJECTIONS	12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

UNIT V	FREEHAND SKETCHING	12

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects. Introduction to drafting packages and demonstration. (Not for examination).

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Construct the orthographic projections of points, straight lines and plane surfaces.

CO2: Sketch the orthographic projections of simple solids.

CO3: Sketch the orthographic projections of sectional solids and lateral surfaces of the solids. CO4: Construct the isometric projections and perspective projections of simple solids. CO5: Sketch the orthographic projection of objects using freehand.
TEXT BOOKS:
1. Natarajan K.V., "A text book of Engineering Graphics", 31st Edition, Dhanalakshmi Publishers, Chennai, 2018. 2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", 15th Edition, New Age International (P) Limited, 2018. 3. Bhatt N.D. and Panchal V.M., "Engineering Drawing", 53rd Edition, Charotar Publishing House, 2014.
REFERENCES:
1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", 2nd Edition, Tata McGraw Hill Publishing Company Limited, 2013. 2. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", 2nd Edition, Oxford University, Press, New Delhi, 2015. 3. Shah M.B., and Rana B.C., "Engineering Drawing", 2nd Edition, Pearson, 2009.

21CS103	PROGRAMMING IN C *(Common to B. E. CSE & B. Tech. IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate the fundamentals of C programming.
- To describe the reusable modules (collections of function).
- To examine code, document, test, and implement a well-structured program using the C.
- To use the C programming concepts in trivial problem solving.
- To develop logics which will help them to create programs, applications in C.

UNIT-I	BASICS OF C PROGRAMMING	9

Introduction to programming paradigms – Applications of C Language - Structure of C program - C programming: Data Types - Constants – Enumeration Constants - Keywords – Operators: Precedence and Associativity - Expressions - Input/Output statements, Assignment statements – Decision making statements - Switch statement - Looping statements – Pre-processor directives - Compilation process

UNIT-II	ARRAYS AND STRINGS	9

Introduction to Arrays: Declaration, Initialization – One dimensional array – Two dimensional arrays - String operations: length, compare, concatenate, copy – Selection sort, linear and binary search.

UNIT-III	FUNCTIONS AND POINTERS	9

Modular programming - Function prototype, function definition, function call, Built-in functions (string functions, math functions) – Recursion, Binary Search using recursive functions – Pointers – Pointer operators – Pointer arithmetic – Arrays and pointers – Array of pointers – Parameter passing: Pass by value, Pass by reference

UNIT-IV	STRUCTURES AND UNION	9

Structure - Nested structures – Pointer and Structures – Array of structures – Self-referential structures – Dynamic memory allocation - Singly linked list – typedef – Union - Storage classes and Visibility

UNIT-V	FILE PROCESSING	9

Files –Defining and Opening a file, closing a file– input/output operations on files– error handling during I/O operations– random access to files–Command Line Arguments.

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Develop simple applications using basic C components.

CO2: Solve applications adopting array and string concepts.

CO3: Construct and implement applications in C using functions and pointers.

CO4: Prepare applications in C by employing structure and union concepts.

CO5: Build applications using sequential and random access file processing.

TEXT BOOKS:

1. ReemaThareja, "Programming in C", Oxford University Press, 2nd Edition, 2016.
2. Kernighan, B.W and Ritchie,D.M, "The C Programming language", 2nd Edition, Pearson Education, 2015.
3. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", 1st Edition, Pearson Education, 2013

REFERENCES:

1. Paul Deitel and Harvey Deitel, "C How to Program with an Introduction to C++", Eighth edition, Pearson Education, 2018.
2. YashwantKanetkar, Let us C, 17th Edition, BPB Publications, 2020.
3. Byron S. Gottfried, "Schaum's Outline of Theory and Problems of Programming with C", McGraw-Hill Education, 1996.
4. PradipDey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013.

21CH103	ENVIRONMENTAL SCIENCE *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To describe the structure and function of an ecosystem and biodiversity
- To interpret the environmental impacts of natural resources.
- To demonstrate causes, effects and control measures of different types of pollution.
- To manipulate the importance of disaster management, environmental ethics and values.
- To dramatize the important social issues and sustainable practices.

UNIT-I	ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY	6

Multidisciplinary nature of environmental studies - ecosystem- general structure and function of an ecosystem- ecological succession-biodiversity-types-values of biodiversity- endangered and endemic species-red data book- hot spots of biodiversity-criteria- hot spots in India-threats to biodiversity(man-animal conflicts, habitat loss, poaching)-case studies-conservation of biodiversity-in-situ and ex-situ conservation.

UNIT-II	NATURAL RESOURCES AND ITS ENVIRONMENTAL IMPACTS	6

Natural resources-forest resource-ecological functions – causes, effects and control measures of deforestation-water resource-sources-conflict over water-dams benefits and problems-food resource-overgrazing- impacts of over grazing- impacts of modern agriculture-energy resource-environmental impacts of wind mills and solar panels- role of an individual in conservation of natural resources.

UNIT III	ENVIRONMENTAL POLLUTION AND CONTROL	6

Air pollution-causes, effects and control methods - water pollution- causes, effects-waste water treatment-soil pollution-causes, effects-solid waste management–e-waste- causes, effects and management-Pollution control acts-air(prevention and control of pollution) act,1981- water(prevention and control of pollution) act,1974- wildlife (protection) act,1972 - e-waste management rules,2016-case studies - role of an individual in control of pollution.

UNIT IV	DISASTER MANAGEMENT AND ENVIRONMENTAL ETHICS	6

Disaster management-causes, effects and management of- flood, landslide, earthquake and tsunami-case studies- environmental ethics- value education-traditional value systems in India-water conservation-rain water harvesting-watershed management.

UNIT V	SOCIAL ISSUES AND SUSTAINABLE PRACTICES	6

Unsustainable development- social issues-climate change-causes, effects and control measures-global warming-causes, effects and control measures-Acid rain-causes, effects and control measures-ozone layer depletion-causes, effects and control measures-nuclear accident and holocausts-EIA-Sustainable development-goals-target- green buildings- ISO 14000 series.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO 1: Explain the concept, structure and function of an ecosystem and biodiversity. CO2: Demonstrate the environmental impacts of natural resources. CO 3: Illustrate the suitable management method for pollution control. CO 4: Relate the proper way of managing disaster with environmental ethics. CO 5: Apply social issues and adopt suitable sustainable practices.
TEXT BOOKS: 1. Kaushik. A &Kaushik. C.P. "Environmental Science and Engineering", 6th Edition, New Age International, 2018. 2. Garg S.K &Garg. Ecological and Environmental studies, Khanna Publishers, 2015. 3. Wright &Nebel, Environmental science towards a sustainable future, 12thEditon, Prentice Hall of India Ltd, 2015.
REFERENCE BOOKS: 1. ErachBharucha, "Text book of Environmental studies for Undergraduate courses", 3rd Edition, UGC, 2021. 2. Ravi P. Agrahari, Environmental ecology, Biodiversity, climatic change & Disaster management, 1st Edition, McGraw Hill, 2020 3. Benney Joseph, "Environmental Science and Engineering", 1st Edition, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017.

21EE104	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING FOR INFORMATION SCIENCE *(Common to B.E. CSE & B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basics of electric circuits and analysis.
- To summarize the basics of working principles and application of AC and DC machines.
- To interpret the domestic and industrial wiring.
- To demonstrate analog devices and their characteristics.
- To illustrate the application of operational amplifier.

UNIT I	ELECTRICAL CIRCUITS	9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws– Simple problems- Nodal Analysis, Mesh analysis. Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor – (Simple problems only)

UNIT II	ELECTRICAL MACHINES	9

Construction and Working principle- DC Separately and Self excited Generators, EMF equation, Types and. Construction and Working Principle of DC motors, Back EMF equation, Types, Speed and Torque Equation, Transformer-Construction, Working principle and Three phase Alternator, Synchronous motor and Three Phase Induction Motor-construction, working principle and Applications(Qualitative Analysis)

UNIT III	DOMESTIC AND INDUSTRIAL WIRING	9

Lighting, provision of sockets-MCB- Selection of wires and cables-Protection-need for earthing, fuses, relay and circuit breakers. Load calculation, generation cost and Energy Tariff calculation for domestic and industrial loads- HT & LT wiring- Power factor correction.

UNIT IV	ANALOG ELECTRONICS	9

Resistor, Inductor and Capacitor in Electronic Circuits- Semiconductor Materials: Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing – Types, I-V Characteristics and Applications, Rectifier. (Qualitative Analysis)

UNIT V	OPERATIONAL AMPLIFIERS AND ITS APPLICATIONS	9

Operational amplifiers, Inverting and Non Inverting Amplifier, Summer, Differentiators, Integrator, Voltage to Current (V/I) and Current to Voltage (I/V) Converter, Multi vibrator using 555timer IC.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret the electric circuit parameters of simple DC Circuits.

CO2: Explain the working principle and applications of DC machines.

CO3: Demonstrate the working principle of AC machines.

CO4: Describe the characteristics of analog electronic devices.

CO5: Summarize the basic concepts of operational amplifiers.

TEXT BOOKS
1. Bhattacharya.S.K "Basic Electrical and Electronics Engineering", 2nd Edition, Pearson Education, 2017. 2. Sedha R.S., "A textbook book of Applied Electronics", 3rd Edition, S. Chand & Co., 2008. 3. Salivahanan.S, Suresh Kumar. N, "Electronic Devices and Circuits", 3rd Edition, Tata McGraw Hill 2012. 4. Roy Choudhary.D, Sheil B. Jani, "Linear Integrated Circuits", 5th Edition , New Ageinternational Pvt Ltd publishers, 2018.
REFERENCES
1. Kothari DP and Nagrath. I.J, "Basic Electrical Engineering", 4th Edition, McGraw Hill Education, 2019. 2. Albert Malvino, David Bates, "Electronic Principles", 7thEdition, McGraw Hill Education; 2017. 3. Badriram, B.H.Vishwakarma, "Power system protection and switchgear", 2nd Edition, New age international Pvt Ltd publishers, 2011.

BoS Chairman

21EM101	ENGINEERING PRACTICES LABORATORY (Common to all B.E / B.Tech. Programmes)	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To draw pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- To demonstrate the basic switch board wiring, fluorescent lamp wiring and stair case wiring using various electrical components.
- To choose various joints in steel plates using arc welding work and machining various simple processes like turning, drilling, tapping in parts
- To build a tray out of metal sheet using sheet metal work.
- To develop electronic circuit and testing for soldering and desoldering using PCB board.

LIST OF EXPERIMENTS:

GROUP – A (CIVIL & ELECTRICAL)

PART – I

CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

- Sawing,
- Planning and Making joints like T-Joint, Cross lap and Dovetail joint.

PART – II

ELECTRICAL ENGINEERING PRACTICES

- Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket
- Staircase wiring
- Fluorescent Lamp wiring with introduction to CFL and LED types.
- Energy meter wiring and related calculations/ calibration
- Study of Iron Box wiring and assembly
- Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac)
- Measurement of resistance to earth of an electrical equipment.

GROUP – B (MECHANICAL & ELECTRONICS)
PART III
MECHANICAL ENGINEERING PRACTICES **WELDING WORK:** • Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding. • Practicing gas welding. **BASIC MACHINING WORK:** • Usage of Spanners and screw drivers • Facing and Turning. • Taper Turning **ASSEMBLY WORK:** • Assembling a centrifugal pump. • Assembling a household mixer. • Assembling an air conditioner. **SHEET METAL WORK:** • Making of a square tray **FOUNDRY WORK:** • Demonstrating basic foundry operations.
PART IV
ELECTRONIC ENGINEERING PRACTICES **SOLDERING WORK:** • Soldering simple electronic circuits and checking continuity. **ELECTRONIC ASSEMBLY AND TESTING WORK:** • Assembling and testing electronic components on a small PCB. **ELECTRONIC EQUIPMENT STUDY:** • Study elements of smart phone. • Assembly and dismantle of computer / laptop
TOTAL: 60 PERIODS
COURSE OUTCOMES:
At the end of the course, learners will be able to CO1: Build various plumbing joints CO2: Develop various carpentry joints. CO3: Construct various wiring electrical joints in common household electrical wire work. CO4: Construct various welded joints, sheet metal and basic machining operations CO5: Develop the electronic circuit for soldering and testing using PCB board.

21CS104	PROGRAMMING IN C LABORATORY *(Common to B.E CSE&B.Tech IT)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To demonstrate the fundamentals of C programming
- To describe the reusable modules (collections of function)
- To examine code, document, test, and implement a well-structured program using the C
- To use the C programming concepts in trivial problem solving.
- To develop logics which will help them to create programs, applications in C.

LIST OF EXPERIMENTS

1. I/O statements, operators, expressions
2. decision-making constructs: if-else, goto, switch-case, break-continue
3. Loops: for, while, do-while
4. Arrays: 1D and 2D, Multi-dimensional arrays, traversal
5. Strings: operations
6. Functions: call, return, passing parameters by (value, reference), passing arrays to function.
7. Recursion
8. Pointers: Pointers to functions, Arrays, Strings, Pointers to Pointers, Array of Pointers
9. Structures: Nested Structures, Pointers to Structures, Arrays of Structures and Unions.
10. Files: reading and writing, File pointers, file operations, random access, processor directives.
11. Mini project.

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Develop simple applications using basic C components.
CO2: Solve applications adopting array and string concepts.
CO3: Construct and implement applications in C using functions and pointers.
CO4: Prepare applications in C by employing structure and union concepts.
CO5: Build applications using sequential and random access file processing.

SEMESTER - III

21MA203	DISCRETE MATHEMATICS *(Common to B.E. (CSE) / B.Tech.(IT)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To extend student's logical and mathematical maturity and ability to deal with abstraction.
- To discuss the basic concepts of Combinatorics.
- To explain the students about the properties and characteristics of different graphs.
- To demonstrate the applications of algebraic structures.
- To identify the concepts and significance of lattices and Boolean algebra which are widely used in computer science and engineering.

UNIT I	LOGIC AND PROOFS	12

Propositional logic – Propositional equivalences - Predicates and quantifiers – Nested quantifiers – Rules of inference - Introduction to proofs – Proof methods and strategy.

UNIT II	COMBINATORICS	12

Mathematical induction – The pigeonhole principle – Permutations and combinations – Recurrence relations – Solving linear recurrence relations – Generating functions – Inclusion and exclusion principle and its applications

UNIT III	GRAPHS	12

Graph terminology and special types of graphs – Matrix representation of graphs and graph isomorphism – Connectivity – Euler and Hamilton paths.

UNIT IV	ALGEBRAIC STRUCTURES	12

Groups – Subgroups – Cyclic groups - Homomorphism – Normal subgroup and Cosets – Lagrange's theorem – Definitions and examples of Rings and Fields.

UNIT V	LATTICES AND BOOLEAN ALGEBRA	12

Partial ordering – Posets – Lattices as posets – Properties of lattices - Lattices as algebraic systems – Sub lattices – Some special lattices : Bounded, Modular, Distributive, complemented.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Extend student's logical and mathematical maturity and ability to deal with abstraction.

CO2: Explain the basic concepts of Combinatorics.

CO3: Make use of the concept of graph theory in computer science and engineering.

CO4: Manipulate the applications of algebraic structures.

CO5: Demonstrate the basic theorems and properties of Lattices and Boolean Algebra.

TEXT BOOKS:

1. Rosen, K.H., "Discrete Mathematics and its Applications", 7th Edition, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 2011.
2. Tremblay J.P. &Manohar.R,"Discrete Mathematics Structures with Application to Computer Science", 1st Edition, Tata McGraw Hill Publication Ltd., New Delhi, 30th reprint 2011.
3. Liu C.L, MohapatraD.P , "Elements of Discrete Mathematics: A computer oriented approach", 4th Edition, Tata McGraw Hill, New Delhi, 2017.

REFERENCES:

1. Grimaldi.R.P.,"Discrete and Combinatorial Mathematics: An Applied Introduction", 4th Edition, Pearson Education Asia, Delhi, 2007.
2. Koshy, "Discrete Mathematics with Applications", 1st Edition, Elsevier Publications, 2006.
3. Bernard Kolman, Robert C Busby, Sharon Cutler Ross , "Discrete Mathematical Structures", 3rd Edition, Prentice Hall, New Delhi, 2015.

21EC201	DIGITAL PRINCIPLES AND SYSTEM DESIGN *(Common to B.E ECE, B.E CSE &B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the digital fundamentals, Boolean algebra and its applications in digital systems.
- To model combinational digital circuits using logic gates.
- To develop synchronous sequential circuits.
- To solve asynchronous sequential circuits.
- To summarize the various semiconductor memories.

UNIT I | **DIGITAL FUNDAMENTALS** | **9**

Number systems – Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes – Binary, BCD, Excess 3, Gray, Alphanumeric codes, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map minimization, NAND and NOR implementations.

UNIT II | **COMBINATIONAL CIRCUIT DESIGN** | **9**

Design of Half and Full adders, Half and Full subtractors, Binary parallel adder – Carry look ahead adder, BCD adder, Multiplexer, Demultiplexer, Magnitude comparator, Decoder, Encoder and Priority Encoder.

UNIT III | **SYNCHRONOUS SEQUENTIAL CIRCUITS** | **9**

Flip flops – SR, JK, T, D, Master / Slave FF – operation and excitation tables, Triggering of FF, Analysis and design of clocked sequential circuits – Design - state minimization, state assignment, circuit implementation – Design of Counters- Ripple counters, Ring counters, Shift registers and Universal shift register.

UNIT IV | **ASYNCHRONOUS SEQUENTIAL CIRCUITS** | **9**

Stable and Unstable states, output specifications, cycles and races, state reduction, race free assignments, Hazards, Essential Hazards, Design of Hazard free circuits.

UNIT V | **MEMORY DEVICES AND VERILOG PROGRAMMING** | **9**

Basic memory structure – ROM -PROM – EPROM – EEPROM –EAPROM, RAM – static and dynamic RAM - Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using PLA, PAL. Design of half adder, full adder, flip flops and counters using Verilog.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of minimization techniques to simplify Boolean algebraic equations.
CO2: Build various combinational circuits using logic gates.
CO3: Develop synchronous sequential circuits using flip flops.
CO4: Build asynchronous sequential circuits using flip flops.
CO5: Explain various semiconductor memories and programmable logic devices.

TEXT BOOKS:

1. M. Morris R. Mano, Michael D. Ciletti, "Digital Design: With an Introduction to the Verilog HDL, VHDL, and SystemVerilog", 6th Edition, Pearson Education, 2017.
2. S.Salivahanan and S.Arivazhagan, "Digital Electronics", 1st Edition, Vikas Publishing House pvt Ltd, 2012.
3. Soumitra Kumar Mandal, "Digital Electronics", 2nd Edition, McGraw Hill Education Private Limited, 2016.

REFERENCES:

1. Charles H.Roth, "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
2. Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011
3. A.Anand Kumar, "Fundamentals of Digital Circuits", 4thEdition, PHI Learning Private Limited, 2016.

K.Kavitha

21CS201	COMPUTER ORGANIZATION AND ARCHITECTURE *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basic organization and operation of computer system.
- To discuss the Arithmetic and logical unit.
- To describe the building of data path with the basic concept of pipelining.
- To illustrate the parallelism and multi-core processors.
- To demonstrate hierarchical memory system and I/O technologies.

UNIT-I	BASIC ORGANIZATION OF COMPUTER SYSTEM	9

Functional Units – Basic Operational Concepts – Performance – Instructions – operations and operands of a computer hardware– representing instructions – Logical operations – Decision making – Addressing and addressing modes.

UNIT-II	ARITHMETIC FOR COMPUTERS	9

Addition and Subtraction – Multiplication – Division – Floating Point Representation – Floating Point Operations.

UNIT-III	PROCESSOR AND CONTROL	9

Basic MIPS implementation – Building a Data path – Control Implementation scheme – Pipelining – Pipelined data path and control – Handling Data hazards & Control hazards – Exceptions.

UNIT-IV	PARALLELISM	9

Parallel processing challenges – Flynn's classification –SISD,MIMD, SIMD,SPMD - Hardware multithreading – Multi-core processors - Message-Passing Multiprocessors.

UNIT-V	MEMORY AND I/O ORGANIZATION	9

Memory hierarchy – Memory technologies – Cache basics – Measuring and improving cache performance – Virtual memory – I/O Interface - Mode of Transfer - Programmed I/O, Interrupt – initiated I/O, DMA -Input/Output processors.

TOTAL:45 PERIODS

COURSE OUTCOMES

At the end of the course, learners will be able to:

CO1: Illustrate the basics structure of computers, operations and instructions.

CO2: Build arithmetic and logic unit to perform the arithmetic operations.

CO3: Utilize the data path to develop control unit.

CO4: Identify multithreading techniques to achieve parallelism.

CO5: Experiment with the performance of various memory and I/O technologies.

TEXT BOOKS:

1. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, 5th Edition, Morgan Kaufmann / Elsevier 2014.
2. Morris Mano, —Computer System Architecture, 3rd Edition, Prentice Hall of India,2017.

3. John L. Hennessey and David A. Patterson, Computer Architecture – A Quantitative Approach, Morgan Kaufmann, 5th Edition, Elsevier Publishers, 2012.

REFERENCES:

1. William Stallings, Computer Organization and Architecture – Designing for Performance, 11th Edition, Pearson Education, 2019.
2. John P. Hayes, Computer Architecture and Organization, 3rd Edition, Tata McGraw Hill, 2012.
3. Govinda rajulu B, "Computer Organization and Architecture"2nd Edition , Tata McGraw Hill,2014.

21CS202	**DATA STRUCTURES** *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the concepts of ADTs
- To describe linear data structures like lists, stacks and queues
- To illustrate nonlinear data structures like trees and graphs
- To demonstrate advanced nonlinear data structures and hashing.
- To develop skills to apply appropriate data structure concept in problem solving.

UNIT-I	LINEAR DATA STRUCTURES – LIST	9

Abstract Data Types (ADTs) – List ADT – Array-based implementation – Linked list implementation —Singly linked lists- Circularly linked lists- Doubly-linked lists – Applications of lists –Polynomial Manipulation – All operations (Insertion, Deletion, Merge, Traversal).

UNIT-II	LINEAR DATA STRUCTURES – STACKS, QUEUES	9

Stack ADT – Operations - Applications - Evaluating arithmetic expressions- Conversion of Infix to postfix expression - Queue ADT – Operations - Circular Queue – Priority Queue - deQue – applications of queues.

UNIT-III	NON LINEAR DATA STRUCTURES – TREES	9

Tree ADT – tree traversals - Binary Tree ADT – expression trees – applications of trees – binary search tree ADT –Threaded Binary Trees- AVL Trees – B-Tree - B+ Tree.

UNIT-IV	ADVANCED NON LINEAR DATASTRUCTURES&HASHING	9

Red-Black trees – Splay trees –Heap-Application of Heap-Binomial Heaps – Fibonacci Heaps. Hashing- Hash Functions – Separate Chaining – Open Addressing – Rehashing – Extendible Hashing.

UNIT-V	NON LINEAR DATA STRUCTURES – GRAPHS	9

Definition – Representation of Graph – Types of graph - Breadth-first traversal - Depth-first traversal – Topological Sort – Bi-connectivity – Cut vertex – Euler circuits – Applications of graphs.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build abstract data types for linear data structures.

CO2:Make use of the different linear data structures for problem solving.

CO3: Select nonlinear tree data structures to resolve computing problems.

CO4: Utilize advanced nonlinear data structure and hashing for solving problems.

CO5: Infer data using graph structure and apply their algorithms for problem solving.

TEXT BOOKS:

1. Mark Allen Weiss, —Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2010.
2. ReemaThareja, —Data Structures Using C, 2nd Edition , Oxford University Press, 2011

3. Allen B Drowney "Think Data Structures" 1st Edition, O'Reilly, 2017.

REFERENCES:

1. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", 2nd Edition, University Press, 2008.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 2ndEdition, McGraw Hill, 2002.
3. Aho, Hopcroft and Ullman, "Data Structures and Algorithms", Pearson Education, 2003.

21CS203	**OBJECT ORIENTED PROGRAMMING** *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe basic java programming constructs, classes, methods and inheritance.
- To develop application using exception handling concepts and strings
- To demonstrate threading and I/O concepts in java applications
- To illustrate generics and collections for solving programming problems.
- To build interactive applications using java swings and database connectivity.

UNIT-I	INTRODUCTION TO OOPS AND JAVA	12

Basic OOPs concepts –Characteristics of Java- Data types , Variables and Arrays-Classes – constructors, methods – Inheritance- Packages –Abstract classes - Interfaces-InnerClasses

UNIT-II	EXCEPTION HANDLING AND STRINGS	7

Exceptions - exception hierarchy - throwing and catching exceptions – built-in exceptions, creating own exceptions, Stack Trace Elements ,Object Class- Strings-String Comparison-String Methods-String buffer-String Tokenizer

UNIT-III	MULTITHREADING AND INPUT/OUTPUT	8

Multi-threading Vs Multitasking-Java Thread model- Creating single and Multiple threads-Thread Methods- Synchronization- Inter thread Communication ,Input / Output Basics – Reading and Writing Console – Reading and Writing Files

UNIT-IV	EVENT DRIVEN PROGRAMMING AND DATABASE CONNECTIVITY	9

Event handling Mechanisms-Event classes- Event Interfaces- Using Delegation event Model-Adapter classes- -Introduction to Swing –Swing Frames - Swing Components – Text Fields , Text Areas – Buttons- Check Boxes – Radio Buttons – Lists-Menus – layout management- Dialog Boxes-Connectivity to Databases- Drivers- DDL and DML operations

UNIT-V	GENERICS AND COLLECTIONS	9

Generic Programming – Generic classes – generic methods – Bounded Types -Collections-Collection Interfaces-Collection Classes-Accessing a Collection – Arrays -ArrayList— Map HashMap

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Develop programs using basic java concepts.

CO2: Prepare java applications employing exception handling and strings

CO3: Construct java applications adopting thread and I/O concepts.

CO4: Solve java programming problems by incorporating Generics and collections.

CO5: Build GUI for java applications with database connectivity.

TEXT BOOK:
1. Herbert Schildt, —Java The Complete Reference, 11th Edition, McGraw Hill Education, 2019. 2.PaulDeitel, Harvey Deitel, —Java SE 8 for programmersl, 3rd Edition, Pearson, 2015. 3.Cay S. Horstmann, Gary cornell, —Core Java Volume –I Fundamentals, 9th Edition, Prentice Hall, 2013.
REFERENCES:
1. DT Editorial Services, "Java 8 Programming Black book", Dreamtech press, 2015. 2. Joshua Bloch, "Effective Java",2nd Edition , Pearsons Education,2016. 3. Allen B. Downey, Chris Mayfield, "Think Java",2nd Edition,O'Reilly,2017.

21EC213	ANALOG AND DIGITAL COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the analog communication techniques.
- To illustrate pulse and data communication techniques.
- To outline digital modulation techniques.
- To classify source and error control coding techniques.
- To explain multi-user radio communication principles.

UNIT I	ANALOG COMMUNICATION	9

Introduction to Communication Systems - Modulation – Need for Modulation - Types – AM, DSBSC & VSB – Generation and Demodulation, Frequency and Phase Modulation – Modulation and Demodulation - Comparison of Analog Communication Systems (AM – FM – PM)

UNIT II	PULSE AND DATA COMMUNICATION	9

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) - Comparison of various Pulse Communication System (PAM – PTM – PCM).

Data Communication: History of Data Communication - Standards Organizations for Data Communication- Data Communication Circuits - Data Communication Codes - Data communication Hardware - serial and parallel interfaces.

UNIT III	DIGITAL COMMUNICATION	9

Amplitude Shift Keying (ASK) – Frequency Shift Keying (FSK)–Phase Shift Keying (PSK) – BPSK – QPSK – Quadrature Amplitude Modulation (QAM) – Comparison of various Digital Communication System (ASK – FSK – PSK – QAM).

UNIT IV	SOURCE AND ERROR CONTROL CODING	9

Entropy , Source encoding theorem – Shannon, Fano coding, Huffman Coding, LZ Coding, Channel capacity, Error control coding – Linear Block codes, Cyclic codes and Convolution codes

UNIT V	MULTI-USER RADIO COMMUNICATION	9

Global System for Mobile Communications (GSM) - Code division multiple access (CDMA) – Cellular Concept and Frequency Reuse - Channel Assignment and Handover Techniques - Overview of Multiple Access Schemes - Satellite Communication - Bluetooth.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply analog communication techniques.

CO2: Demonstrate pulse and data communication techniques CO3: Explain digital communication techniques CO4: Analyze Source and Error control coding CO5: Describe multi user radio communication techniques
TEXT BOOKS: 1. H Taub, D L Schilling, G Saha, "Principles of Communication Systems", 3rd Edition, TMH, 2007. 2. Simon Haykin, Michael Moher, "Introduction to Analog and Digital Communications", 2nd Edition, John Wiley 2012. 3. B.P.Lathi, "Modern Digital and Analog Communication Systems", 4th Edition, Oxford University Press, 2011.
REFERENCES: 1. H P Hsu, Schaum Outline Series – "Analog and Digital Communications", 2nd Edition TMH 2006. 2. B.Sklar, Digital Communications Fundamentals and Applications" 2nd Edition, Pearson Education, 2007. 3. A. Bruce Carlson & Paul B Crilly, "Communication Systems", McGraw Hill, 4th Edition, 2009.

21EC212	DIGITAL SYSTEMS LABORATORY *(Common to B.E. ECE,B.E. CSE &B.Tech.IT)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To explain the various basic logic gates.
- To develop and implement the various combinational circuits.
- To model and implement combinational circuits using MSI devices.
- To build and implement sequential circuits.
- To develop code using HDL programming.

LIST OF EXPERIMENTS:

1. Verification of Boolean theorems using basic gates.
2. Design and implementation of combinational circuits using basic gates for arbitrary functions and code converters.
3. Design and implement Half/Full Adder and Subtractor.
4. Design and implement combinational circuits using MSI devices:
    - 4 – bit binary adder / subtractor
    - Parity generator / checker
    - Magnitude comparator
5. Design and implement shift-registers.
6. Design and implement synchronous counters.
7. Design and implement asynchronous counters.
8. Coding combinational circuits using HDL.
9. Coding sequential circuits using HDL.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of this course, learners will be able to

CO1: Outline the basic working principles of logic gates.
CO2: Build simplified combinational circuits using basic logic gates.
CO3: Model combinational circuits using MSI devices.
CO4: Develop sequential circuits like registers and counters.
CO5: Solve combinational and sequential circuits using HDL.

21CS204	DATA STRUCTURES LABORATORY *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To demonstrate linear and non-linear data structures and their implementations.
- To describe the different operations of search trees.
- To compare various techniques of hashing.
- To illustrate graph traversal algorithms.
- To develop applications using different data structures.

List of Experiments

1. Implementation of Singly Linked List
2. Implementation of Doubly Linked List
3. Application of Linked List
4. Implementation of Stacks
5. Implementation of Queues
6. Application of Stack
7. Implementation of Tree Traversal
8. Implementation of Binary Search tree
9. Implementation of Balanced Tree
10. Create a hash table using open addressing with the following operations:
11. Implementation of Graph traversal Algorithms
12. Mini Project

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Develop functions for implementing linear data structures.

CO2: Make use of the different linear data structures for computational problem solving.

CO3: Build functions for implementing nonlinear tree data structures.

CO4: Choose appropriate hashing functions for collision free data storage and retrieval.

CO5: Utilize graph structure for manipulating data and problem solving

21CS205	OBJECT ORIENTED PROGRAMMING LABORATORY *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To describe basic java programming constructs, classes, methods and inheritance.
- To develop application using exception handling concepts and strings
- To demonstrate threading and I/O concepts in java applications
- To illustrate generics and collections for solving programming problems.
- To build interactive applications using java swings and database connectivity

LIST OF EXPERIMENTS

1. Arrays and Classes
2. Inheritance and Interfaces
3. Packages and Strings
4. Exception handling
5. Multithreading
6. Thread Synchronization
7. File I/O
8. Generic Programming
9. Collections
10. Event driven Programming
11. Database connectivity
12. Mini project

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Develop programs using basic java concepts.

CO2: Prepare java applications employing exception handling and strings

CO3: Construct java applications adopting thread and I/O concepts.

CO4: Solve java programming problems by incorporating Generics and collections.

CO5: Build GUI for java applications with database connectivity.

SEMESTER – IV

21MA205	STOCHASTIC PROCESS AND ITS APPLICATIONS *(Common to B.E. CSE & B.Tech. IT)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To discuss the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To explain the basic probability concepts with respect to two dimensional random variables
- To make use of the basic concepts of random processes which are widely used in IT fields.
- To experiment the significance of advanced queueing models.
- To identify the required mathematical support in real life problems and develop probabilistic models which can be used in several areas of science and engineering.

UNIT I	RANDOM VARIABLES	12

Discrete and Continuous random variables-Moments-Moment Generating Function-Discrete Probability Distribution (Binomial , Poisson & Geometric) - Continuous Probability Distribution (Uniform, Exponential, Normal, Weibull& Gamma)

UNIT II	TWO DIMENSIONAL RANDOM VARIABLES	12

Joint Distributions-Marginal and Conditional Distributions-Covariance-Correlation and Linear Regression.

UNIT III	RANDOM PROCESSES	12

Classification – Stationary process – Markov process - Poisson process – Discrete parameter Markov chain – Chapman Kolmogorov equations – Limiting distributions.

UNIT IV	QUEUEING MODELS	12

Markovian queues – Birth and Death processes – Single and multiple server queueing models – Little's formula - Queues with finite waiting rooms - Finite source models - M/G/1 queue – PollaczekKhinchin formula.

UNIT V	NETWORKS, SERIES AND CYCLIC QUEUES	12

Series queues - Open Jackson networks - Closed Jackson networks - cyclic queues - extension of Jackson networks – Non Jackson networks.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the basic concepts of Random variables and standard discrete and continuous distributions.

CO2: Calculate the correlation and regression of two dimensional random variables.

CO3 :Construct the functions of time when the probability measure is associated through random process.

CO4: Develop the knowledge of various queueing models.

CO5: Solve the given network (open) problem using the suitable techniques.

TEXT BOOKS:

1. Ibe. O.C., "Fundamentals of Applied Probability and Random Processes", 2nd Edition, Academic Press, 2014.
2. Gross. D. and Harris. C.M., "Fundamentals of Queueing Theory", 4th Edition, Wiley & Sons, 2004.
3. John.F.Shortle, James M.Thompson, Donald Gross "Fundamentals of Queueing Theory", 5th Edition ,Wiley Series, 2018.
4. Sheldon M.Ross, "Introduction to Probability Models". 11th Edition, Academic Press, 2014.

REFERENCES:

1. Robertazzi, "Computer Networks and Systems: Queueing Theory and performance evaluation", 3rd Edition, Springer, 2006.
2. Taha. H.A., "Operations Research", 8th Edition, Pearson Education, Asia, 2007.
3. Trivedi.K.S., "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 2nd Edition, John Wiley and Sons, 2002.
4. Hwei Hsu, "Schaum's Outline of Theory and Problems of Probability, Random Variables and Random Processes", Tata McGraw Hill Edition, 2004.
5. Yates. R.D. and Goodman. D. J., "Probability and Stochastic Processes", 2nd Edition, Wiley India Pvt. Ltd.,Bangalore, 2012.

21CS206	DATA BASE MANAGEMENT SYSTEM *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of data models and to represent a database system.
- To describe the internal storage structures using different file and indexing techniques which will help in physical DB design.
- To illustrate the fundamental concepts of transaction processing- concurrency control techniques and recovery procedures.
- To demonstrate Storage and Query processing Techniques.
- To develop a solutions to the real time problems using NoSQL.

UNIT I	RELATIONAL DATABASES	9

Purpose of Database System – Views of data – Data Models – Database System Architecture – Introduction to relational databases – Relational Model – Keys – Relational Algebra – SQL fundamentals – Advanced SQL features – PL/SQL, Triggers, Embedded SQL– Dynamic SQL.

UNIT II	DATABASE DESIGN	9

Entity-Relationship model – E-R Diagrams – Enhanced-ER Model – ER-to-Relational Mapping – Functional Dependencies – Non-loss Decomposition – First, Second, Third Normal Forms, Dependency Preservation – Boyce/Codd Normal Form – Multi-valued Dependencies and Fourth Normal Form – Join Dependencies and Fifth Normal Form

UNIT III	TRANSACTIONS	9

Transaction Concepts – ACID Properties – Schedules – Serializability – Concurrency Control – Need for Concurrency – Locking Protocols – Two Phase Locking – Deadlock – Transaction Recovery - Save Points – Isolation Levels – SQL Facilities for Concurrency and Recovery.

UNIT IV	IMPLEMENTATION TECHNIQUES	9

RAID – File Organization – Organization of Records in Files – Indexing and Hashing –Ordered Indices – B+ tree Index Files – B tree Index Files – Static Hashing – Dynamic Hashing – Query Processing Overview – Query optimization using Heuristics and Cost Estimation.

UNIT V	NOSQL DATABASE	9

Introduction to NoSQL Database system – Classification of NoSQLDatabases : Graph databases – key – value stores – document stores – NoSQLvs SQL – Limitations of NoSQL – Mongo DB document model .

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Build and manipulate relational database using Structured Query Language and relational languages

CO2: Prepare database using ER-Diagram for real time Applications.

CO3:Make use of Normalization techniques to reduce cost due to redundancy constraints

CO4:Illustrate different types of scheduling and recovery techniques for concurrent transactions CO5:Construct data structures like indexes and hash tables for the fast retrieval of data and Validate the query evaluation plan
TEXT BOOKS: 1. Abraham Silberschatz, Henry F. Korth, S. Sudharshan, —Database System Conceptsl, 6th Edition, Tata McGraw Hill, 2011. 2. RamezElmasri, Shamkant B. Navathe, —Fundamentals of Database Systems, Pearson Education, 2011. 3. Raghu Ramakrishnan, —Database Management Systemsl, 4th Edition, McGraw-Hill College Publications, 2015.
REFERENCES: 1. C.J.Date, A.Kannan, S.Swamynathan, —An Introduction to Database Systemsl,8th Edition, Pearson Education, 2006. 2. Elvis C Foster,"Database Systems-A pragmatic Approach"2nd EditionCRC Press,2016 3. G.K.Gupta,"Database Management Systems, 1stEdition,Tata McGraw Hill, 2011.

21CS207	**DESIGN AND ANALYSIS OF ALGORITHM** *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe about different types of computing problem algorithms and learn how to analyze its efficiency.
- To explain how computing problems are solved using brute force and divide and conquer methods.
- To demonstrate dynamic programming and greedy techniques for solving the problem.
- To construct iterative improvement method for problem solving.
- To illustrate backtracking, branch and bound techniques.

UNIT-I	INTRODUCTION	9

Introduction to Algorithm – Fundamentals of Algorithmic Problem Solving – Important Problem Types – Fundamentals of the Analysis of Algorithmic Efficiency –Asymptotic Notations and Basic efficiency classes- - Mathematical analysis for Recursive and Non-Recursive algorithms-Example: Fibonacci Numbers

UNIT-II	BRUTE FORCE AND DIVIDE-AND-CONQUER	9

Brute Force: Selection sort and Bubble sort-Sequential search and String Matching - Closest-Pair and Convex-Hull Problems-Exhaustive Search: Travelling Salesman Problem-Knapsack Problem-Assignment problem. Divide and Conquer: Binary Search-Merge sort – Quick sort- Multiplication of Large Integers – Strassen's Matrix Multiplication

UNIT-III	DYNAMIC PROGRAMMING AND GREEDY TECHNIQUE	9

Dynamic programming: Coin-row problem, Computing a Binomial Coefficient –The Knapsack problem and Memory functions- Optimal Binary Search Trees – Warshall's and Floyd's algorithm. Greedy Technique: -Dijikstra's Algorithm - Huffman Trees and codes

UNIT-IV	ITERATIVE IMPROVEMENT	9

The Simplex Method - The Maximum-Flow Problem – Maximum Matching in Bipartite Graphs, Stable marriage Problem

UNIT-V	BACKTRACKING AND BRANCH &BOUND	9

Backtracking: n-Queen problem - Hamiltonian Circuit Problem – Subset Sum Problem. Branch and Bound: Assignment problem – Knapsack Problem – Travelling Salesman Problem – P,NP-Approximation Algorithms for NP-Hard Problems – Travelling Salesman problem – Knapsack problem

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1:Examine mathematically the notion of algorithm, asymptotic notations, and algorithmic efficiency with properties.

CO2: Discover the efficiency of algorithms of time and space complexity using brute force and divide and conquer strategies.

CO3: Inspect the time and space complexity of the algorithms designed using Dynamic Programming and Greedy techniques.

CO4: Identify various iterative improvement techniques for problem solving

CO5: Construct the best solution for the given problem using backtracking and Branch & Bound technique.

TEXT BOOKS:

1. AnanyLevitin,"Introduction to the Design and Analysis of Algorithms", 3rd Edition, Pearson Education, 2012.
2. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", 3rd Edition, PHI Learning Private Limited, 2012.
3. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", 3rd Edition, Pearson Education, Reprint 2006.

REFERENCES:

1. S. Sridhar," Design and Analysis of Algorithms" ,1st Edition, Oxford University Press,2015.
2. Chandra Mohan," Design and Analysis of Algorithms" ,1st Edition, PHI Learning,2012.
3. R.Pannerselvam, Design and Analysis of Algorithms,2nd Edition, PHI Learning,2016.

21CS208	OPERATING SYSTEMS *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the working of Assembler, Macro Processor, Loader and Linker.
- To explain Scheduling algorithms and Synchronization.
- To illustrate the concept of Deadlocks.
- To distinguish various memory management schemes.
- To demonstrate I/O management and File systems.

UNIT-I	OVERVIEW OF SYSTEM SOFTWARE	9

Assemblers & Macro Processors: Simple Assembly Scheme, Pass Structure of assemblers, Macro Definition and Call, Macro Expansion, Nested Macro Calls, Linkers and Loaders: Introduction, Relocation and linking Concepts and Types of Loaders.

UNIT-II	OVERVIEW OF OPERATING SYSTEMS	9

Introduction: Computer System Organization, Computer System Architecture,Operating System Operations. Operating System Structure: OS Services, System calls, Types of System Calls, Operating – System Structure, OS Generation and System Boot.

UNIT-III	PROCESS MANAGEMENT AND DEADLOCK	9

Process Management: Process Synchronization. CPU Scheduling: Scheduling Criteria, Scheduling Algorithms. Deadlock: System Model, Characterization, Deadlock Detection, Deadlock Prevention, Deadlock Avoidance, Deadlock Recovery.

UNIT-IV	STORAGE MANAGEMENT	9

Memory Management: Main Memory – Swapping, Contiguous Memory Allocation, Paging, Structure of the Page Tables, Segmentation. Virtual Memory: Demand paging, Page Replacement, Allocation, Thrashing; Allocating Kernel Memory, OS Examples.

UNIT-V	FILE SYSTEMS AND I/O SYSTEMS	9

Mass Storage System-Overview of Mass Storage Structure, Disk Structure, Disk Scheduling and Management, Swap-Space Management; File-System Interface-File Concept, Access Methods, Directory Structure, Directory Organization, File system mounting, File Sharing and Protection; File System Implementation-File System Structure, Directory Implementation, Allocation Methods, Free Space Management, Efficiency and Performance ,Recovery: I/O Systems –I/O Hardware, Application I/O Interface, Kernel I/O subsystem, Streams and Performance.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Examine the elements with various data structures used in development of language processors.

CO2: Make use of process scheduling, deadlocks and synchronization concepts to develop solutions for multi-programmed environment.

CO3: Compare and contrast various memory management schemes. CO4: Discover the functionality of file systems and disk. CO5: Distinguish various schemes for I/O Management and File Systems.
TEXT BOOKS:
1. Leland L.Beck," System Software - An Introduction to System Programming", 3rdEdition, Pearson Education, 2011. 2. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, "Operating System Concepts", 9th Edition, John Wiley and Sons Inc., 2018. 3. William Stallings, "Operating Systems – Internals and Design Principles", 7th Edition, Prentice Hall, 2017.
REFERENCES:
1. D.M.Dhamdhere," System Programming, Tata McGraw Hill", 2ndRevised Edition, 2011. 2. Andrew S. Tanenbaum, Albert S.WoodHull: Operating Systems, Design and Implementation, 3rd Edition, Prentice Hall, 2012. 3. Remzi H. Arpaci-Dusseau, Andrea C. Arpaci-Dusseau,"Operating Systems-Three easy pieces",2nd Edition,CreateSpace Independent Publishing Platform,2020.

21IT201	COMPUTER NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the basic concepts of protocol layer and its function.
- To identify the characteristics of data link layer.
- To classify the functions of network layer and the various routing protocols.
- To explain the protocols of the transport layer.
- To infer the various protocols of the application layer.

Unit-I	INTRODUCTION AND PHYSICAL LAYER	9

Networks – Network Types – Protocol Layering – TCP/IP Protocol suite – OSI Model –Physical Layer: Performance – Transmission media – Switching – Circuit-switched Networks – Packet Switching.

Unit-II	DATA-LINK LAYER & MEDIA ACCESS	9

Introduction – Link-Layer Addressing – DLC Services – Data-Link Layer Protocols – HDLC– PPP - Media Access Control - Wired LANs: Ethernet - Wireless LANs – Introduction –IEEE 802.11, Bluetooth – Connecting Devices.

Unit-III	NETWORK LAYER	9

Network Layer Services – Packet switching – Performance – IPV4 Addresses – Forwarding of IP Packets - Network Layer Protocols: IP, ICMP v4 – Unicast Routing Algorithms –Protocols – Multicasting Basics – IPV6 Addressing – IPV6 Protocol.

Unit-IV	TRANSPORT LAYER	9

Introduction – Transport Layer Protocols – Services – Port Numbers – User Datagram Protocol – Transmission Control Protocol – SCTP.

Unit-V	APPLICATION LAYER	9

WWW and HTTP – FTP – Email –Telnet –SSH – DNS – SNMP.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Summarize the basic concepts of protocol layer and its function.

CO2: Identify the characteristics of data link layer.

CO3: Outline the functions of network layer.

CO4: Interpret the various transport layer protocols in the network.

CO5: Explain the various protocols of the application layer.

Text Books:

1. Behrouz A. Forouzan, "Data Communications and Networking", 5th edition TMH, 2017.
2. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", 5th edition, Morgan Kaufmann Publishers Inc., 2012.
3. William Stallings, "Data and Computer Communications", 10th edition, Pearson Education,

2013.

Reference Books:

1. Nader F. Mir, "Computer and Communication Networks", 2nd Edition, Prentice Hall, 2014.
2. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, "Computer Networks: An Open Source Approach", McGraw Hill Publisher, 2011.
3. James F. Kurose, Keith W. Ross, "Computer Networking, A Top-Down Approach Featuring the Internet", 6th Edition, Pearson Education, 2013.

21IT202	DESIGN THINKING AND PRODUCT INNOVATION	L	T	P	C
		2	0	0	1

COURSE OBJECTIVES:

- To explain the concept of design thinking for product and service development.
- To summarize the fundamental concept of innovation and design thinking.
- To identify the methods of implementing design thinking in the real world.
- To make use of the strategic innovations in design thinking.
- To develop and implement design thinking workshop.

Unit-I	**PROCESS OF DESIGN**	**6**
Understanding Design thinking - Shared model in team-based design – Theory and practice in Design thinking – Explore presentation signers across globe – MVP or Prototyping		
Unit-II	**TOOLS FOR DESIGN THINKING**	**6**
Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design.		
Unit-III	**DESIGN THINKING IN IT**	**6**
Design Thinking to Business Process modelling – Agile in Virtual collaboration environment – Scenario based Prototyping		
Unit-IV	**DT FOR STRATEGIC INNOVATIONS**	**6**
Growth – Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design.		
Unit-V	**DESIGN THINKING WORKSHOP**	**6**
Design Thinking Work shop Empathize, Design, Ideate, Prototype and Test.		
		TOTAL : 30 PERIODS

COURSE OUTCOMES

At the end of the course, learners will be able to:

CO1: Explain the various design process procedure.

CO2: Infer the design ideas through different technique.

CO3: Identify the significance of reverse Engineering to Understand products.

CO4: Develop the technical drawing for design ideas.

CO5: Model the ways to organise design thinking workshop.

TEXT BOOKS:

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", 2nd edition, Cengage learning (International edition), 2013.

2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage",2nd edition, Harvard Business Press , 2009.

3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve– Apply",1st edition, Springer, 2011.

REFERENCE BOOKS:

1. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", 2nd edition, Cengage Learning, 2011.

2. Jeanne Liedtka, Andrew King and Kevin Bennett, "Solving Problems with Design Thinking - Ten Stories of What Works" 2nd edition, Columbia Business School Publisher, 2013.

3. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School",2nd edition, John Wiley & Sons 2013.

21CS210	DATABASE MANAGEMENT SYSTEMS LABORATORY *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To explain data definitions and data manipulation commands
- To illustrate the use of nested and join queries
- To describe functions, procedures and procedural extensions of data bases
- To make use of a front end tool
- To construct the database applications

LIST OF EXPERIMENTS

1. Data Definition Language Commands
2. Data Manipulation Language Commands
3. Data Control Language Commands, Nested queries
4.Set Operators and Join Queries
5. Views, Sequences, Synonyms
6. Database Programming using PL/SQL
7. PL/SQL – Triggers
8. PL/SQL – Functions
9. PL/SQL – Procedures
10. PL/SQL – Cursors
11. Database Connectivity with Front End Tools
12. Document database creation using Mongo DB
13.Case Study using real life database applications

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will able to

CO1: Use data definition language commands and declare and enforce integrity constraints on a database.

CO2: Populate and query a database using simple SQL queries and complex SQL queries.

CO3: Make use of database objects such as views, sequences and synonyms using SQL.

CO4: Prepare database Triggers, stored procedures, stored functions and cursors using PL/SQL.

CO5: Construct Mongo DBfor database creation.

21CS211	**OPERATING SYSTEMS LAB** *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To describe the process involved in Assembler, Macro Processor, Loader and Linker.
- To illustrate Process Creation and Inter Process Communication.
- To demonstrate Deadlock Avoidance and Deadlock Detection Algorithms
- To explain Page Replacement Algorithms
- To discuss File Organization and File Allocation Strategies

List of Experiments:

1. Implementation of Single Pass Assembler.
2. Implementation of Multi Pass Assembler.
3. Given the list of processes, their CPU burst times, display/print the Gantt chart for FCFS and SJF. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.
4. Given the list of processes, their CPU burst times display/print the Gantt chart for Priority and Round robin. For each of the scheduling policies, compute and print the average waiting time and average turnaround time.
5. Implement the Producer – Consumer problem using semaphores.
6. Developing Application using Inter Process Communication (using shared memory, pipes or message queues.
7. Implementation of Deadlock Avoidance using Bankers algorithm.
8. Implementation the following Memory Allocation Methods for fixed partition
   i. a) First Fit b) Worst Fit c) Best Fit
9. Implement the Paging Technique of Memory Management.
10. Implementthe following Page Replacement Algorithms
    a) FIFO b) LRU c) Optimal
11. Implement the following File Allocation Strategies
    a) Sequential b) Indexed c) Linked
12. Implement Disk Management using Algorithms such as FCFS, SSTF, SCAN and C- SCAN.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Develop the programson Assembler, Macro Processor, Loader and Linker

CO2:Make use of Scheduling Algorithms such as FCFS, SJF , Priority and Round Robin to schedule a given set of processes.

CO3: Utilize Banker's Algorithm for Deadlock avoidance. CO4: Infer Solutions to Critical Section Problem using Semaphores. CO5: Compare the performance of the various Memory management techniques.

SEMESTER- V

21IT301	FOUNDATIONS OF DATA SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline data preparatory and preprocessing steps.
- To explain the statistical methods for data science.
- To make use of the packages in Python for data science.
- To summarize the regression techniques.
- To utilize the visualization techniques for interpreting data.

UNIT-I	INTRODUCTION	9
Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating and transforming data – exploratory data analysis – build the models – presenting and building applications.		
UNIT-II	**DESCRIBING DATA I**	**9**
Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked data – describing variability – range – variance – standard deviation – degrees of freedom – inter quartile range – variability for qualitative and ranked data.		
UNIT-III	**PYTHON FOR DATA HANDLING**	**9**
Basics of Numpy arrays – aggregations – computations on arrays – comparisons, masks, Boolean logic – fancy indexing – structured arrays – data manipulation with Pandas – data indexing and selection – operating on data – missing data – hierarchical indexing – combining datasets – aggregation and grouping – pivot tables.		
UNIT-IV	**DESCRIBING DATA II**	**9**
Normal distributions – z scores – normal curve problems – finding proportions – finding scores – more about z scores – correlation – scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean.		
UNIT-V	**PYTHON FOR DATA VISUALIZATION**	**9**
Visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings and density – three dimensional plotting – geographic data – data analysis using statsmodels and seaborn – graph plotting using Plotly – interactive data visualization using Bokeh.		

	TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the methods for data inspecting and cleansing.

CO2: Compare the statistical methods for data science.

CO3: Make use of the packages in Python for data science.

CO4: Outline the prediction techniques using regression models.

CO5: Experiment with different visualization techniques.

TEXT BOOKS:

1. John S. Witte and Robert S.Witte , "Statistics", 11th edition, John Wiley and sons inc., 2021.
2. Jake VanderPlas, "Python Data Science Handbook", 1st edition, O'Reilly, 2016.
3. David Cielen, Arno D. B. Meysman, and Mohamed Ali, "Introducing Data Science", Manning Publications, 2016.

REFERENCES:

1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", 2nd edition, O'Reilly, 2015.
2. Allen B. Downey, "Think Stats: Probability and Statistics for Programmers", 1st edition, Green Tea Press, 2011.
3. Avirm Blum, John Hopcroft and Ravindran kanan, "Foundations of Data Science", Cambridge University press, 1st edition, 2020.

21IT302	PRINCIPLES OF CLOUD COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of cloud computing.
- To summarize about various virtualization tools.
- To infer about cloud data storage.
- To outline the quality of services for cloud computing.
- To build applications using various cloud computing frameworks.

UNIT-I	INTRODUCTION	9

Roots of cloud computing, Cloud characteristics, Deployment models - private, public, hybrid and community, Service models - SaaS, PaaS, IaaS, paaS, Challenges of cloud computing - security risks and threats, Microservices.

UNIT-II	VIRTUALIZATION	9

Basics of Virtualization, Types of virtualization, Benefits, Provisioning and manageability, Migration, Emulation, Virtualization environment, Study on virtualization tool, Linux Container - Docker, Kubernetes, Serverless computing.

UNIT-III	CLOUD DATA STORAGE	9

Storage system architecture, Storage as a Service, Cloud storage landscape, Hybrid storage networking technologies: NAS and SAN - Configuration, File System: GFS, HDFS, Programming Model: Map reduce paradigm and its applications, Bigtable+GFS, Hbase+HDFS+HIVE, Amazon Simple Storage Service (S3).

UNIT-IV	QUALITY OF SERVICE	9

Interoperability, Scalability, SLA management: Types - Lifecycle - Automated policy management in cloud, Identity management, billing and accounting, Fault tolerance, API's to interact with cloud, secure access to cloud software services.

UNIT-V	CLOUD COMPUTING FRAMEWORK	9

Amazon AWS, Microsoft Windows Azure, Google App Engine, OpenStack, Jelastic, iCloud, Live Mesh.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the fundamentals of cloud computing.

CO2: Outline about various virtualization tools.

CO3: Experiment with various cloud storage techniques.

CO4: Identify the different qualities of services.

CO5: Make use of various cloud computing frameworks for implementing software applications.

TEXT BOOKS:

1. Ian Foster and Dennis B Gannon, "Cloud Computing for Science and Engineering", 1st edition

PHI Learning , 2019.

2. Rajkumar Buyya, James Broberg and Andrzej Goscinski, "Cloud Computing: Principles and Paradigms", 1st edition, A John Wiley and sons publications, 2011.
3. Mathew Portnoy, "Virtualization Essentials", 2nd edition, Sybex publications, 2016.

REFERENCES :

1. Thomas Erl, ZaighamMahmood and Ricardo Puttini, "Cloud Computing: Concepts, Technology and Architecture", Pearson Education, 2017.
2. Anthony T Velte, Toby J Velte and Robert Elsenpeter, "Cloud Computing – A Practical Approach", McGraw Hill education, 2017.
3. Kris Jamsa, "Cloud Computing: SaaS, PaaS, IaaS, Virtualization, Business Models, Mobile, Security, and More", 1st edition, Jones and Bartlett publishers, 2013.

21IT303	SOFTWARE ENGINEERING	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To explain about various Software Development Life Cycle (SDLC) models.
- To interpret how to elicit and formulate requirements.
- To identify various tools for designing a software.
- To plan test strategies for validating and verifying the developed software.
- To make use of various software estimation techniques for forecasting the cost of development.

UNIT-I	PRODUCT AND PROCESS	15

The Nature of Software – The changing nature of Software – The Software Process – Process models – Prescriptive Process Models – Specialized Process Models – Agile Development – Extreme Programming (XP) – Other Agile Process Models.

Suggested Activities :

- Study of various process models.

UNIT-II	REQUIREMENTS ANALYSIS AND SPECIFICATION	15

Requirements Analysis – Software Requirements – Requirements Engineering – Eliciting Requirements – Developing Use Cases – Building the Requirements Model – Negotiating and Validating Requirements.

Suggested Activities :

- Preparation of Software Requirement Specification Document.

UNIT-III	ANALYSIS AND DESIGN	15

Requirements Modeling: Scenarios, Information, Analysis Classes – Scenario Based Modeling – Data Modeling – Class-Based Modeling – Flow Oriented Models – Behavioral Models. Design Process and Concepts – Design Model: Data Design Elements – Architectural Design – Component Level Design – Deployment Level Design – User Interface Design – Pattern-Based Design.

Suggested Activities :

- Design and development using various CASE tools.

UNIT-IV	SOFTWARE TESTING	15

Software Testing Strategies – System Testing – Debugging – White Box Testing – Black Box Testing – Model Based Testing – Testing for Specialized Environments, Architectures and Applications – Testing Object-Oriented and Web Based Applications – User Interface Testing – Configuration Testing – Security Testing – Performance Testing.

Suggested Activities :

- Generation of test cases for various white box and black box testing techniques.

UNIT-V	SOFTWARE PROJECT MANAGEMENT	15

Software Project Management Concepts – Process and Project Metrics – Estimation for Software Projects – Project Scheduling – Risk Management – Software Configuration Management – Software

Process Improvements (SPI) – The SPI Process – Capability Machine Model Integration (CMMI) – Other SPI Frameworks.

Suggested Activities :

Activity Planning in Software Project Management.

TOTAL : 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Summarize software engineering process models.

CO2: Translate end-user requirements in to software requirements

CO3: Make use of systematic approaches and diagnostic tools for developing end to end solutions.

CO4: Experiment with different Software testing methods.

CO5: Plan the cost of developing software and studying the risk associated with it.

TEXT BOOKS:

1. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", 8th edition, McGraw Hill International Edition, 2019.
2. Gopalaswamy Ramesh, "Managing Global Software Projects", 1st edition, Tata McGraw Hill Education , 2017.
3. Sagar Naik and Piyu Tripathy, "Software Testing and Quality Assurance Theory and Practice",2nd edition, Wiley publication, 2010.

REFERENCES :

1. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, "Design patterns: Elements of Reusable Object-Oriented Software", 1st edition, Pearson education, 2015.
2. Martin Fowler, "UML Distilled: A Brief Guide to the Standard Object Modeling Language", 3rd edition, Addison Wesley, 2003.
3. Royce walker , "Software Project Management", 1st edition, Pearson India, 2004.

21IT304	FOSS AND CLOUD LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To develop applications using GNU Compiler Collection(GCC)
- To make use of version control systems
- To build web applications in cloud
- To demonstrate parallel programming using Hadoop.
- To apply new schedulers to simulate a cloud environment.

LIST OF EXPERIMENTS:

1. Use gcc to compile c-programs. Split the programs to different modules and create an application using make command.
2. Use version control systems command to clone, commit, push, fetch, pull, checkout, reset, and delete repositories.
3. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows 7 or 8.
4. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
5. Install Google App Engine. Create hello world app and other simple web applications using python/java.
6. Use GAE launcher to launch the web applications.
7. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
8. Find a procedure to transfer the files from one virtual machine to another virtual machine.
9. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
10. Install Hadoop single node cluster and run simple applications like wordcount.

HARDWARE/SOFTWARE REQUIREMENTS

1. Dream Weaver or Equivalent, MySQL or Equivalent, Apache Server, WAMP/XAMPP.
2. Netbeans IDE or equivalent.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of virtualization tools such as Virtual Box, VMware work station.

CO2: Build web application in a PaaS environment.

CO3: Model a cloud environment to implement new schedulers.

CO4: Utilize a generic cloud environment that can be used as a private cloud.

CO5: Develop web applications and deploy them in a cloud based environment.

SEMESTER- VI

21IT305	MOBILE COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basic concepts of mobile computing.
- To outline the basics of mobile telecommunication systems.
- To demonstrate the network layer protocols and Ad-Hoc networks.
- To summarize the basis of transport and application layer protocols.
- To make use of different mobile platforms and application development.

UNIT-I	INTRODUCTION	9

Introduction to Mobile Computing – Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols – Cellular Systems - GSM – Services & Architecture – Protocols Security – Handover – Security.

UNIT-II	WIRELESS NETWORKS	9

Wireless LANs–IEEE 802.11 Standard –Architecture –Services – GPRS, UMTS – LTE & 5G Network Basics - Wireless PANs – Blue Tooth-Wi-Fi –WiMAX.

UNIT-III	MOBILE NETWORK LAYER	9

Mobile IP –DHCP –Ad-Hoc–Proactive and Reactive Routing Protocols –Multicast Routing-Vehicular Ad Hoc networks (VANET) –MANET Vs VANET –Security.

UNIT-IV	MOBILE TRANSPORT AND APPLICATION LAYER	9

Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML.

UNIT-V	MOBILE PLATFORMS AND APPLICATIONS	9

Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the basics of mobile telecommunication systems.

CO2: Illustrate the generations of telecommunication systems in wireless networks.

CO3: Summarize the functionality of MAC, network layer and Identify a routing protocol for a given Ad hoc network.

CO4: Explain the functionality of transport and application layers.

CO5: Develop a mobile application using android/blackberry/ios/Windows SDK.

TEXT BOOKS:

1. Jochen Schiller, "Mobile Communications", 2nd edition, PHI Learning, 2003.

2. Prasant Kumar Pattnaik and Rajib Mall, "Fundamentals of Mobile Computing", 2nd edition, PHI Learning, New Delhi, 2015.
3. Alexander Kukushkin, "Introduction to Mobile Network Engineering", John Wiley & Sons Ltd, 2018.

REFERENCES :

1. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems", 3rd edition, Cengage Learning Publishing, 2010.
2. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", 2nd edition, Springer, 2006.
3. William.C.Y. Lee, "Mobile Cellular Telecommunications-Analog and Digital Systems", 2nd edition, Tata McGraw Hill Edition, 2006.

21IT306	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate the awareness of intelligent agents and problem solving using different search algorithms.
- To interpret the use of different knowledge representation methods.
- To make use of uncertain knowledge for planning and reasoning in AI applications.
- To explain the basics of decision making.
- To apply the knowledge of machine learning methods in AI applications.

UNIT-I	INTRODUCTION AND PROBLEM SOLVING	9

Intelligent Agents. forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms.

UNIT-II	KNOWLEDGE REPRESENTATION AND REASONING	9

Ontologies, foundations of knowledge representation and reasoning, representing and reasoning about objects, relations, events, actions, time, and space; predicate logic, situation calculus, description logics, reasoning with defaults, reasoning about knowledge.

UNIT-III	PLANNINGAND REASONING WITH UNCERTAIN KNOWLEDGE	9

Planning as search, partial order planning, construction and use of planning graphs, probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference.

UNIT-IV	DECISION-MAKING	9

Basics of utility theory, decision theory, sequential decision problems, elementary game theory.

UNIT-V	MACHINE LEARNING AND KNOWLEDGE ACQUISITION	9

Learning from memorization, examples, explanation, and exploration. learning nearest neighbour, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the awareness of intelligent agents and problem solving using different search Algorithms.

CO2: Outline the use of different knowledge representation methods

CO3: Identify uncertain knowledge for planning and reasoning in AI applications

CO4: Infer the basics of decision making.

CO5: Build the knowledge of machine learning methods in AI applications.

TEXT BOOKS:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence – A Modern Approach", 4th edition, Pearson Education, 2021.
2. Elaine Rich, Kevin Knight and Shivashankar B.Nair, "Artificial Intelligence", 3rd edition,Tata McGraw Hill Publishing Company Limited, 2009.

3. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving", 6th edition, Pearson Education, 2008.

REFERENCES :

1. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", 1st edition, Harcourt Asia Pvt. Ltd., 2000.
2. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents", 1st edition, Cambridge University Press, 2010.
3. Judith S.Hurwitz , Marcia Kaufman and Adrian Bowles, "Cognitive Computing and Big Data Analytics", 1st edition, Wiley Publication, April 2015.

21IT307	INTERNET OF THINGS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To explain the fundamentals of Internet of Things (IoT).
- To summarize the basics of IoT protocols.
- To understand about IoT design and development.
- To experiment with the knowledge about data analytics for IoT.
- To apply the concept of Internet of Things in the real world scenario.

UNIT I	FUNDAMENTALS OF IoT	15

Internet of Things - Physical Design - Logical Design - IoT Enabling Technologies - IoT and M2M – M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT Reference Architecture.

Suggested Activities:

- Familiarization with the concept of IOT, Arduino / Raspberry Pi and perform necessary software installation.

UNIT II	IoT PROTOCOLS	15

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN – CoAP.

Suggested Activities:

- Study of different operating systems for Raspberry Pi / Beagle board. Understanding the process of Os installation on Raspberry – Pi.

UNIT III	IoT DESIGN AND DEVELOPMENT	15

Design Methodology – Embedded Computing Basics – Microcontrollers – Systems on Chips - IoT system Building Blocks - Arduino – Board Details, IDE Programming – Raspberry Pi Interfaces - Raspberry Pi with Python Programming.

Suggested Activities:

- Study of Connectivity and Configuration of Raspberry-Pi circuit with basic peripherals, LEDs, Understanding GPIO and its use in program.

UNIT IV	DATA ANALYTICS FOR IoT	15

Data Analytics Overview and Challenges - Structured vs Unstructured Data - Data in Motion vs Data at Rest – Role of Machine Learning: Supervised Learning – Unsupervised Learning – Data Analytics Tools and Technology: NoSQL Databases – Hadoop - Apache Kafka, Apache Spark - Edge Streaming Analytics - Network Analytics – Chef - NETCONF-YANG.

Suggested Activities:

- MySQL Database Installation in Raspberry Pi.

UNIT V	CASE STUDIES / INDUSTRIAL APPLICATIONS	15

Home Automation: Smart Lighting – Home Intrusion Detection – Smart Cities: Smart Parking - Smart Traffic Control – Environment: Weather Monitoring System – Air Pollution Monitoring – Forest Fire Detection – Agriculture: Smart Irrigation.

Suggested Activities:

- Mini projects for Industrial Applications.

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain about the fundamentals of Internet of Things (IoT).

CO2: Interpret the knowledge about the basics of IoT protocols.

CO3: Summarize about IoT Design and Development.

CO4: Experiment with the information using data analytics for IoT.

CO5: Apply IoT in Real World Design Constraints.

TEXT BOOK:

1. David Hanes and Ganzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols and Use cases for Internet of Things", 1st edition, Pearson education, 2017.
2. Adrain McEwen and Hakim Cassimally,"Designing the Internet of Things" , 1st edition, Wiley , 2014.
3. Arshdeep Bahga and Vijay Madisetti, "Internet of Things – A hands on approach", 1st edition, University press , 2015.

REFERENCES:

1. Dieter Uckelmann, Mark Harrison and Michahelles, Florian (Eds), "Architecting the Internet of Things", 1st edition, Springer, 2011.
2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 1st edition, 2012.
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand and David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", 1st edition, Academic Press, Elsevier, 2014.
4. Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2nd edition, 2012.

21EN301	PROFESSIONAL COMMUNICATION LABORATORY *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To demonstrate communication skills that can lead to improved interpersonal relationships.
- To plan to set and achieve goals with focus.
- To organize themselves in work life to face the professional set up with confidence.
- To interpret ideas and participate in group discussion with positive attitude.
- To develop their confidence and help learners to attend interviews successfully.

UNIT I	COMMUNICATION AND PROFESSIONAL ETIQUETTES	6

Importance and Types of Communication Verbal communication -Presentation skills- Non-Verbal communication - Personal Appearance, Posture, Gestures, Facial Expressions, Eye Contact and Space Distancing - Professional Etiquette

UNIT II	GOAL SETTING AND MOTIVATION	6

Short term and Long term Goals- Strategies to set and achieve goals- Motivation

UNIT III	TIME AND STRESS MANAGEMENT	6

Importance of Time - Time Management Skills - Sources of Stress - Managing Stress - Analysis of the Case Studies on time and stress management

UNIT IV	GROUP DISCUSSIONS AND POSITIVE ATTITUDE	6

Group Discussions - Leadership Qualities - Decision Making - Problem Solving - Negotiation Skills - Positive Attitude

UNIT V	RESUME MAKING AND INTERVIEW SKILLS	6

Preparing Resume - E - Resume - Covering Letter – Job Application through email - Career Portfolio - Types of Interviews - Mock Interviews

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Demonstrate effective communication skills through presentations.

CO2: Utilize their knowledge of motivation in setting and achieving goals.

CO3: Examine time and stress management.

CO4: Formulate their ideas into an effective communication in formal contexts.

CO5: Develop a well-composed resume and face interviews confidently.

TEXTBOOKS:

1. Dhanavel S P, "English and Soft Skills", First Edition , Orient BlackSwan Ltd, Hyderabad : 2012.
2. Dr. Tobin Porterfield & Bob Graham ,"The 55 Soft Skills That Guide Employee and Organizational Success," Mason – West Publishing House , (January 4, 2018)
3. Prashant Sharma, "Soft Skills Personality Development for Life Success, " BPB Publications, New Delhi, January 2018.

REFERENCES:

1. M. Ashraf Rizvi, "Effective Technical Communication," Tata McGraw Hill Education Pvt. Ltd.

New Delhi, 2016.

2. Mohan Krishna & Meera Banerji, "Developing Communication Skills," First Edition, Trinity Press, 2017.
3. N. Krishnaswami& T. Sriraman, "Creative English for Communication,"Third edition, Laxmi Publications Private Limited, 2017.

SEMESTER - VII

21IT401	BIG DATA ENGINEERING *(Common to B.E.CSE/B.Tech.IT)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of big data.
- To develop simple Map Reduce applications.
- To outline the concepts of data analytics.
- To experiment with data models.
- To demonstrate MongoDB architecture and its operations.

UNIT-I	INTRODUCTION	9

Big Data Overview, Evolution of Big Data, Definition of Big Data, Challenges with Big Data - State of practice in Analytics, Key roles for New Big Data Ecosystem, Data Analytics Lifecycle Overview, Examples for Big Data Analytics.

UNIT-II	MAP REDUCE	9

HDFS Overview, Hadoop and Spark, Map Reduce Programming Basics, Analyzing the data with Hadoop: Java MapReduce - Developing Map Reduce Application.

UNIT-III	DATA ANALYTICS	9

Map reduce solution: Market Basket Analysis, K-means Clustering, Naïve Bayes, Implementation in Spark - KNN Classification, Logistic Regression, streaming data analytics.

UNIT-IV	TECHNOLOGY AND TOOLS	9

Hadoop Ecosystem: PIG - Data Storage: Value of Relational Databases – The emergence of NoSQL, Aggregate Data Models: Key value - Document Data Models - Column Family Stores - Hbase.

UNIT-V	MONGODB	9

Introduction to MongoDB – Architecture – Schema Design and Modelling – CRUD operations - Integration of MongoDB with Hadoop and Data Migration MongoDB with Hadoop (MongoDB to Hive)

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Outline the big data technologies used for storage, analysis and manipulation of data.

CO2: Develop simple applications using Hadoop MapReduce framework.

CO3: Outline the concepts of data analytics.

CO4: Make use of technology and tools for data modeling.

CO5: Explain the MongoDB architecture and its operations.

TEXT BOOKS:

1. EMC Education services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", 2nd edition, John Wiley and Sons, 2015.

2. Mahmoud Parsian, "Data Algorithms: Recipes for Scaling Up with Hadoop and Spark", 1st edition, O'Reilly media Inc., 2015.
3. Kyle Banker, Peter Bakkum, et al.,"MongoDB in Action, 2nd edition, Manning Publications, 2016.

REFERENCES :

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", 1st edition,Wiley publications, 2014.
2. Pramod J. Sadalage and Martin Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence",1st edition, Addison Wesley, 2013.
3. Tom White, "Hadoop: The Definitive Guide", 4th edition, O'Reilly, USA, 2015.
4. Wes McKinney, "Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython", O'Reilly Media, 2017.

21IT402	SOFTWARE PROJECT MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify project planning and evaluation techniques for managing software projects.
- To illustrate how to manage projects at each stage of the Software Development Life Cycle.
- To experiment with activity planning and risk management principles for managing software projects.
- To plan the development of software projects and control software deliverables.
- To explain the staffing pattern in software projects.

UNIT-I	PROJECT EVALUATION AND PROJECT PLANNING	9

Importance of Software Project Management – Activities Methodologies – Categorization of Software Projects– Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

UNIT-II	PROJECT LIFE CYCLE AND EFFORT ESTIMATION	9

Software process and Process Models – Choice of Process models – mental delivery– Rapid Application development – Agile methods – Extreme Programming – SCRUM – Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points – COCOMO II A Parametric Productivity Model – Staffing Pattern.

UNIT-III	ACTIVITY PLANNING AND RISK MANAGEMENT	9

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Monitoring – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical patterns – Cost schedules.

UNIT-IV	PROJECT MANAGEMENT AND CONTROL	9

Framework for Management and control – Collection of data Project termination – Visualizing progress – Cost monitoring – Earned Value Analysis- Project tracking – Change control- Software Configuration Management – Managing contracts – Contract Management.

UNIT-V	STAFFING IN SOFTWARE PROJECTS	9

Managing people – Organizational behavior – Best methods of staff selection – Motivation – The Oldham- Hackman job characteristic model – Ethical and Programmed concerns – Working in teams – Decision making – Team structures – Virtual teams – Communications genres – Communication plans.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Plan for project evaluation using basic principles.

CO2: Summarize about project life cycle and effort estimation. CO3: Build activity diagram to determine project duration. CO4: Construct various reporting structure for monitoring the progress of project. CO5: Explain the staffing pattern in software projects.
TEXT BOOKS: 1. Bob Hughes, Mike Cotterell and Rajib Mall, "Software Project Management", 6th edition, Tata McGraw Hill, 2005. 2. Gopalaswamy Ramesh, "Managing Global Software Projects", 1st edition, Tata McGraw Hill Education, 2017. 3. Dimitre Dimitrov, "Software Project Estimation", 1st edition, Apress publications, 2020.
REFERENCES : 1. Walker Royce, "Software Project Management- A unified framework", 6th edition, Addision- Wesley, 2000. 2. Pankaj Jalote, "Software Project Management in Practice", 1st edition, Addision- Wesley, 2002. 3. Ashfaque Ahmed, "Software Project Management: A Process-Driven Approach", 1st edition, CRC press, 2012.

VERTICAL 1- DATA SCIENCE

21PCS01	DATA SCIENCE AND BIG DATA ANALYTICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To illustrate the data science process and mathematics required for data science.
- To demonstrate Python programming for data analytics.
- To develop knowledge on analytic tools.
- To experiment NoSQL database.
- To choose the techniques for big data analytics.

UNIT-I	INTRODUCTION TO DATA SCIENCE	6 +6

Data Science - Related Terminologies - Types of Analytics - Applications of Data Science - Data Science Process Model – Data Exploration - Mathematical preliminaries for Data Science: Probability – Statistics - Linear Algebra.

SUGGESTED ACTIVITIES:

- Case study-1: Outlier analysis on real-time data using probability and statistics.
- Case study-2: Application of linear algebra in dimensionality reduction, correlation analysis and regression analysis of real-world data.

UNIT-II	DATA ANALYTICS USING PYTHON	6 +6

Introduction to Python- Data types and basic operators – Environment setup and essentials – Python libraries: NUMPY for mathematical essentials –Data manipulation using PANDAS – Data visualization by MATPLOTLIB.

SUGGESTED ACTIVITIES:

- Data pre-processing using PYTHON.
- Visualizing statistical analysis using PYTHON.

UNIT-III	DATA ANALYTICS – TECHNOLOGY AND TOOL	6 +6

Map Reduce and Hadoop - Hadoop Framework, Understanding Map Reduce functions Analytics of Unstructured Data, Hadoop Eco System: PIG, HIVE, HBASE.

SUGGESTED ACTIVITIES:

- K-means clustering using Map Reduce.
- Setting up single node cluster in Hadoop to run word count application.

UNIT-IV	NOSQL DATA MANAGEMENT FOR BIG DATA	6+6

Introduction to NoSQL –RDBMS vsMongoDB - MongoDB: Introduction - Data types - MongoDB Query Language: Creating - Updating and deleing documents – Querying.

SUGGESTED ACTIVITIES:

- Creating and manipulating NOSQL database using MongoDB.

UNIT-V	TECHNIQUES FOR ANALYTICS	6+6

Defining big data analytics -Visual data analysis - Analytics techniques for decision making: Descriptive - Diagnostics - Predictive - Prescriptive–Case studies: Sentiment analysis - Health

Care – Finance.

SUGGESTED ACTIVITIES:

- Prescriptive analysis on health care data using PYTHON.
- Predictive analysis on finance using PYTHON.

TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Utilize probability, statistics and linear algebra for data science process and data exploration.

CO2: Make use of PYTHON for statistical data analytics on real world data applications.

CO3: Utilize Hadoop and Map Reduce technologies for huge data storage and management.

CO4: Experiment the NoSQL database usingMongoDB.

CO5: Examine the variants of data analytic techniques to analyze the data of various domains.

TEXT BOOKS:

1. B. Uma Maheswari, R. Sujatha, "Introduction to Data Science: Practical Approach with R and Python", 1st Edition, Wiley, 2021.
2. Wes McKinney, "Python for Data Analysis Data Wrangling with Pandas, NumPy, and IPython", 2nd Edition, O'Reilly Media, Inc, 2017.
3. Rafael A. Irizarry, "Introduction to Data Science Data Analysis and Prediction Algorithms with R", 1st Edition, Chapman & Hall, 2020.

REFERENCES:

1. Raj Kamal and PreetiSaxena, "Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning", 1st Edition, TMH, 2019.
2. Steven S. Skiena, "The Data Science Design Manual", Springer, 2017.
3. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", 1st Edition, Wiley Publishers, 2015.

21PCS02	EXPLORATORY DATA ANALYSIS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To describe the methods and characteristics of data.
- To identify the relationship and groups among data.
- To demonstrate the characteristics of the data through statistical analysis.
- To summarize the concepts of building models from data.
- To examine and analyze the real time data.

UNIT-I EXPLORING AND UNDERSTANDING DATA 6+6

Introduction: Sources of data – Process for making sense of data - Describing data: Variable types – Distribution of data – Hypothesis test – Preparing data tables: Cleaning the data – data type conversion – Combining variables – Unstructured data.

SUGGESTED ACTIVITIES: Hypothesis test, Cleaning the data

UNIT-II RELATIONSHIPS AND GROUPS AMONG DATA 6+6

Understanding relationship: Exploring relationships between variables – Visualizing relationships – Understanding groups: Clustering - Association Rules - Learning Decision Trees from Data.

SUGGESTED ACTIVITIES: Association Rules, Decision Trees

UNIT-III EXPLORING THE DATA VISUALY 6+6

Principles of Analytic Graphics: Show comparisons - Show multivariate data - Exploratory Graphs: Characteristics of exploratory graphs – Boxplot – Histogram – Barplot – Scatterplots - Plotting Systems: The Base Plotting System - The ggplot2 System.

SUGGESTED ACTIVITIES: Boxplot, Scatterplots

UNIT-IV BUILDING MODELS FROM DATA 6+6

Overview - Linear Regression - Logistic Regression - k-Nearest Neighbors - Classification and Regression Trees.

SUGGESTED ACTIVITIES: Linear Regression, Logistic Regression

UNIT-V CASE STUDIES 6+6

Data Analysis Case Study: Changes in Fine Particle Air Pollution – Credit card fraud detection – Trend analysis in stock market data.

SUGGESTED ACTIVITIES: Stock market data.

TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Make use of modern tools to explore the data and its characteristics.

CO2. Illustrate the relationship and groups among the data for decision Making.

CO3. Experiment with the statistics and group the nature of the data.

CO4. Develop the data models using regression and classification techniques for real world data.

CO6: CO5. Complete appropriate analysis technique for solving the data.

TEXT BOOKS:

1. Glenn J. Myatt, Wayne P. Johnson, "Making Sense of Data I: A Practical Guide to Exploratory

Data Analysis and Data Mining", 2nd Edition, Wiley, 2014.
2. Roger D. Peng, "Exploratory Data Analysis with R", 1st Edition, Leanpub, 2020.
3. Ronald K. Pearson,"Exploratory Data Analysis Using R", 1st Edition, CRC Press, 2018.

REFERENCES:

1. Brett Lantz, "Machine Learning with R", 2nd Edition, Packt Publishing, 2013.
2. Moro, P. Cortez and P. Rita. "A Data-Driven Approach to Predict the Success of Bank Telemarketing." Decision Support Systems, Elsevier, June 2014.
3. Steven S. Skiena, "The Data Science Design Manual", Springer, 2017.

21PCS03	NEURAL NETWORKS AND DEEP LEARNING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize the theoretical foundations, algorithms and methodologies of neural network
- To experiment with different activation functions working in neural network.
- To design building blocks of deep learning models.
- To construct architectures and to train deep neural network.
- To utilize the practical knowledge in handling and analyzing real world applications

UNIT-I	INTRODUCTION TO NEURAL NETWORKS	6 +6

Neural Networks: The Biological Neuron- The Perceptron - Multilayer Feed-Forward Networks. Training Neural Networks: Back propagation Learning.

SUGGESTED ACTIVITIES:

- Implement XOR problem using Multilayer perceptron.

UNIT-II	ACTIVATION FUNCTIONS AND PARAMETERS	6 +6

Activation functions, Loss Functions: Notation - Loss function for Reconstruction - Parameters Vs Hyper parameters

SUGGESTED ACTIVITIES:

- Estimate depth and width of Neural Networks

UNIT-III	INTRODUCTION TO DEEP NETWORKS	6 +6

Defining Deep Learning - Common Architectural Principles of Deep Networks - Building Blocks of Deep Networks

SUGGESTED ACTIVITIES:

- Build CNN model for Handwritten Digit Recognition

UNIT-IV	ARCHITECTURES OF DEEP NETWORKS	6 +6

Introduction to Convolutional Neural Networks (CNNs) - Recurrent Neural Networks - Recursive Neural Networks.

SUGGESTED ACTIVITIES:

- Develop a code to design object detection and classification using CNN

UNIT-V	APPLICATIONS	6 +6

Large-Scale Deep Learning. Computer Vision- Speech Recognition- Natural Language Processing-Other Applications

SUGGESTED ACTIVITIES:

- Predict Sentiment for Movie Reviews Using Deep Learning

TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1.Utilize different methodologies to create application using neural network
CO2. Make use of activation function and parameters to train the neural network
CO3. Experiment with working knowledge of deep learning models for solving problem
CO4. Identify appropriate deep learning models for analyzing the data for a variety of problems.
CO5. Build deep learning models for solving real world problems.

TEXT BOOKS:

1. Josh Patterson, Adam Gibson "Deep Learning: A Practitioner's Approach",1st Edition O'Reilly Media, 2017
2. Ian Good fellow, Yoshua Bengio, Aaron Courville. Deep Learning, 1st Edition, The MIT press, 2017
3. Bengio, Yoshua. "Learning deep architectures for AI. Foundations and trends in Machine Learning2.1", 1st Edition, Now Publishers, 2009

REFERENCES:

1. Nikhil Buduma and Nicholas Lacascio, "Fundamentals of Deep Learning", 1st Edition, O.Reilly, 2017.
2. Pradeep Pujari, Md. And Rezaul Karim, Mohit Sewak, "Practical Convolutional Neural Networks", 1st Edition, Packt Publishing, 2018.
3. Ragav Venkatesan and Baoxin Li, "Convolutional Neural Networks in Visual Computing (Data Enabled Engineering)", 1st Edition, CRC Press, 2017.

21PCS04	INFORMATION RECOMMENDER SYSTEMS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To identify the basic concepts of recommender systems.
- To describe different techniques of recommendation techniques.
- To discuss the performance evaluation of recommender systems based on various metrics.
- To indicate the advanced topics and current applications of recommender systems.
- To infer a simple recommender system using R.

UNIT-I	INTRODUCTION TO RECOMMENDER SYSTEMS	6 +6

Introduction to Recommender system -Recommender System Function-Recommendation Techniques-Applications and Evaluation of recommendation systems-Issues with recommender system-Data Mining methods for Recommender System

SUGGESTED ACTIVITIES:

- Construct the Similarity matrix for given application using R.

UNIT-II	COLLABORATIVEFILTERING	6 +6

User-based nearest neighbor Recommendation-Item-based nearest neighbor recommendation-Model based and pre-processing based approaches-Advances in Collaborative Filtering: Matrix Factorization model.

SUGGESTED ACTIVITIES:

- Develop the model applicable for given application using R.

UNIT-III	CONTENT-BASEDRECOMMENDATION	6 +6

High level architecture of content-based systems-Advantages and drawbacks of content based filtering-State of art continent based system: Item Representation, Methods for user profiles-The role of user generated content in the recommendation.

SUGGESTED ACTIVITIES:

- Identify the data ratings based on the customer feedback.

UNIT-IV	KNOWLEDGE BASED RECOMMENDATION	6+6

Introduction-Knowledge representation and reasoning-Interacting with constraint-based recommenders- Interacting with case-based recommenders-Developing constraint based recommenders.

SUGGESTED ACTIVITIES:

- Choose the appropriate data set based on the similarity to evolve recommender models.

UNIT-V	HYBRID APPROACHES AND EVALUATION	6+6

Opportunities for hybridization-Monolithic hybridization design-Parallelized hybridization design –Pipelined hybridization design-Evaluation of Recommender System: Experimental Settings, Recommnedation System Properties-Recent Developments: Attackes on Collaborative recommender System

SUGGESTED ACTIVITIES:

- Develop the recommender system using ITEM based collaborating filtering.

TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Relate the basic knowledge of recommender systems for real world problems.

CO2: Prepare the concepts of collaborative filtering for measuring the similarity.

CO3: Make use of content based and knowledge based techniques for solving real world applications.

CO4: Choose hybrid approaches for current applications to generate precise recommendations.

CO5: Develop a simple recommender system using R programming.

TEXT BOOKS:

1. Francesco Ricci · LiorRokach · BrachaShapira · Paul B. Kantor,"Recommender Systems Handbook",3rdEdition,Springer,2022
2. JannachD., ZankerM.andFelFering A., "Recommender Systems: An Introduction", 1stEdition, Cambridge University Press,2011.
3. C.C. Aggarwal, Recommender Systems: The Textbook", Springer Edition, 2016.

REFERENCES:

1. Suresh K. Gorakala, MicheleUsuelli,"Building a Recommendation System with R", 1st Edition, Packt Publishing, 2015.
2. J. Leskovec, A. Rajaraman and J. Ullman, "Mining of massive datasets", 2ndEdition. Cambridge, 2012.
3. Manouselis N., Drachsler H., Verbert K., Duval E., "Recommender Systems for Learning", 1st Edition, Springer, 2013.

21PCS05	COMPUTER VISION ALGORITHMS AND APPLICATIONS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To learn the image processing foundations for computer vision.
- To acquire knowledge of edge detection techniques.
- To gain knowledge in digital morphology.
- To demonstrate three-dimensional motion and object recognition techniques.
- To detect and recognize the face and human gait analysis.

UNIT-I | IMAGEPROCESSING FOUNDATIONS | 6+6

Introduction- Elements of visual perception- Histogram Processing-Spatial Filters-Image Restoration and Reconstruction

SUGGESTED ACTIVITIES:

- Develop application to display grayscale image using read and write operation.

UNIT-II | EDGE-DETECTION TECHNIQUES | 6+6

Edge Detection - Models of Edges- Noise- Template-Based Edge Detection- The Canny Edge Detector- The Shen-Castan (ISEF) Edge Detector- Color Edges.

SUGGESTED ACTIVITIES:

- Create application for Non Linear Filtering technique using edge detection.

UNIT-III | DIGITAL MORPHOLOGY | 6+6

Morph Grey-Level Morphology-Elements of Digital Morphology: Binary Operations, Binary Dilation, Binary Erosion, MAX, Color Morphology.

SUGGESTED ACTIVITIES:

- Create avision program to implement the binary operations.

UNIT-IV | 3D VISION AND MOTION | 6+6

Methodsfor3Dvision–projectionschemes–shapefromshading–photometricstereo–shapefromtexture – shape from focus-3D object recognition

SUGGESTED ACTIVITIES:

- Develop a program to determine the 3D shape from texture and 3D object detection.

UNIT-V | APPLICATIONS | 6+6

Application: Photoalbum–Facedetection–Facerecognition–Eigenfaces–Activeappearanceand3D shape-human gait analysis.

SUGGESTED ACTIVITIES:

- Create an application to face detection and human gait actions.

TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Demonstrate the image processing foundations for computer vision.

CO2: Make use of edge detection techniques for image segmentation and data extraction.
CO3: Classify the elements of digital morphology techniques.
CO4: Make use of 3D vision, motion for object recognition techniques.
CO5: Develop applications to recognize the face and human gait analysis.

TEXT BOOKS:

1. Rafael C.Gonzalez, Richard E.Woods," Digital Image Processing", 3rd Edition, Pearson, 2018.
2. J.R.Parker,"Algorithms for Image Processing and Computer Vision", 2nd Edition,Wiley, 2019.
3. Richard Szeliski,"ComputerVision: Algorithmsand Applications", 2nd Edition, Springer 2022.

REFERENCES:

1. Jan Erik Solem,"Programming Computer Vision with Python: Tools and algorithms for analyzing images", 2nd Edition, O'Reilly Media, 2019.
2. Mark Nixon and Alberto S. Aquado,"Feature Extraction & Image Processing for Computer Vision", 3rd Edition, Academic Press, 2018.
3. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", 2nd Edition, Cambridge University Press, 2018.

21PCS06	IMAGE AND VIDEO ANALYTICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To describe the basic steps image processing system.
- To demonstrate the feature extraction techniques.
- To impart knowledge on image retrieval and object recognition.
- To get exposed to video enhancement and noise reduction.
- To explore and demonstrate video analysis action recognition.

UNIT-I IMAGE PROCESSING 6+6

Basic steps of Image processing system–Pixel relationship-Image Transforms-Image Enhancement- Image Segmentation.

SUGGESTED ACTIVITIES:

- Create a program for implement the Contrast-limited adaptive histogram equalization on medical images.

UNIT-II FEATURE EXTRACTION 6+6

Feature Extraction- Binary object feature, Histogram-based (Statistical) Features, Intensity features, Shape feature extraction.

SUGGESTED ACTIVITIES:

- Create application for geometric and radiometric distortions of binary images.

UNIT-III OBJECT RECOGNITION AND IMAGERETRIEVAL 6+6

Object Recognition-Patterns and pattern class, Bayes' Parametric classification, Feature Selection and image retrieval.

SUGGESTED ACTIVITIES:

- Create a vision program to determine the edge detection of an image using different operators.

UNIT-IV DIGITAL VIDEO PROCESSING 6+6

Digital Video, Sampling of video signal, Video Enhancement and Noise Reduction- Change Detection.

SUGGESTED ACTIVITIES:

- Develop an application for video enhancement and noise reduction.

UNIT-V VIDEO ANALYSISACTION RECOGNITION 6+6

Video Analysis Action Recognition, Video based rendering, Context and scene understanding. Case Study: Surveillance.

SUGGESTED ACTIVITIES:

- Create a program for video action recognition in surveillance systems.

TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Demonstrate the steps involved image processing system.

CO2: Classify the feature extraction for real time applications.

CO3: Make use of the image retrieval and object recognition.

CO4: Demonstrate the video enhancement and noise reduction.

CO5: Develop applications in video analysis action recognition.

TEXTBOOKS:

1. RafaelC.GonzalezandRichard E. Woods, "Digital Image Processing", 4th Edition., Prentice-Hall,2018.
2. Murat Tekalp, "Digital Video Processing", 2nd Edition, Prentice Hall, 2015.
3. Debjyoti Paul, Charan Puvvala,"Video Analytics Using Deep Learning",1st Edition, APress, 2020.

REFERENCES:

1. OgeMarques,"PracticalImageandVideoProcessingUsingMATLAB",2nd EditionWiley-IEEE Press,2019
2. Francesco Camastra and Alessandro Vinciarelli,"Machine Learning for Audio, Image and Video Analysis",1st Edition, Springer, 2018.
3. Mark Nixon and Alberto S.Aquado, "Feature Extraction & Image Processing for Computer Vision", 3rd Edition, Academic Press, 2019.

21PCS07	TEXT AND SPEECH ANALYSIS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To describe the basic need of Online Data Analysis.
- To indicate the text processing models involved in Text Mining.
- To build Text classification using supervised learning algorithms.
- To explain filters and transform methods in Speech Processing.
- To summarize various classification methods in Speech recognition.

UNIT-I | INTRODUCTION | 6+6

Introduction –Approaches to Text Analysis – Analysis of Text as Social Information – Online Data sources –NGram viewer- Challenges and limitations of Online data Digital sources.

SUGGESTED ACTIVITIES:

- Implement Ngram viewer using Python.
- Text Preprocessing Using Python.

UNIT-II | TEXT PREPROCESSING | 6+6

Lexical Resources – WordNet, Roget Thesaurus, Wikipedia –Basic Text Processing – Tokenization , Stop word Removal , Stemming and Lemmatization –Language Models –Text statistics – Advanced Text processing – Part of speech Tagging, Collocation identification.

SUGGESTED ACTIVITIES:

- Perform Text analysis using Voyant tool.

UNIT-III | TEXT CLASSIFICATION | 6+6

Supervised Learning Algorithms – Regression , Decision Trees, Support vector Machines – Text Analysis Methods – Approaches, Plan and Qualitative Narrative Analysis – Sentimental Analysis

SUGGESTED ACTIVITIES:

- Sentiment analysis using Stanford's sentiment analysis.

UNIT-IV | SPEECH PROCESSING | 6+6

Introduction – dimensions of Automatic Speech recognition – Digital signal processing –Digital filters - Discrete Fourier Transforms – Fast Fourier Transforms methods – relation between DFT and Digital filters

SUGGESTED ACTIVITIES:

- Speech processing using MatLab.

UNIT-V | SPEECH ANALYSIS | 6+6

Feature Extraction – Pattern classification Methods – Minimum Distance Classifiers, Discriminant Functions, Generalized discriminators – Minimum Error classification –Bayes Classifier – Iterative Training : The EM Algorithm

SUGGESTED ACTIVITIES:

- Explore the Tool PRRAT for speech analysis.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of Ngram viewer as a tool for text analysis.

CO2: Choose the available tools for text preprocessing.

CO3: Utilize Supervised classification algorithms to perform text classification.

CO4: Experiment with filter and Transformation methods for speech processing.

CO5: Select the appropriate Classification methods for pattern analysis.

TEXT BOOKS:

1. Gabe Ignatow and Radamihalcea, "An Introduction to Text mining, Research Design, Data Collection and Analysis",1st Edition, SAGE Publications, 2018.
2. Brandon walsh, Sarah Horowitz, A course book on "Introduction to Text Analysis", License under Creative Commons Attribution-Non Commercial-ShareAlike 4.0, 1st Edition, International License. 2018.
3. Ben Gold, Nelson Morgan, Dan Ellis, "Speech and Audio Signal Processing", 2nd Edition, Willey Publications, 2011.

REFERENCES:

1. Cheng Xiang Zhai, Sean Massung, "Text Data Management and Analysis: A Practical Introduction toInformation Retrieval and Text Mining", 1stEdition, Morgan & Claypool Publishers, 2016.
2. Emil Hvitfeldt, Julia Silge, "Supervised Machine Learning for Text Analysis in R", 1stEdition , Chapmanand Hall/CRC, 2021
3. Himanshu Mohan, MeghaYadav , "Speech Recognition System and its Application", 3rd Edition, LAPLAMBERT Academic Publishing.2019.

21PCS08	ESSENTIALS OF BUSINESS ANALYTICS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To discuss the concepts and methods of business analytics.
- To summarize the knowledge of organizational structures of business analytics.
- To infer the knowledge of descriptive analytics in business analytics.
- To identify the concept of predictive and prescriptive analytics in real world problems.
- To demonstrate the business analytics concepts in recent trends.

UNIT-I	INTRODUCTION TO BUSINESS ANALYTICS	6 +6

Business analytics-Terminology-Business Analytics Process-Relationship of Business Analytics Process and organization Decision making Process-Business Analytics Data-Business Analytics Technology

SUGGESTED ACTIVITIES:

Make use of analytics tool for health care analytics.(Case Study).

UNIT-II	ORGANIZATION STRUCTURES OF BUSINESS ANALYTICS	6 +6

Organization Structures of Business analytics-Team management-Management Issues: Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes.

SUGGESTED ACTIVITIES:

Select the measures to determine the data set for health care analytics.

UNIT-III	DESCRIPTIVE ANALYTICS	6 +6

Introduction, Visualizing and Exploring Data, Descriptive Statics, Sampling and Estimation, Introduction to probability Distributions.

SUGGESTED ACTIVITIES:

Develop the model using descriptive analytics for healthcare analytics.

UNIT-IV	PREDICTIVE ANALYTICS	6+6

Introduction to Predictive Modelling, Logic Driven Models, Data Driven Models, Data Mining: Simple illustration of Data Mining, Data Mining methodologies

SUGGESTED ACTIVITIES:

Develop and test predictive model for health care analytics.

UNIT-V	PRESCRIPTIVE ANALYTICS	6+6

Introduction to prescriptive modeling, Linear Optimization, Integer and Non Linear Optimizations, Optimization Analytics

SUGGESTED ACTIVITIES:

Develop the prescriptive model for health care applications.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Discover the knowledge of business analytics to solve the business problems.

CO2: Choose the organizational structures for small business.

CO3: Make use of technical skills in descriptive analytics for real world problems.

CO4: Demonstrate the concept of predictive analytics and prescriptive analytics to establish best decision for the small business.

CO5: Develop data-driven solutions to support decision-making in real-world business situations.

TEXT BOOKS:

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M., "Starkey Business Analytics Principles, Concepts, and Applications with SAS: What, Why, and How", 1st Edition, Pearson Education, 2014.
2. James Evans," Analytics, Global Edition", 1st Edition, Pearsons Education, 2020.
3. Jay Liebowitz ,"Business Analytics, An introduction", 1st Edition, Auerbach Publications, 2013.

REFERENCES:

1. Randy Bartlett,"A Practitioner's Guide to Business Analytics: Using Data Analysis Tools to Improve Your Organization's Decision Making and Strategy", 1st Edition, McGraw Hill Professional, 2013.
2. Larissa T. Moss and Shaku Atr,"Business Intelligence Roadmap: The Complete Project Lifecycle for Decision-Support Applications", 1st Edition, Addition Wesley Technology Series, 2013.
3. S. Albright, Wayne Winston," Business Analytics: Data Analysis & Decision Making", 6th edition, Cengage Learning, 2014.

VERTICAL 2-FULL STACK DEVELOPMENT

21PCS09	PRINCIPLES OF PROGRAMMING LANGUAGES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the various ways to describe syntax and semantics of programming languages
- To interpret data, data types, and basic statements of programming languages
- To demonstrate the parameter passing and function call mechanisms
- To illustrate the object-orientation, concurrency, and event handling in programming languages
- To summarize knowledge about functional and logic programming paradigms

UNIT-I	SYNTAX, SEMANTICS AND BASIC STATEMENTS	6 +6

Describing syntax & semantics: Introduction – The General Problem of Describing Syntax – Formal Methods of Describing Syntax – lexical analysis – The Parsing Problem – Recursive-decent parsing – Bottom-up parsing – Data Types: User-Defined Ordinal Types – Array Types – Record Types - Statement-level Control structures.

SUGGESTED ACTIVITIES: Determine type compatibility rules of a C compiler, Determine the scope of variables having the same name and different names declared within a while / for loop.

UNIT-II	SUBPROGRAMS	6 +6

Subprograms – Design Issues – Local referencing – Overloaded subprograms – Generic Subprograms – Design Issues for function.

SUGGESTED ACTIVITIES: Devise a subprogram and calling code in which pass-by-reference and pass-by-value-result of one or more parameters produces different results.

UNIT-III	IMPLEMENTING SUBPROGRAMS	6 +6

The general semantics of calls and returns – Implementing subprograms with Stack-Dynamic Local Variables – Nested Subprograms – Blocks – Implementing Dynamic Scoping.

SUGGESTED ACTIVITIES: Chess / checkers game using object oriented programming – C++/Smalltalk / Python / Java, Design a Tic-tac-toe game that uses even driven programming concepts.

UNIT-IV	FUNCTIONAL PROGRAMMING	6+6

Introduction – Mathematical Functions - Fundamentals of Functional programming languages – Introduction to LISP – An Introduction to Scheme – Common LISP – F# - Error handling.

SUGGESTED ACTIVITIES: Lisp recursive function to return 'nth' item from a list, diagonal of a matrix, sum of the diagonal of matrix & a sub-string from a string.

UNIT-V	LOGIC PROGRAMMING	6+6

Introduction – Logic Programming concept – Prolog – Theoretical Foundation: Clausal Form, Limitations, Skolemization - Logic Programming in Perspective.

SUGGESTED ACTIVITIES: Prolog program to find the factorial of a number, simplification of arithmetic expression involving additive, multiplicative identity & solve Sudoku puzzle.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate data types, functions, syntax and semantics of all programming languages

CO2: Classify the design of subprograms

CO3: Develop a dynamic subprograms

CO4: Examine the concepts of Functional Programming LISP and F#

CO5: Inspect Prolog Programming to solve logical problems

TEXT BOOKS:

1. Robert W. Sebesta, "Concepts of Programming Languages", 10th Edition, Addison Wesley, 2012.
2. Michael L. Scott, "Programming Language Pragmatics", 3rd Edition, Morgan Kaufmann, 2009.
3. Allen B Tucker, and Robert E Noonan, "Programming Languages – Principles and Paradigms", 2nd Edition, Tata McGraw Hill, 2007.

REFERENCES:

1. Richard A. O'Keefe, "The Craft of Prolog", 1st Edition, MIT Press, 2009.
2. R. Kent Dybvig, "The Scheme Programming Language", 4th Edition, MIT Press, 2009.
3. W. F. Clocksin, C. S. Mellish, "Programming in Prolog: Using the ISO Standard", 5th Edition, Springer, 2003.

21PCS10	WEB TECHNOLOGY AND DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To applyHTML5 elements to create webpages.
- To build interactive webpages at client side using CSS3.
- To utilize java script for event handling and form validation.
- To construct dynamic web applications using PHP.
- To develop web application using AJAX and XML.

UNIT-I HTML5 6 +6

HTML5: Heading, Linking, Images, Lists, Tables, internal linking- Form

SUGGESTED ACTIVITIES:

- Create Websites using HTML 5 tags
- Use Image maps in webpages

UNIT-II CSS3 6 +6

Inline Style sheet- Embedded Style Sheet- External Style Sheet- Positioning Elements: Absolute Positioning, z-index, Relative Positioning, span, Backgrounds, Box Model, Text Flow- Text Shadows, Box Shadows, Animations, Transitions and Transformations.

SUGGESTED ACTIVITIES:

- Design Websites using stylesheets
- Create an attractive webpage for any product using Animations, transition and transformation

UNIT-III JAVA SCRIPT 6 +6

Prompt Dialogs – Control Statements – Functions- Arrays – Objects- DOM – Event Handling

SUGGESTED ACTIVITIES:

- Form validation using JavaScript
- Use Event handling and DOM to change content of any tags

UNIT-IV PHP 6+6

PHP: Converting between data types, Arithmetic Operators, Arrays, Strings, Regular Expressions, Form Processing, Reading From Databases, Cookies

SUGGESTED ACTIVITIES:

- Validate the form using PHP regular expression.
- Create a web application that uses PHP and MySQL

UNIT-V XML and AJAX 6+6

XML Basics – Structuring Data – XML Namespaces – DTD – XSLT transformation – Creating AJAX Applications using XML Http Request Object and JSON

SUGGESTED ACTIVITIES:

- Creating AJAX application using PHP a

- Transforming XML using XSL and XSLT

TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Construct Web pages using HTML5.

CO2: Make use of CSS3 to create interactive webpages.

CO3: Build dynamic web pages with validation using Java Script objects.

CO4: Make use of PHP programming to develop web applications.

CO5: Construct web applications using XML and AJAX.

TEXT BOOKS:

1. Deitel and Deitel and Nieto, "Internet and World Wide Web - How to Program", 5th Edition, Prentice Hall, 2011.
2. Jeffrey C and Jackson, "Web Technologies A Computer Science Perspective", 2ndEdition, Pearson Education, 2011.
3. Gopalan N.P. and Akilandeswari J., "Web Technology, Prentice Hall of India", 2nd Edition, 2011.

REFERENCES:

1. Stephen Wynkoop and John Burke," Running a Perfect Website", 2nd Edition, QUE, 1999.
2. Chris Bates, "Web Programming – Building Intranet Applications", 3rd Edition, Wiley Publications, 2009.
3. UttamK.Roy, "Web Technologies,"2nd Edition, Oxford University Press, 2011.

21PCS11	CLOUD SERVICES MANAGEMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To enumerate the basic concepts of Cloud services.
- To demonstrate the IaaS with Amazon VPC.
- To illustrate the knowledge of PaaS and SaaS with Google App Engine.
- To summarize the concepts of Cloud security.
- To develop web services with AWS.

UNIT-I	CLOUD SERVICES - INTRODUCTION	6+6

Understanding Cloud computing – Developing Cloud services – Pros & cons of Cloud service Development, Types of Cloud services development – Cloud services development services and Tools – Cloud services for Everyone.

SUGGESTED ACTIVITIES:

- Explore online Calender Applications using cloud services.

UNIT-II	CLOUD SERVICE MODELS	6+6

Cloud Ecosystem – Cloud Design Objectives, Cost Model – Importance of Cloud Services-Infrastructure as a Service (Iaas) - Amazon VPC

SUGGESTED ACTIVITIES

- Use GAE launcher to launch the web applications.

UNIT-III	PLATFORM & SOFTWARE SERVICE MODELS	6+6

Platform as a Service (PaaS) – Types of PaaS – PaaS Products (Google Cloud, Microsoft Azure, AWS) – Software as a Service (SaaS) – SaaS Applications – Characteristics of SaaS- benefits of SaaS and its Applications – Saleforce , Zoom.

SUGGESTED ACTIVITIES

- Build a Serverless Web Application using Amazon Web services.

UNIT-IV	CLOUD SECURITY	6+6

Cloud security Risks – Privacy Impact Assesment – Operating system security – security of virtualization –Security risk posed by Shared images , Management OS

SUGGESTED ACTIVITIES

- Use Xoar to achieve cloud security.

UNIT-V	CLOUD APPLICATION DEVELOPMENT	6+6

Amazon Web services: EC2 instances –Connecting clients – security rules – launching EC2, S3 and SQL services - Cloud-Based Simulation of a Distributed Trust Algorithm - A Trust Management Service

SUGGESTED ACTIVITIES

- Use the AWS Management Console to launch an EC2 instance and connect to an AWS Account.

	TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build Web Applications using cloud.

CO2: Make use of IaaS Model in Cloud Ecosystem along with Amazon VPC.

CO3: Construct Paas, SaaS Models to meet the real-world challenges.

CO4: Utilize security Tools to avoid the security risk on the web services.

CO5: Develop applications using Amazon Web Services.

TEXT BOOKS:

1. Micheal Miller, "Cloud Computing, web based applications, That change the way you Work and Collaborate online", Que Publishers,1st Edition, Aug 2008
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things",1st Edition, Morgan Kaufmann Publishers, 2012
3. Dan C.Marinescu, "Cloud computing, Theory and Practice",1st Edition, Morgan Kaufmann, 2103.

REFERENCES:

1. Rajkumar Buyya, Christian Vacchiola and S Thamarai Selvi, "Mastering Cloud Computing",1st Edition,McGrawHill,2013.
2. Michael Miller, "Cloud Computing: Web based Applications that change the way you work and collaborate online", 1st Edition, Pearson Education, 2008.
3. John W Rittinghouse and James F Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, Hard cover Edition, 2020.

21PCS12	ANDROID APP DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize system requirements for android applications
- To model suitable design using android mobile development frameworks
- To utilize SQLite for mobile applications.
- To make use of Audio, Video, Bluetooth for mobile development.
- To choose Sensors and GPS for location-based services

UNIT-I — ANDROID BASICS — 6 +6

Creating Applications and Activities: Android Application manifest file, Externalizing resources ,Android application life cycle, Android Application class , Activity Life cycle, Activity class

SUGGESTED ACTIVITIES:

- Construct an application that draws basic graphical primitives on the screen
- Develop an application that uses Font and Colours

UNIT-II — ANDROID USER INTERFACE DESIGN — 6 +6

Building User Interfaces: Android user interface fundamentals, Layouts , Fragments , Android widgets – Views, Adapters -Intents and Broadcast Receivers

SUGGESTED ACTIVITIES:

- Develop an application that uses Layout Managers
- Develop an application that uses event listeners

UNIT-III — ANDROID DATA STORAGE — 6 +6

Databases and Content Providers – Introduction to SQLite, Content values and cursors, Working with SQLite Databases, Creating and using content providers, Adding search to the application. Expanding the User Experience: Action bars ,Menus , Dialogs , Toast , Notification

SUGGESTED ACTIVITIES:

- Develop an application that uses GUI components
- Develop an application that makes use of databases.

UNIT-IV — ANDROID NATIVE CAPABILITIES — 6+6

Audio, Video and Using the Camera: Playing Audio and Video, Using camera for taking pictures, Recording Video- Bluetooth, NFC, Networks and WIFI : Using Bluetooth, Managing Network and Internet Connectivity, Managing WiFi, Near Field Communication- Telephony and SMS.

SUGGESTED ACTIVITIES:

- Develop an application that plays Audio and Video
- Develop an application that sends SMS to a user

UNIT-V — SENSORS AND GPS — 6+6

Hardware Sensors – Maps, Geo Coding and Location based Services: Using Emulator for Location based services, selecting a location Provider, Finding Your Current Location, Using the Geocoder, creating Map based activities.

SUGGESTED ACTIVITIES:

- Develop a native application that uses GPS location information
- Develop an application that uses Google Maps

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Sketch the basics of Android applications.

CO2: Build user interface for mobile applications.

CO3: Make use of database to store mobile data of android applications.

CO4: Examine native capabilities of android applications.

CO5: Utilize Sensors and GPS for Android applications

TEXT BOOKS:

1. Reto Meier, "Professional Android 4 Development", 1st Edition, John Wiley and Sons, 2012.
2. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", 2nd Edition, Wrox, 2012.
3. Valentino Lee, Heather Schneider, and Robbie Schell, "Mobile Applications: Architecture, Design, and Development", 2nd Edition, Prentice Hall, 2004.

REFERENCES:

1. Brian Fling,"Mobile Design and Development",2nd Edition, O"Reilly Media,2009
2. Maximiliano Firtman , "Programming the Mobile Web ", 2nd Edition, O"Reilly Media, 2010.
3. Rajiv Ramnath, Roger Crawfis, and Paolo Sivilotti, "Android SDK3 for Dummies", 2ndEdition, Wiley 2011.

21PCS13	WEB APPLICATION SECURITY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize the common Web application Security vulnerabilities.
- To outline the capabilities of various browser proxies.
- To demonstrate the SQL Injection Vulnerabilities.
- To explain the principles of file security.
- To illustrate the security of a large scale web application.

UNIT-I INTRODUCTION **6 +6**

Introduction - The OWASP Top Ten List - Security Fundamentals: Input Validation, Attack Surface Reduction, Classifying and Prioritizing Threats – Authentication.

SUGGESTED ACTIVITIES: Installation of rootkits and examine the variety of options available, IP Address and Port Scanning, Service Identity Determination: Nmap - IP scanning in Windows

UNIT-II BROWSER SECURITY PRINCIPLES **6 +6**

Defining the Same-Origin Policy - Exceptions to the Same-Origin Policy - Cross-Site Scripting - Cross-Site Request Forgery – CSRF.

SUGGESTED ACTIVITIES: Perform reconnaissance to find all the relevant information on selected website, Exploit MS web server, attacking vulnerabilities.

UNIT-III DATABASE SECURITY PRINCIPLES **6 +6**

Database Security Principles - Structured Query Language (SQL) Injection - Setting Database Permission - Stored Procedure Security

SUGGESTED ACTIVITIES: Install and configure the virtual machines to perform SQL Injection attack

UNIT-IV FILE SECURITY PRINCIPLES **6+6**

File Security Principles: Keeping Your Source Code Secret - Security Through Obscurity - Forceful Browsing - Directory Traversal.

SUGGESTED ACTIVITIES: Experimenting with password-cracking utilities, attempting dictionary, hybrid, and brute-force attacks; Use any tool to find all the vulnerabilities with its level and generate a report for an organization

UNIT-V SECURE DEVELOPMENT AND DEPLOYMENT **6+6**

Secure Development Methodologies - Baking Security In - The Holistic Approach to Application Security - Industry Standard Secure Development Methodologies and Maturity Models: SDL - CLASP - SAMM - BSIMM

SUGGESTED ACTIVITIES: Exploit windows to gain access of victim's machine using a penetration testing framework, Perform a study on CLASP Application Security Process.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At end of the course, learners will be able to:

CO1: Make use of OWASP to understand the need of web application security.

CO2: Discover and prevent web security vulnerabilities.

CO3: Examine the various SQL Injections and the possible Vulnerabilities.

CO4: Develop the practices of applying the File Security Principles.

CO5: Identify and aid in fixing any security vulnerabilities during the web development process.

TEXT BOOKS:

1. Bryan and Vincent, "Web Application Security, A Beginners Guide", 1st Edition, McGraw-Hill, 2011.
2. Alfred Basta, Melissa Zgola, "Database Security", 1st Edition, Course Technology, 2012.
3. Michael Gertz and Sushil Jajodia, "Handbook of Database Security — Applications and Trends", Springer, 2008.

REFERENCES:

1. Bhavani Thuraisingham, "Database and Applications Security", 1st Edition, Auerbach Publications, 2005.
2. Dafydd Stuttard, and Marcus Pinto, "The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws", 2nd Edition, John Wiley & Sons; 2011.
3. W. F. Clocksin, C. S. Mellish, "Programming in Prolog: Using the ISO Standard", 5th Edition, Springer, 2003.

21PCS14	SOFTWARE TESTING AND AUTOMATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain the basics of testing process.
- To interpret the test cases criteria in simple applications.
- To illustrate the design of test cases.
- To summarize the test management and test automation techniques.
- To outline the needs for test metrics and measurements.

UNIT-I INTRODUCTION 6+6

Testing axioms, Basic definitions, Software Testing Principles, The Tester's Role in a Software Development Organization, Origins of Defects, Cost of defects, Defect Classes, The Defect Repository and Test Design

SUGGESTED ACTIVITIES:

- Examine the open source testing tool "Selenium"

UNIT-II TEST CASE DESIGN STRATEGIES 6+3

Test case Design Strategies, Using Black Box Approach to Test Case Design, Boundary Value Analysis, Equivalence Class Partitioning, Graph based testing-Cause-effect graphing, Using White Box Approach to Test design, Test Adequacy Criteria, Code Coverage Testing

SUGGESTED ACTIVITIES:

- Develop C program for the programming constructs such as if, for, switch, while, do while, if-else, and build the possible test cases.

UNIT-III LEVELS OF TESTING 6+12

The need for Levels of Testing, Unit Testing, Integration Testing, API testing, System Testing, Acceptance Testing, Regression Testing, Alpha Testing, Beta Testing, Adhoc Testing

SUGGESTED ACTIVITIES:

- Select any two functionalities in GMAIL and develop the test cases with sample and expected output.
- Plan the test cases for simple calculator in windows application.
- Build a simple website for a user registration and login. Perform all possible levels of testing in the website and validate the results.

UNIT-IV TEST MANAGEMENT 6+3

People and organizational issues in testing, Organization structures for testing teams, Test Planning, Test Plan Components, Test Plan Attachments, Introducing the test specialist, Skills needed by a test specialist

SUGGESTED ACTIVITIES:

- Develop a test plan document for Library Management System.

UNIT-V TEST AUTOMATION 6+6

Need for Software test automation, Manual to Automated Testing, Tools needed for automation, Design and architecture for automation, Coverage in Test Automation, Types of Test Automation

SUGGESTED ACTIVITIES:

- Examine any one free test automation tool e.g. Katalon Studio.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Infer the basic concepts and terminologies of testing to test simple applications.

CO2: Develop test cases using design strategies by employing suitable techniques.

CO3: Utilize the various levels of testing to validate the systems.

CO4: Choose suitable organizational structures for managing the issues in testing.

CO5: Develop the skills needed for various automation testing techniques.

TEXT BOOKS:

1. Srinivasan Desikan and Gopalaswamy Ramesh, "Software Testing – Principles and Practices", 1st Edition, Pearson Education, 2017.
2. Dr. D. Chitra, A. Kaliappan, "Software Testing", 1st Edition, Technical Publications, 2019.
3. Arnon Axelrod, "Complete Guide to Test Automation: Techniques, Practices, and Patterns for Building and Maintaining Effective Software Projects", 1st Edition, Apress Publisher, 2018.

REFERENCES:

1. Paul C. Jorgensen, Byron DeVries, "Software Testing A Craftsman's Approach", 5th Edition, Auerbach Publications, 2021.
2. Ilene Burnstein, "Practical Software Testing", Springer International Edition, 2003.
3. Aditya P. Mathur, "Foundations of Software Testing - Fundamental Algorithms and Techniques", 1st Edition, Pearson Education, 2008.

21PCS15	INTRODUCTION TO DEV-OPS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize the basic concepts of DevOps.
- To construct the Pipeline for development of life cycle.
- To demonstrate and develop DevOps code.
- To make use of continuous integration and continuous deployment Pipeline.
- To build the applications using Docker and Kubernetes.

UNIT-I | DEVOPS: AN OVERVIEW | 6 + 6

DevOps: Origins, Roots: Addressing Dev versus Ops Practices: Continuous Integration, Continuous Delivery, Supporting Practices, Culture, Containerization Tools.

SUGGESTED ACTIVITIES:

- To study and install Version Control System / Source Code Management, install git and create a GitHub account.
- To implement various GIT operations on local and Remote repositories using GIT Cheat-Sheet

UNIT-II | ESTABLISHING DEVOPS | 6 + 6

Embracing the New Development Life Cycle: Inviting Everyone to the Table, Changing Processes, Shifting Ops "Left": Thinking about Infrastructure. Planning Ahead: Moving beyond the Agile Model, Forecasting Challenges, Gathering Requirements, Designing an MVP.

SUGGESTED ACTIVITIES:

- To build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server.

UNIT-III | DESIGNING AND DEVELOPING DEVOPS CODE | 6 + 6

Designing: Constructing Your Design, Designing for DevOps, Architecting Code for the Six Capabilities of DevOps, Documenting Design Decisions, Avoiding Architecture Pitfalls.

Developing Code

Engineering for Error, Writing Maintainable Code, Programming Patterns, Choosing a Language Avoiding Anti-Patterns, Dev Opsing Development, Establishing Good Practices.

SUGGESTED ACTIVITIES:

- To implement Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.

UNIT-IV | DEVOPS CI/CD PIPELINE | 6 + 6

Overviewing Git and its command lines, Understanding the Git process and Git Flow pattern. The CI/CD principles, Using a package manager Using Jenkins, Using Azure Pipelines.

SUGGESTED ACTIVITIES:

- To develop Software Configuration Management and provisioning using Puppet

Blocks(Manifest, Modules, Classes, Function)		
UNIT-V	**CONTAINERIZED APPLICATIONS WITH DOCKER AND KUBERNETES**	6 + 6
Installing Docker, Creating a Docker file, Building and running a container on a local machine, Pushing an image to Docker Hub, Deploying a container to ACI with a CI/CD pipeline. Installing Kubernetes, First example of Kubernetes application deployment, Using HELM as a package manager, Using AKS, Creating an AKS service. **SUGGESTED ACTIVITIES:** • To implement a LAMP/MEAN Stack using Puppet Manifest.		
		TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Utilize the basic concepts of DevOps.

CO2: Make use of the development life cycle using pipelining.

CO3: Develop the DevOps code by applying the basic concepts.

CO4: Model the continuous integration and continuous deployment Pipeline in GIT.

CO5: Construct the real time applications for given scenario using Docker and Kubernetes.

TEXT BOOKS:

1. Sanjeev Sharma," The DevOps Adoption Playbook", 1st Edition, Wiley Publication, 2017.
2. Emily Freeman,"DevOps for Dummies", 1st Edition, 2020.
3. Mikael Krief,"Learning DevOps" 1st Edition, Packt Publishing, 2019.

REFERENCES:

1. James Turnbull, Sid Orlando, "The Art of Monitoring", 1st Edition, 2016.
2. Jeff Geerling, "Ansible for DevOps: Server and configuration management for humans", 1st Edition, 2015.
3. David Johnson, "Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps", 2nd Edition, 2016.

21PCS16	PYTHON APPLICATION PROGRAMMING INTERFACE DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To show the prospects of application programming interface in web development.
- To build a Restful API service using the Flask-Restful package.
- To utilize Python APIs to build and access database.
- To construct an authentication and security services with JWT.
- To develop a function to send out mails using Mailgun API and upload image using Flask-Uploads.

UNIT-I INTRODUCTION TO API **6 +6**

Understanding API - Open API -The Flask Web Framework - Building a Simple Recipe Management Application - Using curl or httpie to Test All the Endpoints – Postman.

SUGGESTED ACTIVITIES:

- Build a Simple Recipe Management Application using FLASK

UNIT-II FLASK-RESTFUL **6 +6**

Flask-RESTful - Virtual Environment - Creating a Recipe Model - Configuring Endpoints - Making HTTP Requests to the Flask API using curl and httpie,

SUGGESTED ACTIVITIES:

- Build a basic web application using Flask Web Framework

UNIT-III DATABASE MANIPULATION WITH SQLALCHEMY **6 +6**

Databases – SQL – ORM - Defining Models - Password Hashing.

SUGGESTED ACTIVITIES:

- Build a Database using Flask-Migrate

UNIT-IV AUTHENTICATION SERVICES AND SECURITY WITH JWT **6+6**

JWT - Flask-JWT-Extended - Designing the Methods in the Recipe Model - Refresh Tokens - The User Logout Mechanism.

SUGGESTED ACTIVITIES:

- Develop a user login function using Flask-JWT Extended package.

UNIT-V MAILGUN API **6+6**

Mailgun API- Mailgun API to Send Out Emails - User Account Activation Workflow - HTML Format Email – Working with images.

SUGGESTED ACTIVITIES:

- Develop an Email activation function using Mailgun API.
- Develop an image uploading API using Flask-Uploads .

TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Demonstrate the concept of APIs to interface the web services with the backend. CO2: Build a Restful API service using the Flask-Restful package. CO3: Make use of Python APIs for database management. CO4: Develop a user login/logout function using JWT. CO5: Utilize Python APIs for sending mails and working with image.
TEXT BOOKS: 1. Jack Chan, Ray Chung, Jack Huang, "Python API Development Fundamentals", 1st Edition, Packt Publishing, 2019. 2. Kunal Relan, "Building REST APIs with Flask", 1st Edition, APress, 2019. 3. Gaston C. Hillar, "Hands-On RESTful Python Web Services", 2nd Edition, Packt Publishing, 2018.
REFERENCES: 1. Python Development Team, Guido Van Rossum, "Python 3.5 C API", 1st Edition, Samurai Media Limited, 2015. 2. Jose Haro Peralta, "Micro service APIs Using Python, Flask, FastAPI, OpenAPI and More", 1st Edition, Manning, 2022. 3. William S. Vincent, "Django for APIs: Build web APIs with Python and Django", 1st Edition, Welcome to Code publisher, 2022.

VERTICAL 3-DATA CENTRE TECHNOLOGIES

21PCS17	DATA WAREHOUSING CONCEPTS AND IMPLEMENTATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To identify the scope and components of Data Warehousing.
- To explain the issues in Data Warehousing.
- To solve the real time problems using Source integration tools..
- To develop various algorithms based for Multidimensional Data Models.
- To choose various Query Processing and Optimization techniques for Reporting.

UNIT-I | DATA WAREHOUSE - AN OVERVIEW | 6 +6

Data Warehouse Components- Designing the Data Warehouse- Building a Data warehouse - Getting Heterogeneous Data into the Warehouse -Getting Multidimensional Data out of the Warehouse-Physical Structure of Data Warehouses-Metadata Management-Data Warehouse Project Management.

SUGGESTED ACTIVITIES:

- Build a Data Warehouse/Data Mart (using open-source tools like Pentaho Data Integration tool)

UNIT-II | DATA WAREHOUSE - ISSUES AND PROJECTS | 6 +6

Data Extraction and Reconciliation-Data Aggregation and Customization-Query Optimization-Update Propagation- Modeling and Measuring Data Warehouse Quality- Interestingness of Patterns -Three Perspectives of Data Warehouse Metadata.

SUGGESTED ACTIVITIES:

- Explore visualization features of the tool for analysis like identifying trends etc.

UNIT-III | SOURCE INTEGRATION | 6 +6

Schema Integration - Data Integration - Virtual - Materialized - Architecture for Source Integration - data integration workflows -Methodology for Source Integration.

SUGGESTED ACTIVITIES:

- Design multi-dimensional data models namely Star, snowflake and Fact constellation schemas for any one enterprise (ex. Banking, Insurance, Finance, Healthcare, Manufacturing, Automobile, etc.).

UNIT-IV | MULTIDIMENSIONAL DATA MODELS AND AGGREGATION | 6+6

Multidimensional View of Information- ROLAP Data Model - MOLAP Data Model- Logical Models for Multidimensional Information-Conceptual Models for Multidimensional Information-Inference Problems for Multidimensional Conceptual Modeling, Multidimensional versus Multirelational OLAP.

SUGGESTED ACTIVITIES:

- Perform various OLAP operations such slice, dice, roll up, drill down and pivot.

UNIT-V	QUERY PROCESSING AND OPTIMIZATION	6+6

Queries at the Back End-Queries at the Front End- Queries in the Core-Transactional Versus Data Warehouse Queries -Canned Queries Versus Ad-hoc Queries-Multidimensional Queries - Reporting and Query tools and Applications -Extensions of SQL

SUGGESTED ACTIVITIES:

- Perform various Query Operations (Canned Queries, Ad-hoc Queries).

TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1:Identify the warehousing components and tools for organizing large database

CO2: Outline the issues for Modeling and measuring data warehousing Quality.

CO3: Classify various Source integration tools to solve the real time problems.

CO4: Determine the Multidimensional Data Models and Aggregation to analyze Multidimensional Information.

CO5: Develop Multidimensional Queries for process and Optimization.

TEXT BOOKS:

1. Matthias Jarke, Maurizio Lenzerini, Yannis Vassiliou and Panos Vassiliadis, "Fundamentals of Data Warehouse", 2nd Edition, Springer 2022.
2. Alex Petrov, "Database Internals: A Deep-Dive Into How Distributed Data Systems Work", 1st Edition, O'Reilly Media 2019.
3. Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", 10th Edition, Tata McGraw – Hill, 2016.

REFERENCES:

1. Ralph Kimball, Margy Ross," The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling", 3rd Edition, Wiley 2015.
2. Alan Beaulieu, "Learning SQL: Generate, Manipulate, and Retrieve Data", 1st Edition, O'Reilly Media 2020.
3. Dan Linstedt , Michael Olschimke, "Building a Scalable Data Warehouse with Data Vault 2.0", Elsevier Science & Technology ,2015.

21PCS18	DATA STORAGE TECHNOLOGIES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To enumerate the information and data storage concepts.
- To demonstrate the different approaches of data storage.
- To show the concepts of Data Storage Devices.
- To summarize the architecture of storage system.
- To choose the concept of Networked Attached Storage and Storage Area Networks.

UNIT-I	INTRODUCTION TO INFORMATION AND DATA STORAGE	6 +6

Information and Data, Data in business Environments, Data life cycle Management, Data Storage Models, Creating Structured Data, Data Base management systems, Challenges in Data Storage Management, Data Centre Environment.

SUGGESTED ACTIVITIES:

- Review and understand the components and Systems in a Data Centre Environment

UNIT-II	DATA STORAGE APPROACHES	6 +6

Types of Data Storage, File Based Storage, Block Level Data Storage, Object Based Data Storage, Working on stored data, Storage Performance Tuning.

SUGGESTED ACTIVITIES:

- Block Level Data Storage, Object Based Data Storage

UNIT-III	DATA STORAGE DEVICES	6 +6

Data Storage Units, Primary And Secondary Storages, Hard Disk Drives, Magnetic Tapes, Optical Storage Discs, Solid State Drives, Storage Arrays, Selecting Storage Devices, Improving Data Storage Efficiency.

SUGGESTED ACTIVITIES:

- Storage Devices

UNIT-IV	STORAGE SYSTEM ARCHITECTURE	6+6

Storage Architecture basics, storage logical components, Direct attached storage, Intelligent Storage systems, Storage consolidation, Tiered storage.

SUGGESTED ACTIVITIES:

- Explore the management interface and general task to be performed within an Intelligent Storage system

UNIT-V	NETWORKED STORAGE SYSTEMS	6+6

Review of Enterprise Networking Options, Towards Networked Storage, Networked Attached storage, Storage Area Networks, Choosing NAS or SAN, Multi-protocol Arrays, Implementing Storage Solutions.

SUGGESTED ACTIVITIES:

- Explore the management interface and general task to be performed within the fibre channel SAN
- Configure the interface and provision storage within an IP SAN

TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Discuss the challenges in data Storage Management for business Environment.

CO2: Select suitable data storage for an application.

CO3: Identify the efficiency for improving the data storage.

CO4: Develop the Storage system architecture for data storage.

CO5: Build the different network storage area systems for real time scenario.

TEXT BOOKS:

1. K. L.J ames, "Data Storage Technologies", 1st Edition, independently Published, 2019.
2. G. Somasundaram and Alok Shrivastava, "Information Storage and Management", EMC Education Series, 2 nd Edition, Wiley, Publishing Inc., 2012.
3. R.Marc Farley, —"Building Storage Networks", 1 st Edition, Tata McGraw Hill, Osborne, 2001.

REFERENCES:

1. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, "Introduction to Storage Area Networks", 9th Edition, IBM Corp, 2017.
2. Robert Spalding,"Storage Networks: The Complete Reference", 1stEdition, Tata McGraw Hill Osborne, 2003.
3. Meeta Gupta, "Storage Area Network Fundamentals", 1st Edition, Pearson Education Limited, 2002.

21PCS19	SOFTWARE DEFINED NETWORKS	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To illustrate the separation of data plane and control plane in software defined networks.
- To demonstrate the functions and components of the SDN architecture.
- To examine the role of SDN in data center networks.
- To develop programs to interface different applications with SDN.
- To utilize SDN controllers for improved network management and application performance.

UNIT-I	INTRODUCTION TO SDN	6 +6

History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Need for SDN: Evolution of switches and control planes, data center innovation and needs –SDN Working – Centralized and Distributed Control and Date Planes.

SUGGESTED ACTIVITIES:

- Installation of Mininet and Open Day Light controller

UNIT-II	OPEN FLOW & SDN CONTROLLERS	6 +6

Open Flow Specification: Openflow 1.0 and Open Flow Basics - Drawbacks of Open SDN - SDN via APIs, SDN via Hypervisor Based Overlays – SDN via Opening up the Device – SDN Controllers: General Concepts.

SUGGESTED ACTIVITIES:

- Configuring Open Flow switches and capture the data flow

UNIT-III	DATA CENTERS	6 +6

Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE.

SUGGESTED ACTIVITIES:

- Build and emulate network protocols using Mininet

UNIT-IV	SDN PROGRAMMING	6+6

Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV).

SUGGESTED ACTIVITIES:

- ONOS deployment and Northbound – Southbound Interfacing

UNIT-V	SDN APPLICATION AND USECASES	6+6

Juniper SDN Framework – IETF SDN Framework – Open Daylight Controller – Floodlight Controller – Bandwidth Calendaring – Data Center Orchestration

SUGGESTED ACTIVITIES:

- Setting up the Environment and Implementation of Open day light Controllers in Mininet

	TOTAL : 60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Distinguish between the features of Software Defined Network with traditional network

CO2: Outline the various components and functionalities of SDN

CO3: Examine the role of SDN in data centers

CO4: Make use of SDN Northbound APIs to communicate between the SDN Controller and the services

CO5: Experiment with the applications and use cases of SDN

TEXT BOOKS:

1. Paul Goransson and Chuck Black, "Software Defined Networks: A Comprehensive Approach", 2nd Edition, Morgan Kaufmann, 2017.
2. Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks", 1st Edition, O'Reilly Media, 2013.
3. Vivek Tiwari, "SDN and Open Flow for Beginners, Amazon Digital Services", 1st Edition, M.M.D.D. Multimedia LLC., 2013.

REFERENCES:

1. Siamak Azodolmolky, "Software Defined Networking with Open Flow", 1st Edition, Packet Publishing, 2013.
2. Fei Hu (Editor), "Network Innovation through Open Flow and SDN: Principles and Design", 1st Edition, CRC Press, 2014.
3. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud", 1st Edition, Addison-Wesley Professional, 2015.

21PCS20	CLOUD COMPUTING AND VIRTUALIZATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To understand the concept of cloud computing.
- To summarize the various issues in cloud computing.
- To express the emergence of cloud as next generation computing paradigm
- To describe the novel concepts of virtualization
- To understand Server, desktop and storage virtualization

UNIT-I INTRODUCTION TO CLOUD COMPUTING 6+6

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing - Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics

SUGGESSTED ACTIVITIES:

- Install virtual box/VM ware workstation
- Implementation of virtual machine using Ubuntu OS

UNIT-II CLOUD ARCHITECTURE, SERVICES AND STORAGE 6+6

NIST- Service Oriented Architecture – REST -Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers – S3

SUGGESSTED ACTIVITIES:

- Case study:-Azure Cloud, Open stack

UNIT-III CLOUD ENABLING TECHNOLOGIES 6+6

Web Services – Publish-Subscribe Model – Hadoop – MapReduce – Google App Engine- Federation of cloud

SUGGESSTED ACTIVITIES:

- Install Google App Engine
- Install Hadoop

UNIT-IV INTRODUCTION TO VIRTUALIZATION 6+6

Basics of Virtualization: Characteristics – Taxonomy of Virtualization Techniques – Hardware Level Virtualization – Operating System Level Virtualization

SUGGESSTED ACTIVITIES:

- Case study: Types of virtualization

UNIT-V SERVER ,DESKTOP AND STORAGE VIRTUALIZATION 6+6

Microsoft virtual server -Server virtualization platforms -Desktop Virtualization: Installing (PC, Windows, Linux)-Deploying and managing VMs-Storage Virtualization-overview-Appliances-services

SUGGESSTED ACTIVITIES:

- Microsoft virtual PC

	TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Complete in-depth and comprehensive knowledge of the Cloud Computing fundamentals.

CO2: Discover the architecture of cloud computing and storage in cloud.

CO3:Relate the cloud knowledge and enabling technologies that help in the development of cloud.

CO4: Illustrate the various types of virtualizations and its importance.

CO5: Demonstrate the server, desktop and storage virtualization concepts.

TEXT BOOKS:

1. Rajkumar Buyya, Christian Vecchiola and Thamari Selvi S, "Mastering in Cloud Computing", 1st Edition , Tata McGraw Hill Education Private Limited, 2017.
2. David Marshall and Wade A. Reynolds, "Advanced Server Virtualization: VM ware and Microsoft Platform in the Virtual Data Center", 1st Edition , Auerbach Publications , 2006.
3. Chris Wolf and Erick M. Halter, "Virtualization: From the Desktop to the Enterprise",1st Edition , A Press 2005.

REFERENCES:

1. Tom Clark, "Storage Virtualization: Technologies for Simplifying Data Storage and Management", 1st Edition, Pearson Education, 2018.
2. Jon Tate, Pall Beck, Hector Hugo Ibarra, Shanmuganathan Kumaravel and Libor Miklas, "Introduction to Vivek Tiwari, "SDN and Open Flow for Beginners", 1st Edition, Amazon Digital Services, Inc., 2017.
3. James E. Smith and Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 1 st Edition 2005.

21PCS21	INFORMATION STORAGE AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the components and functions of information storage systems.
- To demonstrate the functionalities of storage networking.
- To develop the storage for the given specification.
- To demonstrate the process of backup and replication.
- To identify the storage components and security mechanism for the storage networking models.

UNIT-I	STORAGE SYSTEM	9

Introduction - Evolution of storage architecture - Key Data center elements – Host, connectivity, storage, and application in both classic and virtual environments – RAID implementations – techniques - RAID levels - impact of RAID on application performance -Components of Intelligent Storage Systems - Provisioning and Intelligent Storage System

UNIT-II	STORAGE NETWORKING TECHNOLOGIES	9

Fibre Channel SAN - components - Connectivity options - topologies - Access protection mechanism – zoning - FC protocol stack – Addressing – SAN based virtualization – VSAN - IP SAN - iSCSI and FCIP protocols for Storage access over IP network - FCoE and its components - Network Attached Storage (NAS)– NAS Hardware devices– NAS Software Components – NAS Connectivity options - NAS operations – Applying the NAS Solution – File level virtualization in NAS – Integration of NAS and SAN - CAS –Object based storage - Unified Storage platform.

UNIT-III	BUSINESS CONTINUITY	9

Information availability and Business Continuity - Business Continuity terminologies - Business Continuity Planning Life cycle– Failure Analysis: Single Points of Failure, solution, - Clustering and Multi pathing software –Business Impact Analysis –Practice : EMC power path –Features, Dynamic Load balancing – Automatic power path Failover.

UNIT-IV	BACKUP AND RECOVERY	9

Backup purpose, Methods, targets and topologies - Data Deduplication: Method, implementation-backup in virtualized environment – Fixed Content and Data Archive and solution – Replication - Local Replication - Remote Replication (local host, storage array & Network based replication)- Three-Site Remote Replication - Continuous Data Protection

UNIT-V	SECURING AND MANAGING STORAGE	9

Information security framework – Storage Security Domains – Implementation in storage networks: FC-SAN, NAS, IP-SAN – securing Cloud Service Environments - Monitoring the storage infrastructure - Parameters, components – Storage infrastructure management activities - Information lifecycle management (ILM) and Storage Tiering.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Categorize the components and functions of information storage systems

CO2: Illustrate the functionalities of storage networking.

CO3: Demonstrate the process of business continuity for storage networking system

CO4: Show the process of backup and replication

CO5: Choose the storage components and security mechanism for the storage networking models

TEXT BOOKS:

1. John Wiley and Sons, "Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments", EMC Education Services, 2nd Edition, 2012.
2. Robert Spalding, "Storage Networks: The Complete Reference", McGraw Hill Education, 1st Edition, 2017.
3. Shanmuganathan Kumaravel, Libor Miklas Tata, Jon Tate, Pall Beck and Hector Hugo Ibarra," Introduction to Storage Area Networks", IBM Redbooks, 9th Edition, 2017.

REFERENCES:

1. Gerardus Blokdyk ,"Storage Virtualization A Complete Guide",5 STAR Cooks, 2019.
2. Thejendra B S, "Disaster Recovery and Business Continuity", IT Governance Publishing, 3rd Edition, 2016.
3. James O'Reilly, "Network Storage: Tools and Technologies for Storing Your Company's Data", Morgan Kaufmann, 2016.

21PCS22	STREAM PROCESSING FRAMEWORK	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To describe concepts and challenges of distributed stateful stream processing.
- To demonstrate Flink's system architecture, event-time processing mode and fault-tolerance model.
- To explain the fundamentals and building blocks of the DataStream API.
- To identify data from and write data to external systems with exactly-once consistency.
- To indicate the continuous running streaming applications.

UNIT-I	FUNDAMENTALS OF STATEFUL STREAM PROCESSING	6 + 6

Traditional Data Infrastructures-Stateful Stream Processing-The Evolution of Open Source Stream Processing-Introduction to Dataflow Programming-Processing Streams in Parallel-Time Semantics-State and Consistency Models

SUGGESTED ACTIVITIES:

- Install Oracle Virtual box and create two VMs on your laptop.
- Develop a Hello World application using Google App Engine.

UNIT-II	THE ARCHITECTURE OF APACHE FLINK	6 + 6

Introduction to Dataflow Programming-Processing Streams in Parallel-Time Semantics-The Architecture of Apache Flink-Event-Time Processing-State Management-Checkpoints-Save points, and State Recovery.

SUGGESTED ACTIVITIES:

- Use Azure Cloud Shell within the Azure portal to run the file creation simulator located on GitHub.

UNIT-III	THE DATASTREAM API (V1.7)	6 + 6

Set Up the Execution Environment-Transformations-Setting the Parallelism-Supported Data Types- Defining Keys and Referencing Fields-Implementing Functions-Including External and Flink Dependencies

SUGGESTED ACTIVITIES:

- Implementation of Para-Virtualization using VM Ware's Workstation/ Oracle's Virtual Box.

UNIT-IV	TIME-BASED AND WINDOW OPERATORS	6 + 6

Configuring Time Characteristics-Process Functions-Window Operators-Joining Streams on Time-Handling Late Data.

SUGGESTED ACTIVITIES:

- Create an application (Ex: Word Count) using Hadoop Map/Reduce.

UNIT-V	STATEFUL OPERATORS AND APPLICATIONS	6 + 6

Implementing Stateful Functions-Enabling Failure Recovery for Stateful Applications-Ensuring the Maintainability of Stateful Applications-Performance and Robustness of Stateful Applications-Evolving Stateful Applications-Queryable State.

SUGGESTED ACTIVITIES:

- Clone the Starter Project from GitHub and Perform a Test Run.
- Implementation of Single-Sing-On.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the concepts of distributed stateful stream processing.

CO2: Demonstrate the architecture of Apache Flink for event-time processing mode and fault-tolerance model.

CO3: Build the fundamentals of DataStream API.

CO4: Experiment with time-based and window operators.

CO5: Evaluate and implement the Stateful Operators and Applications.

TEXTBOOKS:

1. Fabian Hueske and Vasiliki Kalavri, "Stream Processing with Apache Flink," 1st Edition, O'Reilly Media, 2019.
2. Idan Gabrieli, "Cloud Computing for Beginners-Database Technologies and Infrastructure as a Service" Packt Publishing, 2021.
3. Michael Miller, "Cloud Computing: Web-based Applications that change the way you work and collaborate "1st Edition, Pearson Education, 2008.

REFERENCES:

1. Rajkumar Buyya, Christian Vacchiola and S Thamarai Selvi, "Mastering Cloud Computing", 1st Edition, McGraw Hill, 2013.
2. IBM, "Introduction to Storage Area Networks and System Networking", 5th Edition, November 2012.
3. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 6th reprint 2003.

21PCS23	FOG AND EDGE COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the concept of fog and edge computing.
- To paraphrase the Edge computing Architecture.
- To relate the fog and edge computing in Internet of things.
- To summarize the improved performance of network slicing in enabling technologies.
- To describe the concept of optimization in fog and edge computation.

UNIT-I	INTERNET OF THINGS (IOT) AND NEW COMPUTING PARADIGMS	9

Introduction- Relevant Technologies- Fog and Edge Computing Completing the Cloud- Hierarchy of Fog and Edge Computing - Business Models- Opportunities and Challenges- Networking Challenge-Management Challenge.

UNIT-II	INTEGRATING IOT , FOG , CLOUD INFRASTRUCTURES	9

Introduction-Methodology-Integrated C2F2T Literature by Modeling Technique-Integrated C2F2T Literature by Use-Case Scenarios-Integrated C2F2T Literature by Metrics-Future Research Directions.

UNIT-III	MANAGEMENT AND ORCHESTRATION OF NETWORK SLICES	9

Introduction-Background-Network Slicing-Network Slicing in Software-Defined Clouds-Network Slicing Management in Edge and Fog- Internet of Vehicles : Architecture, Protocol and Security-Seven layered model architecture for Internet of Vehicles- IoV: Network Models, Challenges and future aspects.

UNIT-IV	OPTIMIZATION PROBLEMS IN FOG AND EDGE COMPUTING	9

Preliminaries-The Case for Optimization in Fog Computing-Formal Modeling Framework for Fog Computing-Metrics-Further Quality Attributes-Optimization Opportunities along the Fog Architecture-Optimization Opportunities along the Service Life Cycle-Toward a Taxonomy of Optimization Problems in Fog Computing.

UNIT-V	APPLICATIONS AND ISSUES	9

Exploiting Fog Computing in Health Monitoring-Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking-Fog Computing Model for Evolving Smart Transportation Applications-Testing Perspectives of Fog-Based IoT Applications-Legal Aspects of Operating IoT Applications in the Fog- Case Study: Technologies in Fog Computing.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Illustrate the concept of fog and edge computing for relevant business models.

CO2: Use the integration modelling techniques for IOT and FOG infrastructure.

CO3: Relate the orchestration of slicing concept in different network models.

CO4: Solve the issues of formal modeling framework using optimization.

CO5: Demonstrate the technologies of fog and edge computing for a given real time scenarios.

TEXT BOOKS:

1. Rajkumar Buyya, Satish Narayana Srirama, " Fog and Edge Computing: Principles and Paradigms" ,1st Edition, Wiley Publication, 2019.
2. John Mutumba Bilay , Peter Gutsche, Mandy Krimmel and Volker Stiehl ,"SAP Cloud Platform Integration: The Comprehensive Guide", 2ndEdition, Rheinwerg Publishing, 2019.
3. Perry Lea ,"IoT and Edge Computing for Architects", 2nd Edition, Packt Publishing, 2020.

REFERENCES: :

1. Bahga, Arshdeep, and Vijay Madisetti, " Cloud computing: A hands-on approach", 1st Edition, Create Space Independent Publishing Platform, 2013.
2. Ovidiu Vermesan and Peter Friess, "Internet of Things –From Research and Innovation to Market Deployment", 1st Edition, River Publishers, 2014.
3. Michael Missbach, Thorsten Staerk, Cameron Gardiner, Joshua McCloud, Robert Madl, Mark Tempes and George Anderson, " SAP on Cloud", 1st Edition, Springer, 2016.

21PCS24	CLOUD DATA CENTRE NETWORK ARCHITECTURES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To outline the basics of Cloud DCNs.
- To interpret the Architecture and Technology Evolution of DCNs.
- To relate the Interaction Technologies between Cloud DCN components.
- To summarize the concept of Cloud DCN Security.
- To express the Cutting -Edge Technologies for cloud Application.

UNIT-I | INTRODUCTION TO CLOUD DCNs | 6+6

Cloud computing -Virtualization Technologies in cloud computing-SDN for cloud computing-DCN Prospects-DCN Challenges.

SUGGESTED ACTIVITIES:

- Implementation of Para-Virtualization using VM Ware's Workstation/ Oracle's Virtual Box and Guest O.S.
- Place the application and its datasets into a VM cloud environment connecting to existing enterprise applications and datasets on-premises as required.

UNIT-II | ARCHITECTURE AND TECHNOLOGY EVOLUTION OF DCNs | 6+6

Physical Architecture of DCNs-Technology Evolution of DCNs-Service models of cloud DCNs-Interaction between components in the Cloud DCN solution.

SUGGESTED ACTIVITIES:

- Create a Cloud Plat form using Python for Cloud DNS API.
- Set up a Development Environment using Python libraries.

UNIT-III | INTERACTION TECHNOLOGIES BETWEEN CLOUD DCN COMPONENTS | 6+6

Components of Cloud DCN solutions-Physical cloud engine switches-Cloud Engine Virtual Switches; Interaction Technologies – Open Flow- NETCONF-OVSDB-YANG.

SUGGESTED ACTIVITIES:

- Develop a Case study application and store the application data in cloud data store.
- Store Image and video files in cloud storage using python.

UNIT-IV | CLOUD DCN SECURITY | 6+4

Cloud DCN Security Challenges-Cloud DCN Security Architectures-Benefits of Cloud DCN Security Solution.

SUGGESTED ACTIVITIES:

- Find a procedure to transfer the files from one virtual machine to another virtual machine.

UNIT-V | CUTTING -EDGE TECHNOLOGIES AND APPLICATION | 6+8

Container-Hybrid Cloud-AI Fabric; Application Scenarios-Advanced Content Security Defense.

SUGGESTED ACTIVITIES:

- Find a procedure to launch virtual machine using try stack.
- Create a Cloud Storage bucket using Amazon Simple Storage Service.

Tools Used: Python	
	TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the basis of Cloud DCNs.

CO2: Make use of Architecture and Technology Evolution of DCNs.

CO3: Utilize the Interaction Technologies between Cloud DCN components.

CO4: Develop the knowledge on Cloud DCN Security.

CO5: Build the cloud applications using Cutting -Edge Technologies.

TEXT BOOKS:

1. Lei Zhang and Le Chen , "Cloud Data Center Network Architectures and Technologies" 1st Edition, CRC Press, 2021.
2. Dinesh G.Dutt, "Cloud Native Data Center Networking Architecture,Protocols, and Tools", 1st Edition , O'Reilly Media, 2020.
3. Yang Liu , Jogesh K.Muppala, Malathi Veeraraghavan,Dong Lin and Mounir Hamdi , "Data Center Networks Topologies ,Architectures and Fault -Tolerance Characteristics", 1st Edition ,Springer,2013.

REFERENCES:

1. Thomas Erl, Ricardo Puttini and Zaigham Mahmood, "Cloud Computing Concepts, Technology & Architecture", 1st Edition, Pearson Education, 2013.
2. James Bond, "The Enterprise Cloud Best Practices for Transforming Legacy IT", 1st Edition, O'Reilly Media, 2015.
3. Gary Lee, "Cloud Networking Understanding Cloud-based Data Center Networks", 1st Edition, Elsevier Science, 2014.

VERTICAL 4: CYBER SECURITY AND DATA PRIVACY

21PIT01	CRYPTOGRAPHIC TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate various encryption techniques.
- To experiment with various symmetric key models.
- To utilize the principles of public key cryptosystems for privacy.
- To build systems using the principles of hash functions and digital signature.
- To summarize the various aspects of Modern cryptography techniques.

UNIT-I	INTRODUCTION	9

Basics of Number theory – Integers and Operations on Integers – Modular arithmetic – Prime Numbers – Primality related properties and Algorithms – Pseudo Random Number Generation. Classical Cryptography: Basic conventions and Terminology – Substitution Ciphers -Transposition ciphers – Rotor machines – Cryptanalysis.

UNIT-II	SYMMETRIC KEY CRYPTOGRAPHY	9

Mathematics Of Symmetric Key Cryptography: Algebraic structures – Modular arithmetic-Euclid"s algorithm- Congruence and matrices – Groups, Rings, Fields- Finite fields- Symmetric Key Ciphers: SDES – Block cipher Principles of DES – Strength of DES – Differential and linear cryptanalysis – Evaluation criteria for AES – Advanced Encryption Standard – RC4 -Key distribution.

UNIT-III	PUBLIC KEY CRYPTOGRAPHY	9

Mathematics Of Asymmetric Key Cryptography: Primes – Primality Testing -Factorization – Eulers totient function, Fermats and Eulers Theorem – Chinese Remainder Theorem – Exponentiation and logarithm – Asymmetric Key Ciphers: RSA cryptosystem – Key distribution – Key management – Diffie Hellman key exchange -ElGamal cryptosystem – Elliptic curve arithmetic-Elliptic curve cryptography.

UNIT-IV	MESSAGE AUTHENTICATION AND INTEGRITY	9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC – SHA –Digital signature and authentication protocols – DSS- Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications - Kerberos, X.509

UNIT-V	MODERN ASPECTS OF CRYPTOGRAPHY	9

Modern Cryptography - Principles - Perfectly Secret Encryption - Shannon's Theorem - Constructing CPA-Secure Encryption Schemes - CPA-Secure Encryption from Pseudorandom Functions

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the fundamentals of classical encryption techniques.

CO2: Apply the different operations of symmetric cryptographic algorithms.

CO3: Make use of different cryptographic operations of public key cryptography.

CO4: Build the various authentication schemes to simulate different applications.

CO5: Summarize the various aspects of Modern Cryptography principles.

TEXT BOOKS:

1. William Stallings, "Cryptography and Network Security principles-and-practice", 7th edition, Pearson publication, 2017.
2. Jonathan Katz and Yehuda Lindell, "Introduction to Modern Cryptography", 2nd edition, CRC press, 2015.
3. Padmanabhan T R, Shyamala C K and Harini N, "Cryptography and Security", 1st Edition, Wiley Publications, 2011.

REFERENCES :

1. William Stallings, "Cryptography and Network Security", 4th edition, Pearson Education Asia, Prentice Hall, 2000.
2. Forouzan B. A., "Cryptography and Network Security", 7th edition, Pearson Education, 2017.
3. Wen Bo Mao, "Modern Cryptography-Theory and Practice", 1st edition, Prentice Hall, USA, 2003.

21PIT02	PARADIGMS OF NETWORK SECURITY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To explain various security attacks, services and mechanisms.
- To identify various encryption techniques for authentication.
- To develop sniffing solutions using public key cryptography.
- To apply the fundamentals of IP security for Email authentication.
- To construct model for dealing security issues.

UNIT I	SECURITY ATTACKS ,SERVICES AND MECHANISMS	12

Security Attacks (Interruption, Interception, Modification and Fabrication), Security Services (Confidentiality, Authentication, Integrity, Non-repudiation, access Control and Availability) and Mechanisms, A model for Internetwork security, Understanding Session Hijacking, TCP session hijacking, ARP attacks, route table modification, UDP hijacking.

Suggested Activities :

- Prevention from XSS Attack and ARP Poisoning.

UNIT II	CONVENTIONAL ENCRYPTION AND HARDWARE HACKING	12

Symmetric Encryption Principles, Symmetric encryption algorithms, cipher block modes of operation, Understanding Brute Force, Understanding Amateur Cryptography Attempts, Understanding Hardware Hacking, Housing and Mechanical Attacks, External Interfaces , Protocol Analysis.

Suggested Activities :

- Implementation of DES Algorithm, substitution techniques and Transposition Techniques.

UNIT III	PUBLIC KEY CRYPTOGRAPHY AND SNIFFING	12

Public key cryptography principles, public key cryptography algorithms, digital signatures, digital Certificates, Certificate Authority and key management Kerberos, X.509 Directory Authentication Service, Popular Sniffing Software, Advanced Sniffing Techniques.

Suggested Activities :

- Implementation of RSA algorithm.
- Configuration of a mail agent to support Digital Certificates.

UNIT IV	EMAIL PRIVACY AND IP SECURITY	12

Internet Mail Architecture, E-mail Formats, E-mail Threats and Comprehensive, E-mail Security, Pretty Good Privacy (PGP) and S/MIME. IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations.

Suggested Activities :

- Authentication of Email.

UNIT V	VIRUSES AND THREATS	12

Introduction, Types of Malicious Software, Dealing with Cross-platform Issues, How to Secure against Malicious Software, Intrusion Detection Systems, Password Management, Firewall Design principles.

Suggested Activities :

- Detection Method of IDS.

	TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the security attacks, services and mechanisms.

CO2: Make use of encryption techniques for authentication.

CO3: Apply public key cryptography algorithm for authentication.

CO4: Experiment with Email privacy and security.

CO5: Build a model of Firewall and test the security issues.

TEXT BOOKS:

1. William Stallings, "Network Security Essentials (Applications and Standards)" 6th edition, Pearson Education, 2018.
2. Ryan Russell, Dan Kaminsky, Rain Forest Puppy, Joe Grand, David Ahmad, Hal Flynn Ido Dubrawsky, Steve W.Manzuik and Ryan Permeh and Wiley Dreamtech, "Hack Proofing your network", 2nd edition, Syngress publications, March 1, 2002.
3. Matt Bishop, "Computer Security: Art and Science," Addison Wesley, 2nd edition, 2019.

REFERENCES:

1. Charlien Kaufman, Radia Perlman and Mike Speciner "Network Security – Private Communication in a Public World", 1st edition, Pearson education, 2011.
2. Michael Whitman and Herbert Mattord, "Principles of Information Security" , 6th edition, Cengage Learning, 2017.
3. William Stallings, "Cryptography and network Security", 6th edition, Pearson education, 2015.

21PIT03	ENGINEERING SECURE SOFTWARE SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To compare various critical and non-critical systems.
- To illustrate software requirements document and formal specification for a software system.
- To outline distributed system design and architectures.
- To identify the system security failures.
- To build a framework for highly secure software.

UNIT I	SECURITY A SOFTWARE ISSUE	9
Introduction, the problem, Software Assurance and Software Security, Threats to software security, Sources of software insecurity, Benefits of Detecting Software Security, What Makes Software Secure: Properties of Secure Software, Influencing the security properties of software, Asserting and specifying the desired security properties.		
UNIT II	**REQUIREMENTS ENGINEERING FOR SECURE SOFTWARE**	**9**
Introduction, Misuse and Abuse Cases, The SQUARE process Model, SQUARE sample outputs, Requirements elicitation and prioritization.		
UNIT III	**SECURE SOFTWARE ARCHITECTURE AND DESIGN**	**9**
Introduction, software security practices for architecture and design: architectural risk analysis, software security knowledge for architecture and design: security principles, security guidelines and attack patterns Secure coding and Testing: Code analysis, Software Security testing, Security testing considerations throughput the SDLC.		
UNIT IV	**SECURITY AND COMPLEXITY**	**9**
System Assembly Challenges: introduction, security failures, functional and attacker perspectives for security analysis, system complexity drivers and security.		
UNIT V	**GOVERNANCE AND MANAGING FOR MORE SECURE SOFTWARE**	**9**
Governance and security, Adopting an enterprise software security framework, Risk Management Framework for software security, Security and project management, Maturity of Practice.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Compare and contrast the critical and non-critical systems.

CO2: Explain the software requirements document and formal specification for a software system.

CO3: Summarize the distributed system architectures and design.

CO4: Identify the system security failures.

CO5: Build a framework for highly secure software.

TEXT BOOK:

1. Julia H. Allen, "Software Security Engineering: A Guide for Project Managers", Addison-Wesley Professional, Pearson Education, 1st edition, May 2008.
2. Asoke K. Talukder and Manish Chaitanya, "Architecting Secure Software Systems", CRC Press, 1st edition, Auerbach Publications, 2019.
3. Mark S. Merkow and Lakshmikanth Raghavan, "Secure and Resilient Software", CRC Press, 1st edition, 2019.

REFERENCES:

1. Gary McGraw, "Software Security Building Security in", 1st edition, Addison Wesley, 2006.
2. Jason Grembi, "Secure Software Development A Security Programmer's Guide", 1st edition, Cengage Learning, 2009.
3. Nancy R. Mead, Julia H. Allen,et.al., "Software Security Engineering A Guide for Project Managers",1st edition, Pearson Education, 2004.

21PIT04	DIGITAL AND MOBILE FORENSICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basic digital forensics techniques.
- To interpret well-trained computer crime investigators.
- To apply the knowledge for processing evidence using forensic tools.
- To identify the various tools involved in forensic investigation.
- To outline the various phases of mobile forensics extraction.

UNIT-I	FUNDAMENTALS OF DIGITAL FORENSICS	9

Computer forensics fundamentals, Benefits of forensics, computer crimes, computer forensics evidence and courts, legal concerns and private issues- Introduction to computer crime Investigations& its types– Assess the situation – Acquire the data – Analyze the data – Report the investigation.

UNIT-II	DATA ACQUISITION AND TOOLS	9

Digital evidence, First responder tool kit, techniques of digital forensics, recovery of deleted files, stochastic forensics, steganography, Acquisition methods, The Booting Process, web attack forensics, web application forensic tool.

UNIT-III	PROCESSING EVIDENCE	9

Types of digital evidence, Evidence gathering consideration, data security requirement, Preservation stratergies, seizure, acquisition and examination analysis, Rules of evidence, Good forensic practices.

UNIT-IV	FORENSICS INVESTIGATION TOOLS	9

Current computer forensics tools- software, hardware tools, validating and testing forensic software, E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.

UNIT-V	MOBILE FORENSICS	9

Mobile forensics- Mobile forensic & its challenges- Mobile phone evidence extraction process: The evidence intake phase- The identification phase, The preparation phase, The isolation phase, The processing phase, The verification phase, The document and reporting phase , The presentation phase- Mobile forensic tool leveling system.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Summarize forensic analysis tools to recover important evidence for identifying Computer crime.

CO2: Demonstrate as well-trained computer crime investigators.

CO3: Apply the knowledge for processing evidence using forensic tools.
CO4: Make use of the various tools involved in forensic investigation.
CO5: Explain the various phases of mobile forensics extraction.

TEXT BOOKS:

1. Dr. Jeetendra Pande and Dr. Ajay Prasad, "Digital forensics", 1st edition, Uttarakhand Open University, 2016.
2. Jason sachouski, "Computer Forensics and Investigations", 2nd edition, CRC press, 2018.
3. Satish Bommisetty, Rohit Tamma and Heather Mahalik, "Practical Mobile Forensics", 2nd edition, Packt Publishing Ltd., 2014.

REFERENCES :

1. Vacca, J, "Computer Forensics, Computer Crime Scene Investigation", 2nd edition, Charles River Media, 2005.
2. Iosifl.Androulidakis, "Mobile phone security and forensics: A practical approach", 1st edition, Springer publications, 2012.
3. Warren G. Kruse II and Jay G. Heiser, "Computer Forensics: Incident Response Essentials", 1st edition, Addison Wesley, 2002.

21PIT05	ETHICAL HACKING EXPLOIT DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To infer various security tools to assess the computing system.
- To identify publicly available tools used to gather information on potential targets.
- To apply scanning techniques used to identify network system open ports.
- To classify network system vulnerabilities and confirm their exploitability.
- To construct flawless wireless network and apply security patches.

UNIT-I **INTRODUCTION TO HACKING** **12**

Introduction to Hacking – Important Terminologies – Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement –Penetration Testing Methodologies – OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary –Reports.

Suggested Activities:

- Setup a honey pot and monitor the honey pot on network.

UNIT-II **INFORMATION GATHERING AND SCANNING** **12**

Information Gathering Techniques –Active Information Gathering –Passive Information Gathering– Sources of Information Gathering-Tracing the Location-Traceroute-ICMP Trace route –TCP Trace route and its Usage – UDP Trace route –Enumerating and Fingerprinting the Webservers –Google Hacking – DNS Enumeration –Enumerating SNMP –SMTP Enumeration – Target Enumeration and Port Scanning Techniques–Advanced Firewall/IDS Evading Techniques.

Suggested Activities:

- Create a social networking website login page using phishing techniques.

UNIT-III **NETWORK ATTACKS** **12**

Vulnerability Data Resources – Exploit Databases – Network Sniffing – Types of Sniffing – Promiscuous and Non promiscuous versus Mode – MITM, ARP, Denial of Service and Hijacking Session with MITM Attacks – SSL Strip: Stripping HTTPS Traffic –DNS,ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing –Remote Exploitation – Attacking Network Remote Services – Overview of Brute Force and Traditional Brute Force – Attacking SMTP, SQL Servers – Testing for Weak Authentication.

Suggested Activities:

- Demonstration of DoS attacks.
- Install jcrypt tool (or any other equivalent) and demonstrate Asymmetric, Symmetric Crypto algorithm, Hash and Digital/PKI signatures studied in theory Network Security and

Management.

UNIT-IV	EXPLOITATION	12

Introduction to Metasploit–Reconnaissance with Metasploit –Port Scanning with Metasploit, Compromising a windows Host with Metasploit –Client Side Exploitation Methods –Creating a Custom Executable and a Backdoor with SET – PDF Hacking– Social Engineering Toolkit– Browser and Post Exploitation– Acquiring Situation Awareness– Hashing and Windows Hashing Methods – Cracking the Hashes– Brute force Dictionary attacks – Password Salts– Rainbow Tables– John the Ripper– Gathering OS Information– Harvesting Stored credentials.

Suggested Activities:

- Install rootkits and study variety of options.
- Study of Techniques uses for Web Based Password Capturing

UNIT-V	WIRELESS AND WEB HACKING	12

Wireless Hacking – Introducing Air crack – Cracking a WEP – Cracking a WPA/WPA2 Wireless Network Using Air cracking – Evil Twin Attack – Causing Denial of Service on the Original AP.
Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks –Further Reading–Crawling Restricted Links–Testing for the Vulnerability –Authentication Bypass with Insecure Cookie Handling– SQL Injection Attacks –Cross-Site Scripting and it types.

Suggested Activities:

- Demonstration of SQL injection attacks.
- Implement Passive scanning, active scanning, session hizaking, cookies extraction using Burp suit tool.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Summarize the various security tools to assess the computing system.

CO2: Experiment with the vulnerabilities across any computing system using penetration testing.

CO3: Make use of prediction mechanism to prevent any kind of attacks.

CO4: Utilize the various techniques to protect the system from malicious software and worms.

CO5: Identify the wireless network flaws and apply security patches.

TEXT BOOKS:

1. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 1st edition, 2015.
2. Allen Harper, Ryan Linn, Stephen Sims, Michael Baucom and Moses Frost, "Gray Hat Hacking: The Ethical Hacker's Handbook", 5th edition , McGraw Hill,2018.
3. Stefano Novelli, Marco Stefano Doria and Marco Silvestri, "Hacklog Volume 1 Anonymity: IT Security & Ethical Hacking Handbook",1st edition , BW / Inforge ,2019.

REFERENCES:

1. Alana Maurushat, "Ethical Hacking", 1st edition, University Of Ottawa Press, 2019.
2. Kevin Beaver, "Ethical Hacking for Dummies", 6th edition, Wiley publications, 2018.
3. Mohuya Chakraborty, Satyajit Chakrabarti and ValentinaE.Balas, "Proceedings of International Ethical Hacking Conference 2019", 1st edition, Springer Singapore, 2020.

21PIT06	SOCIAL NETWORK SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the components of the social network analysis.
- To infer about the privacy in social networks.
- To explain about data mining and text mining.
- To interpret the knowledge about web mining.
- To build the real time application systems.

UNIT-I	INTRODUCTION	9

Social Network Analysis – Basic concepts – Design, Theorization, Data Processing – Tensor Decomposition - Characteristics of Online Communication - Rich Media Communication Patterns – Applications of SNA.

UNIT-II	PRIVACY IN SOCIAL NETWORKS	9

Privacy breaches – definitions for publishing data – Privacy preserving mechanisms - Trust Network Analysis - Trust Transitivity Analysis - The Dirichlet Reputation System.

UNIT-III	DATA MINING AND TEXT MINING	9

Data Mining in a Nutshell - Social Media - Motivations for Data Mining in Social Media - Data Mining Methods for Social Media - Related Efforts. Text Mining: Keyword Search - Classification Algorithms - Clustering Algorithms - Transfer Learning in Heterogeneous Networks.

UNIT-IV	WEB MINING	9

Web Community - Web Data Model - Information Retrieval Performance Evaluation Metrics - Web Content Mining - Web Linkage Mining: Web Graph Measurement and Modeling - Web Linkage Mining.

UNIT-V	APPLICATIONS	9

Analysis of Communities and Their Evolutions in Dynamic Networks - Socio-Sense: A System for Analyzing the Societal Behavior from Web Archive - A Hybrid User-based and Item-based Web Recommendation System - User-based and Item-based Collaborative Filtering Recommender Systems.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the components of the social network analysis.

CO2: Interpret knowledge about the privacy in social networks.

CO3: Illustrate about data mining and text mining.

CO4: Demonstrate web mining in social network.

CO5: Develop the application related to real time systems.

TEXT BOOKS:

1. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st edition, Springer, 2010.
2. Guandong Xu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", 1st edition, Springer, 2012.
3. Brij B. Gupta and Somya Ranjan Sahoo, "Online Social Networks Security: Principles, Algorithm, Applications, and Perspectives", 1st edition, CRC Press Publishers, 2021.

REFERENCES :

1. Charu C. Aggarwal, "Social Network Data Analytics", 1st edition, Springer, 2014.
2. Przemyslaw Kazienko and Nitesh Chawla, "Applications of Social Media and Social Network Analysis", 1st edition, Springer, 2015.
3. Nilanjan Dey, Samarjeet Borah, Rosalina Babo, Amira S. Ashour, "Social Network Analytics", 1st edition, Academic Press Publishers, 2018.

21PIT07	SECURITY AND PRIVACY IN CLOUD	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the concept of cloud computing.
- To explain the architecture and services of cloud.
- To identify the need of security in cloud computing.
- To outline the privacy in cloud computing.
- To illustrate cloud security polices for audit and compliance.

UNIT-I	INTRODUCTION	9

Introduction to Cloud Computing – Definition of Cloud – Evolution of Cloud Computing – Underlying Principles of Parallel and Distributed Computing – Cloud Characteristics – Elasticity in Cloud – On demand Provisioning.

UNIT-II	CLOUD ARCHITECTURE, SERVICES AND STORAGE	9

Basics of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms- Public, Private and Hybrid Clouds - IaaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage.

UNIT-III	CLOUD SECURITY STANDARDS	9

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud, Key privacy issues in the cloud.

UNIT-IV	PRIVACY IN CLOUD	9

Privacy- Data Life Cycle- Key privacy concerns in cloud- Responsibility for protecting privacy- Changes to privacy Risk Management and Compliance in Relations to cloud computing- Legal and Regularity Implications- Laws and Regulations.

UNIT-V	AUDIT AND COMPLIANCE	9

Audit and Compliance -Internal Policy Compliance -Governance, Risk, and Compliance (GRC) - Illustrative Control Objectives for Cloud Computing -Incremental CSP-Specific Control Objectives - Additional Key Management Control Objectives- Control Considerations for CSP Users - Regulatory/External Compliance - Auditing the Cloud for Compliance.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Interpret the concept of cloud computing.

CO2: Summarize the architecture and services of cloud.

CO3: Experiment with IAM practices in cloud computing.

CO4: Explain the privacy issues in cloud computing.

CO5: Outline cloud security polices for audit and compliance.

TEXT BOOKS:

1. Tim Mather, Subra Kumaraswamy and Shahed Latif, " Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice)", 1st Edition, O'Reilly Publications, September 2009.
2. Kai Hwang, Geoffrey C. Fox and Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things",1st Edition, Morgan Kaufmann Publishers, 2012.
3. Liliana F. B. Soares, Diogo A. B. Fernandes and Joao V. Gomes," Security ,privacy and trust in cloud systems",1st edition, Springer-Verlag Berlin Heidelberg publications,2014.

REFERENCES :

1. Rajkumar Buyya, Christian Vecchiola and S. ThamaraiSelvi, "Mastering Cloud Computing", 1st Edition, Tata Mcgraw Hill, 2013.
2. Toby Velte, Anthony Velte and Robert Elsenpeter, "Cloud Computing - A Practical Approach", 1st Edition, Tata Mcgraw Hill, 2009.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)", O'Reilly, 2009.

21PIT08	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To infer the basic concepts of Blockchain technologies.
- To identify Ethereum basics and its applications.
- To outline Bitcoin basics and its challenges.
- To apply the fundamentals of crypto currencies.
- To develop the applications of Blockchain technologies and deal with privacy issues.

UNIT I — **INTRODUCTION OF BLOCKCHAIN** — **12**

Peer-to-Peer (P2P) Networking, Blockchain Architecture, Blocks in Blockchain, Types of Block chain, the Logical Components of Blockchain, Core Components of Blockchain Architecture, Smart contracts and their applications.

Suggested Activities :

- Study of Basic Cryptography Concepts for Blockchain

UNIT II — **ETHEREUM BASICS** — **12**

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

Suggested Activities :

- Creating and Building up Ethereum Wallet.
- Building a Private Ethereum Network and Deploying Smart Contract

UNIT III — **INTRODUCTION OF BITCOIN** — **12**

Bitcoin features, Blockchain and Bitcoin, Bitcoin Security, Bitcoin Transaction, Transaction Lifecycle, Consensus Protocol, Role of Bitcoin Crimes, Dark Side of Bitcoin Crimes, Open Challenges to Bitcoin Crimes.

Suggested Activities :

- Creating and Building a Bitcoin Wallet.

UNIT IV — **FUNDAMENTALS OF CRYPTOCURRENCIES** — **12**

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Foundations – Bitcoin Limitations – Name Coin – Prime Coin – Zcash – Smart Contracts – Ricardian Contracts.

Suggested Activities :

- Study of Hyperledger
- Creating a Business Ledger using Hyperledger

UNIT V	SECURITY AND PRIVACY ISSUES OF BLOCKCHAIN TECHNOLOGY	12

Introduction, Blockchain - Aspects for Consideration, Security of block chain, Privacy of blockchains, Security Issues of Blockchain Technology, Privacy Issues of Blockchain Technology, Types of Attack, Security Enhancement to Blockchain Systems, Applications of Blockchain in Health care, Finance.

Suggested Activities :

- Building and deploying multichain private Blockchain

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the concepts of Blockchain technologies.

CO2: Develop Ethereum block chain contract.

CO3: Make use of the concepts of Bitcoin and their usage.

CO4: Experiment with the basic principles of Cryptocurrencies.

CO5: Utilize the knowledge of blockchain technologies to develop various applications.

TEXT BOOKS:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", 2nd edition, Packt Publishing, 2018.
2. Pethuru Raj, Kavita Saini and Chellammal Surianarayanan," Blockchain Technology and Applications", 1st edition, CRC Press, 2021.
3. Elad Elrom, "The Blockchain Developer – A Practical Guide for Designing, Implementing, Publishing, Testing, and Securing Distributed Blockchian-based Projects", 1st edition, Apress, 2019.

REFERENCES:

1. Saravanan Krishnan, Raghvendra Kumar, S. Balaji, , Valentina Emilia Balas and Y. Harold Robinson , "Handbook of Research on Blockchain Technology", 1st edition, Academic Press, 2020.
2. Merunas Grincalaitis, "Mastering Ethereum: Implement Advanced Blockchain Applications using Ethereum-supported Tools, Services, and Protocols", 1st edition, Packt Publishing, 2019.
3. Melanie Swan," Blockchain Blueprint for a New Economy", 1st edition, O'Really Media Inc,2015.
4. Shiho Kim and Ganesh Chandra Deka," Advanced Applications of Blockchain Technology", 1st edition, Springer, 2019.

VERTICAL 5: CREATIVE MEDIA

21PIT09	MULTIMEDIA AND ANIMATION	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To infer multimedia system design.
- To utilize multimedia file handling, various software programs used in creation and implementation of multimedia.
- To identify various types of animation.
- To make use of strong knowledge about the fundamental principles of animation.
- To model various types of drawings.

UNIT I MULTIMEDIA SYSTEM DESIGN 12

Multimedia basics – Multimedia applications – Multimedia system architecture – Evolving technologies for multimedia – Defining objects for multimedia systems – Multimedia data interface standards – Multimedia databases. Compression and decompression – Binary, color, gray scale and still video image compression, Video image compression, audio compression.

Suggested Activities:

Study the notes of a piano and stimulate them using the keyboard and store them in file
Devise a routine to produce the animation effect of a square transforming to a triangle and then to a circle.

UNIT II MULTIMEDIA FILE HANDLING & HYPERMEDIA 12

Data and file format standards – Multimedia I/O technologies – Digital voice and audio – Video image and animation – Full motion video – Storage and retrieval technologies. Multimedia authoring systems- User interface design - Hypermedia messaging -Mobile messaging – Hypermedia message component – Creating hypermedia message – Integrated multimedia message standards – Integrated document management – Distributed multimedia systems.

Suggested Activities:

Write a program to play "wave" or "midi" format sound files

UNIT III ANIMATION BASICS 12

Animation: Stop Motion Photo Animation- Cel and Paper Animation- Cel Animation, Stop Motion Animation, Computer Animation, 2-D Animation, 3-D Animation.

Suggested Activities:

- Designing Flipbook.
- Drawing Basic Shapes.

UNIT IV ANIMATION PRACTICES 12

Squash and Stretch, slow in and slow out, timing and placement, Generic walk, Double bounce and sneak, Full rigged character, Character walk

Suggested Activities:

- Designing Characters with Wax and Oil Based Clay.
- Using characters in stop motion animation.

UNIT V	DRAWINGS	12

Audio record and breakdown, Story Board, Key Pose animation, Key Drawings and in Betweens Clean ups, Background art- Light and shade, Light and Shadow, Depth layering, Inking and colouring, Digital colouring

Suggested Activities:

- Experimental Work with different mediums like sand, stones, grass, hard board, pen and Ink , water colors, poster colors, dry brush etc.
- Draw all kinds of facial expressions.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Outline the design of Multimedia System Design.

CO2: Develop various types of Multimedia File handing methods and experiments with various shapes and hypermedia files.

CO3: Make use of various types of animation in developing applications.

CO4: Identify various techniques in animation.

CO5: Experiment with types of drawings.

TEXT BOOKS:

1. Andleigh, P. K and Kiran Thakrar, "Multimedia Systems and Design", 1st edition, Pearson Education India, 2015.
2. Chris Patmore ," The Complete Animation Course: The Principles, Practice, and Techniques of Successful Animation", 1st edition, Baron's Educational Series, 2003.
3. Tony White, "Animation Masterclasses from Pencils to Pixels- A Complete Course in Animation & Production", 1st edition, CRC Press, 2022.

REFERENCES :

1. Judith Jeffcoate, "Multimedia in practice: Technology and Applications", 1st edition, PHI, 1998.
2. Richard Williams, "The Animator's Survival Kit", 1st edition, Faber and Faber Publications, 2009.
3. Chris Webster, "Animation The Mechanics of motion", 1st edition, Focal Press, 2005.

21PIT10	MULTIMEDIA DATA COMPRESSION AND STORAGE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the fundamentals of compression techniques.
- To illustrate the various coding and algorithms of Text and Image compression.
- To apply the compression techniques in multimedia processing applications.
- To learn about standards and techniques of video compression.
- To explain the basics of multimedia communication and retrieval that is commonly used in industry.

UNIT-I	FUNDAMENTALS OF COMPRESSION	9

Introduction To multimedia – Graphics, Image and Video representations — Storage requirements of multimedia applications – Need for compression – Taxonomy of compression Algorithms - Elements of Information Theory – Error Free Compression – Lossy Compression.

UNIT-II	TEXT AND IMAGE COMPRESSION	9

Huffman coding – Adaptive Huffman coding – Arithmetic coding – Shannon-Fano coding-Dictionary techniques – LZW family algorithms - Image Compression – JPEG Standard –JPEG 2000 standards – JBIG and JBIG2 standards.

UNIT-III	AUDIO COMPRESSION	9

Audio compression Techniques – ADPCM in speech coding– Phase Insensitivity – Chanel Vocoder – Formant vocoder – G.726 ADPCM – MPEG audio – CELP vocoders – Linear Predictive coding.

UNIT-IV	VIDEO COMPRESSION	9

Video compression – MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-4 – Motion compensation techniques –H.261 Standard –H.263 Standard.

UNIT-V	MULTIMEDIA COMMUNICATION AND RETRIEVAL	9

Basics of computer and multimedia network – Multiplexing Technologies –Quality of Multimedia Data Transmission –Multimedia over ATM Networks – Media on Demand– Radio propagation channel –Trends in Wireless Interactive Multimedia.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Outline the fundamentals of multimedia compression techniques.

CO2: Summarize the various algorithms of Text and Image compression.

CO3: Apply the various compression techniques for multimedia processing applications.

CO4: Compare various video compression techniques.

CO5: Explain the basic concepts of multimedia communication and retrieval.

TEXT BOOKS:

1. Darrel Hankerson, Greg A Harris and Peter D Johnson, "Introduction to Information Theory and Data Compression", 2nd edition, Chapman and Hall , CRC press, 2003.
2. Khalid Sayood," Introduction to Data Compression", Morgan Kauffman Harcourt India, 5th edition, 2020.
3. Mark S. Drew and Ze-Nian Li, "Fundamentals of Multimedia", 1st edition, Pearson education, 2004.

REFERENCES :

1. David Solomon, "Data Compression – The Complete Reference", 4th edition, Springer Verlog, New York, 2006.
2. Brusilovsky, Peter et.al, "The Adaptive Web: Methods and Strategies of Web Personalization", 1st edition, Springer, 2007.
3. David Salomon, "Handbook of Data Compression", 5th edition, Springer publication, 2010.

21PIT11	UI AND UX DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To outline the design of graphical user interfaces.
- To illustrate the user interfaces design process.
- To demonstrate the concepts and principles of UX.
- To develop an UX plane for an application.
- To build a simple application with UI and UX.

UNIT I	INTRODUCTION TO THE USER INTERFACE	12

The importance of User Interface (UI) – The importance of Good Design – A Brief Historical Overview of Interface Design – Characteristics of Graphical and Web User Interface – Interaction Styles – The Graphical User Interface – Web User Interface – Principles of UI Design – The Merging of Graphical Business Systems and the Web.

Suggested Activities:

- GUI Basics – Building an Interface.

UNIT II	USER INTERFACE DESIGN PROCESS	12

Know Your User or Client - Understand the Business Function - Understand the Principles of Good Interface and Screen Design - Develop System Menus and Navigation Schemes - Select the Proper Kinds of Windows - Select the Proper Interaction Devices - Choose the Proper Screen-Based Controls - Create Meaningful Graphics, Icons, and Images - Choose the Proper Colors - Organize and Layout Windows and Pages.

Suggested Activities:

- Graphics – The Canvas.

UNIT III	INTRODUCTION TO THE USER EXPERIENCE	12

The Tao of UXD Basics- What Is User Experience Design? - The Broad Definition - The Project Ecosystem - Identify the Type of Site - Choose Your Hats - Understand the Company Culture - Proposals for Consultants and Freelancers - UX Design Guidelines.

Suggested Activities:

- Widget Events – Binding Actions.

UNIT IV	UX PLANE	12

The Strategy Plane - The Scope Plane - The Structure Plane - The Skeleton Plane - The Surface Plane - The Elements Applied - User Experience and the Web - Meet the Elements.

Suggested Activities:

- Improving the User Experience.

UNIT V	UI/ UX Design Tools	12
Invaders Revenge - An Interactive Multi-touch Game - Invaders Revenge – An animated multi-touch game- Atlas – An efficient management of images-Boom – simple sound effects - Ammo – simple animation- Invader – transitions for animations - Dock – automatic binding in the Kivy language - Fleet – infinite concatenation of animations - Scheduling events with the clock- Shooter – multi-touch control- Invasion – moving the shooter with the keyboard - Combining animations with '+' and '&'. **Suggested Activities:** Develop sound effect and shooter for a simple game.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the design of graphical user interfaces.

CO2: Summarize the User Interfaces to design a good product.

CO3: Relate the concepts and principles of UX.

CO4: Experiment with UX plane.

CO5: Develop a simple application incorporating UI and UX.

TEXT BOOK:

1. Wilbert O. Galitz, "The Essential Guide to User Interface Design An Introduction to GUI Design Principles and Techniques", 3rd edition, Wiley Publishing, Inc., 2017.
2. Russ Unger and Carolyn Chandler, "A Project Guide to UX Design: For user experience designers in the field or in the making", 2nd edition, New Riders Publishing, 2012.
3. Roberto Ulloa, "Kivy – Interactive Applications and Games in Python", 2nd edition, Packt Publishing, 2015.

REFERENCES:

1. Jesse James Garrett, "The Elements of User Experience: User-Centered Design for the Web and Beyond", 2nd edition, Pearson Education. 2011.
2. Rex Hartson and Pardha S. Pyla, "The UX Book Process and Guidelines for Ensuring a Quality User Experience", Elsevier, 2012.
3. Pamala Deacon, "UX and UI Strategy: A step by step Guide on UX and UI design", 1st edition, Packt Publishing, 2020.

21PIT12	VIDEO PROCESSING AND ANALYTICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of video processing.
- To identify the moving objects using motion estimation techniques.
- To experiments with video processing tools for analytics.
- To utilize data streams for categorization of videos.
- To construct application for video analytics.

UNIT-I	**VIDEO FUNDAMENTALS**	**9**
Basic Concepts and Terminology – Analog Video Standards – Digital Video Basics – Analog to Digital Conversion – Color Representation and Chroma Sub Sampling – Video Sampling Rate and Standards Conversion – Digital Video Formats – Video Features – Colour, Shape and Textural features.		
UNIT-II	**MOTION ESTIMATION**	**9**
Fundamentals of Motion Estimation – Optical Flow – 2D and 3D Motion Estimation – Block Based Methods – Phase Correlation Methods – Block Matching Methods – Hierarchical Motion Estimation – Genaralized Block Motion Estimation		
UNIT-III	**VIDEO SEGMENTATION AND ANALYTICS**	**9**
Direct Methods – Optical Flow Segmentation – Simultaneous Estimation and Segmentation: Motion Field Model – The Algorithm – Relationship to other algorithms.		
UNIT-IV	**MINING DATA STREAMS**	**9**
Introduction to Streams Concept – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Video Database – Categorization of Videos – Video Query Categorization.		
UNIT-V	**EMERGING TRENDS**	**9**
Affective Video Content Analysis – Parsing a Video into Semantic Segments – Video Indexing and Abstraction for Retrieval – Automatic Video Trailer Generation– Video in painting– Forensic Video Analysis.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES: At the end of the course, learners will be able to: **CO1:** Explain the basic video processing functions. **CO2:** Experiment with optical flow and motion estimation. **CO3:** Make use of segmentation techniques for video analytics. **CO4:** Select techniques to index and retrieve videos for faster access. **CO5:** Develop applications for video analytics.
TEXT BOOKS: 1. A. Murat Tekalp, "Digital Video Processing", 2nd edition, Prentice Hall, 2015. 2. Oges Marques, "Practical Image and Video Processing Using MATLAB", 1st edition, Wiley and Sons (IEEE Press), 2011. 3. Anand Rajaraman and Jeffrey David Ullman, "Mining of Massive Datasets", 1st edition, Cambridge University Press, 2012.
REFERENCES : 1. Alan C. Bovik, "Handbook of Image and Video processing", 2nd edition, Academic Press, 2005. 2. Al Bovik, "The Essential Guide to Video Processing", 1st edition, Academic Press, 2009. 3. Suhel Dhanani and Michael Parker, "Digital Video Processing for Engineers: A Foundation for Embedded Systems Design", 1st edition, Newnes publishers, 2012.

21PIT13	TECHNIQUES FOR VISUAL EFFECTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the basics of visual effects.
- To summarize basic compositing theory.
- To experiment with intermediate compositing techniques.
- To make use of advanced compositing methods.
- To build applications with advanced effects.

UNIT-I	INTRODUCTION	9

Digital Image Basics – Resolution – Color – Packing it in – File formats – Video and Film – Film to Computer – Video to Computer – Image Quality – Desktop Hardware options – Telecine – Film Scanners.

UNIT-II	BASIC COMPOSITING AND TOOLS	9

Basic Compositing theory – Channels – Mattes – Filters – Geometric transformation – Basic tools – Compositing with alpha channel – Simple keying – Filters and Effects – Geometric Transformations.

UNIT-III	INTERMEDIATE COMPOSITING	9

Rig removal with a clean plate – Rotoscoping – Tracking – Stabilizing – Destabilizing – Tracking for animation.

UNIT-IV	ADVANCED COMPOSITING	9

Tweaking Colors – Color tools – Matte painting for the moving camera – Reserving footage – Changing speed – Motion blur – Stretching time.

UNIT-V	QUALITY AND ADVANCED SPECIAL EFFECTS	9

Quality and Efficiency – Minimizing data loss – Consolidating operations – Beyond black and white – Non linear color spaces – working with 3D elements – Related 2D disciplines – case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the concept of Visual Effects.

CO2: Outline about various compositing and tools.

CO3: Utilize the concepts of Intermediate compositing for animation.

CO4: Make use of advanced compositing techniques.

CO5: Experiment with 2D and 3D animation techniques.

TEXT BOOKS:

1. Doug Kelly, " Digital Compositing In Depth: The Only Guide to Post Production for Visual Effects in Film",1st edition, Coriolis Group Books,2000.
2. Ron Brinkmann, "The art and science of digital compositing : Techniques for visual effects, Animation and Motion Graphics",2nd edition, Morgan Kaufmann,2008.
3. Jeffrey Okun and Susan Zwerman ,"The VES Handbook of Visual Effects: Industry Standard VFX Practices and Procedures",Routledge, 3rd edition,2020.

REFERENCES :

1. Angie Taylor," Creative After Effects 7: Workflow Techniques for Animation, Visual Effects and Motion Graphics", 1st edition, Focal press,2006.
2. Charles Finance and Susan Zwerman, "The Visual Effects Producer: Understanding the Art and Business of VFX, Routledge, 1st edition, 2015.
3. Gress Jon, "[digital] Visual Effects and Compositing, 1st edition, New Riders publications, 2014.

21PIT14	GAME DESIGN AND DEVELOPMENT	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To illustrate the basic concepts of game programming.
- To experiment with 3D graphics concepts.
- To apply the terminologies like sound, physics and cameras for developing simple games.
- To choose user interfaces and scripting for developing games.
- To make use of gaming concepts for game development.

UNIT I — INTRODUCTION TO GAME PROGRAMMING — 12

Game Programming Overview: Evolution of Video Game Programming - The Game Loop - Time and Games – Game Objects. 2D Graphics: 2D Rendering Foundations - Sprites – Scrolling - Tile Maps. Linear Algebra for Games.

Suggested Activities:

- Installation of Pygame and Pygame Zero and Implementation of colour models and shading models in Python.

UNIT II — 3D GRAPHICS — 12

Basics - Coordinate Spaces - Lighting and Shading – Visibility - World Transform, Revisited - Input Devices - Event-Based Input Systems - Mobile Input.

Suggested Activities:

- Experiment with game script in natural language for story creation.
- Practical problems in game level design.

UNIT III — SOUND, PHYSICS AND CAMERAS — 12

Basic Sound - 3D Sound - Digital Signal Processing - Planes, Rays, and Line Segments . - Collision Geometry - Collision Detection - Physics-Based Movement - Types of Cameras - Perspective Projections - Camera Implementations - Camera Support Algorithms.

Suggested Activities:

- Implementation of simple animations in Pygame and Processing.py

UNIT IV — USER INTERFACES AND SCRIPTING — 12

Menu Systems - HUD Elements - Other UI Considerations - Scripting Languages - Implementing a Scripting Language - Data Formats.

Suggested Activities:

- Installation of Unity scripts routines for character rendering, transformations and sound processing.

UNIT V — GAME DEVELOPMENT — 12

Side-Scroller for iOS - Tower Defense for PC/Mac - Tetris game.

Suggested Activities:

- Implementation of Sudoku Game
- Implementation of Tic Tac Toe Game

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the basic concepts of game programming.

CO2: Experiment with 3D graphics concepts.

CO3: Make use of the concepts of sound, physics and cameras to develop simple games.

CO4: Apply the concepts of user interfaces and scripting to develop games.

CO5: Utilize the gaming concepts to develop games in various platforms.

TEXT BOOKS:

1. Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach", Addison-Wesley Professional, 2nd edition, 2014.
2. K. Patinson, "Game Development: Gaming Design and Programming", Code Academy Publishers, 1st edition, 2021.
3. James R Parker and J R Parker, "Introduction to Game Development:", Mercury Learning & Information Publishers, 1st edition, 2015.

REFERENCES:

1. Will McGugan, "Beginning Game Development with Python and Pygame: From Novice to Professional", Apress Publishers, 1st edition, 2007.
2. Paul Vincent Craven, "Program Arcade games", Apress Publishers, 4th edition, 2016.
3. Steve Rabin, "Introduction to Game Development", Charies River Media Publishers, 2nd edition, 2009.

21PIT15	CONCEPTS OF AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate various augmented reality methods.
- To explain the scientific, technical and engineering aspects of augmented reality.
- To explain the scientific, technical and engineering aspects of virtual reality.
- To develop applications based on AR and VR technologies.
- To summarize the applications of AR and VR.

UNIT-I	INTRODUCTION	9

Introduction to Augmented Reality, Other Enhancements, The Relationship between Augmented Reality and Other Technologies, Virtual and Mixed Reality, Cyber Space, Virtuality and the Virtuality Continuum, The Reality Continuum, The Metaverse and the Metaverse Roadmap, Introduction to VR – The three I's of VR, Early commercial VR technology, VR becomes an Industry, Five classic components of VR system

UNIT-II	AUGMENTED REALITY HARDWARE	9

The Two-Step Process of Augmented Reality Applications, Hardware Components For AR - Sensors, Processors, Displays, Augmented Reality System.

UNIT-III	VIRTUAL REALITY HARDWARE	9

Input Devices: Trackers, Navigation and Gesture Interfaces, Output Devices: Graphics, Three-Dimensional Sound, and Haptic Displays, Computing Architecture for VR, Modeling.

UNIT-IV	AR AND VR SOFTWARE DEVELOPMENT	9

Software involved directly in the Augmented Reality application- Environmental acquisition, Sensor integration, Application engine, Rendering software, Augmented Reality libraries, Software used to create content for the Augmented Reality Application, VR Programming – Toolkits and Scene graphics, World toolkit, Java 3D, General Haptics Open Software Toolkit (GHOST).

UNIT-V	APPLICATIONS	9

AR Applications – Magic books, Magic Mirrors, Magic Windows and Doors, Magic Lens, Navigation Assistance, Non referential augmentation, Objective view augmented reality, Traditional VR applications – Medical Applications of VR, Virtual anatomy, Triage and Diagnostic, Surgery, Rehabilitation, Education, arts and Entertainment, Military VR Applications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the basic knowledge of AR and VR.

CO2: Outline the scientific, technical and engineering aspects of AR.

CO3: Outline the scientific, technical and engineering aspects of VR.

CO4: Experiment with technologies related to AR and VR software development.

CO5: Summarize the applications of AR and VR engineering.

TEXT BOOKS:

1. Burdea, G. C. and P. Coffet, "Virtual Reality Technology", 2nd edition, Wiley□IEEE Press, 2006.
2. Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", 1st edition, Morgan Kaufmann, 2013.
3. John Vince, "Virtual Reality Systems", 1st edition, Pearson Education, 2002.

REFERENCES :

1. Alan Craig, William Sherman and Jeffrey Will, "Developing Virtual Reality Application, Foundations of Effective Design", 1st edition, Morgan Kaufmann, 2009.
2. George Mather, "Foundations of Sensation and Perception", 3rd edition, Psychology Press, 2009.
3. Chetankumar G Shetty, "Augmented Reality - Theory, Design and Development", 1st edition, McGraw Hill 2020.

21PIT16	STRATEGIES OF DIGITAL MARKETING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of Digital Marketing.
- To outline the optimization of search engine.
- To utilize the most popular social media platforms to grow business.
- To experiment with various tools for digital marketing.
- To plan case studies for understanding real world scenarios.

UNIT-I	INTRODUCTION TO DIGITAL MARKETING	9

Introduction- From Traditional to model marketing-Premise of Traditional Marketing-Evolution of Digital Marketing-Rise of the Internet- Growth and Impact of Search Technologies- Understanding e models-Digital -The next wave of Marketing.

UNIT-II	SEARCH ENGINE OPTIMIZATION (SEO)	9

SEO tools-Picking a product-Picking a domain name-Domain Registration & Hosting-Page Optimization-Home Page Optimization-Site Optimization-Registering with Directories-Link Building-Common SEO Abuse Techniques-Appearing Natural-SEO as a Standalone Product-The Social Elements of Relevancy-Interactive Elements-Choosing a Domain Name-Hosting-Copywriting.

UNIT-III	SOCIAL MEDIA OPTIMIZATION (SMO)	9

Blogging-API-Widget-Likes-Groups-Application-Open Graph-Traditional Marketing Elucidation of out bound tactics-Inbound Marketing- Magnet, Sledgehammer Concept-Content Marketing-Get Found Tactics -Convert Tactics-Analyze Tactics.

UNIT-IV	SEARCH ENGINE MARKETING	9

Emergence of Digital Marketing as a tool- Pull and Push Marketing-Media consumption drivers for new marketing environment-Digital Marketing Channel-Digital Marketing Frame work -Digital Marketing application and benefits-Critical Success Factors for Digital Marketing.

UNIT-V	CASE STUDIES	9

Google Analytics -Website Analysis and Quality Control-A Microlevel Elucidation of Lead Generation Strategy-Content Formats for Mobile-Lead Nurturing-SEO Next-Social Media Monitoring Strategy-Google Algorithms-Steps to increase Google Page Rank.

TOTAL :45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to: CO1: Explain the fundamentals of Digital Marketing. CO2: Summarize about search engine optimization techniques. CO3: Make use of most popular social media platforms to grow business. CO4: Apply the knowledge about various online advertisement techniques. CO5: Plan case studies for understanding real world scenarios.
TEXT BOOKS: 1. Puneet Singh Bhatia," Fundamentals of Digital Marketing," 1st edition, Pearson Education, 2017. 2. Aaron Matthew Wall, "Search Engine Optimization Book", 1st edition, 2005. 3. Dave Chaffey and Fiona Ellis, "Digital Marketing: Strategy, Implementation & Practice", 7th edition, Pearson Education, 2019.
REFERENCES: 1. Rob Stokes, " e Marketing: the essential guide to digital marketing", 6th edition, The Red & Yellow Creative School of Business, 2008. 2. Jayakumar K, "IT Business Process Management and Strategic Marketing", 2nd edition, 2014. 3. Vandana Ahuja , "Digital Marketing", 1st edition, Oxford University Press, 2015.

VERTICAL 6: PROGRESSIVE TECHNOLOGIES

21PIT17	TECHNIQUES OF ROBOTIC PROCESS AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of Robotic Process Automation.
- To model the basics of Robotic Process Automation tool.
- To outline the automation techniques of Robotic Process Automation.
- To experiment with bot using triggering concept.
- To develop and maintain the bot.

UNIT-I	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION	9

History of Automation - What is RPA - RPA vs Automation - Benefits of RPA - Components of RPA - RPA platforms - About UiPath - UiPath Robot - Record and Play-UiPath stack - Learning UiPath Studio-Task recorder-Step-by-step examples using the recorder.

UNIT-II	RPA TOOL	9

What is a Sequence? - Using activities with workflows – Flowchart - Control Flow, Sequencing the workflow - Control flow, various types of loops, and decision making - Step-by-step example using Sequence and Flowchart-Step-by-step example using Sequence and Control flow.

UNIT-III	DATA MANIPULATION	9

Variables and scope–Collections -Arguments – Purpose and use - Data table usage with examples - Clipboard management - File operation with step-by-step example - CSV/Excel to data table and vice versa.

UNIT-IV	TAKING CONTROL OF THE CONTROLS	9

Taking Control of the Controls - Implementing the Attach Window activity -Finding the control - Techniques for waiting for a control - Act on controls – mouse and keyboard activities -Working with UiExplorer - Handling events - Handling events - Screen Scraping-When to use OCR-Types of OCR available - Avoiding typical failure points-SAP automation-Java plugin-Citrix automation.

UNIT-V	HANDLING USER EVENTS AND ASSISTANT BOTS	9

What are assistant bots? - Monitoring system event triggers - Monitoring image and element triggers - Launching an assistant bot on a keyboard event- Common exceptions and ways to handle them - Logging and taking screenshots - Debugging techniques - Collecting crash dumps - Error reporting - Nesting workflows -Reusability of workflows.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the fundamentals of Robotic Process Automation.

CO2: Identify the different Robotic Process Automation tools and its usage.

CO3: Outline the automation techniques of Robotic Process Automation.

CO4: Apply the various triggering concept for monitoring bots.

CO5: Plan, develop and deploy bots.

TEXT BOOKS:

1. Alok Mani Tripathi, "Learning Robotic Process Automation", 1st edition Packt Publishing, 2018.
2. Nandan Mullakara, Arun Kumar and Asokan, "Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere", 1st edition,Packt Publishing, 2020.
3. Robert Fantina, Andriy Storozhuk and Kamal Goyal, "Introducing Robotic Process Automation to Your Organization", 1st edition, Apress Publication, 2021.

REFERENCES :

1. Christian Czarnecki and Peter Fettke, "Robotic Process Automation: Management, Technology, Applications", 1st edition, Walter de Gruyter Publishing, 2021.
2. Tom Taulli "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", 1st edition, Apress Publication, 2020.
3. Husan Mahey "Robotic Process Automation with Automation Anywhere", 1st edition, Packt Publishing LTD, 2021.

21PIT18	CYBER SECURITY ESSENTIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the basics of cyber security.
- To outline the security aspects of operating systems and networks.
- To make use of cryptographic techniques in network security.
- To explain the privacy principles and policies.
- To illustrate the security management and incidents.

UNIT-I	INTRODUCTION TO CYBER SECURITY	9

Introduction -Computer Security - Threats -Harm - Vulnerabilities - Controls – Authentication Access Control and Cryptography - Web-User Side - Browser Attacks - Web Attacks- Targeting Users - Obtaining User or Website Data - Email Attacks.

UNIT-II	SECURITY IN OPERATING SYSTEM & NETWORKS	9

Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service

UNIT-III	DEFENCES: SECURITY COUNTER MEASURES	9

Cryptography in Network Security - Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity - Database Disclosure - Data Mining and Big Data.

UNIT-IV	PRIVACY IN CYBERSPACE	9

Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining - Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies.

UNIT-V	MANAGEMENT AND INCIDENTS	9

Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster - Emerging Technologies - The Internet of Things - Economics - Electronic Voting - Cyber Warfare- Cyberspace and the Law – Information and Laws - Cyber crime - Cyber Warfare and Home Land Security.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the basic concepts of computer security.

CO2: Illustrate methods for Security in operating system and networks.

CO3: Identify the various security counter measures.

CO4: Summarize the privacy principles and policies.

CO5: Interpret the management strategies of cyber space.

TEXT BOOKS:

1. Charles P. Pfleeger, Shari Lawrence Pfleeger and Jonathan Margulies, "Security in Computing", 5th edition, Pearson Education , 2015.
2. Martti Lehto and Pekka Neittaanmäki, "Cyber Security: Analytics, Technology and Automation edited", Springer International Publishing Switzerland, 2015.
3. George K. Kostopoulous, "Cyber Space and Cyber Security", 2nd edition, CRC Press, 2017.

REFERENCES :

1. Jan L.Harrington, "Network Security A Practical Approach", 1st edition, Morgan Kaufmann Publishers, 2005.
2. Edward Amoroso, "Cyber Security", 1st edition, Silicon Press, 2006.
3. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations",1st edition, CBS publishers, New Delhi, 2004.

21PIT19	3D PRINTING AND DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the importance of 3D printing in manufacturing.
- To compare different 3D printing technologies.
- To select a suitable material for 3D printing.
- To choose different methods for Post-processing of 3D printing parts.
- To develop the applications of 3D printing.

UNIT-I	INTRODUCTION AND BASIC PRINCIPLES	9

3D Printing, Generic 3D Printing Process, Benefits of 3D Printing, Distinction Between 3D Printing and CNC Machining, Other Related Technologies Development of 3D Printing Technology: Introduction, Computers, Computer-Aided Design Technology, Other Associated Technologies, The Use of Layers, Classification of 3D Printing Processes, Metal Systems, Hybrid Systems, Milestones in 3D Printing Development, 3D Printing around the World.

UNIT-II	3D PRINTING PROCESS CHAIN & PHOTOPOLYMERIZATION PROCESSES	9

Eight Steps in Additive Manufacture, Variations from One 3D Printing Machine to Another, Metal Systems, Maintenance of Equipment, Materials Handling Issues, design for 3D printing. Introduction to Photopolymerization Processes: Photopolymerization Materials, Reaction Rates, Vector Scan SL, SL Resin Curing Process, SL Scan Patterns, Vector Scan Micro stereolithography, Mask Projection Photopolymerization Technologies and Processes, Two-Photon SL.

UNIT-III	POWDER BED FUSION PROCESSES & EXTRUSION-BASED SYSTEMS	9

Powder Bed Fusion Processes: Introduction, SLS Process Description, Powder Handling, Approaches to Metal and Ceric Part Creation, Variants of Powder Bed Fusion Processes, Process Par 3D Printingeters, Applied Energy Correlations and Scan Patterns, Typical Materials and Applications, Materials - Capabilities and Limitations. Extrusion-Based Systems: Introduction, Basic Principles, Plotting and Path Control, Materials, Limitations of FDM, Bioextrusion, Other Systems.

UNIT-IV	DESIGN, GUIDELINES FOR PROCESS SELECTION & SOFTWARE ISSUES	9

Design for 3D Printing - Design for Manufacturing and Assembly, Core DFM for 3D Printing Concepts and Objectives, 3D Printing Unique Capabilities, Exploring Design Freedoms, Design Tools for 3D Printing. Guidelines for Process Selection - Selection Methods for a Part, Challenges of Selection, Preliminary Selection, Production Planning and Control.

Software Issues for 3D Printing - Preparation of CAD Models – the STL File, Problems with STL Files, STL File Manipulation, Beyond the STL File, Additional Software to Assist 3D Printing.		
UNIT-V	**MEDICAL APPLICATIONS & FUTURE DIRECTIONS FOR 3D PRINTING**	**9**
Medical Applications for 3D Printing - Use of 3D Printing to Support Medical Applications, Software Support for Medical Applications, Limitations of 3D Printing for Medical applications, Further Development of Medical 3D Printing Applications. Use of Multiple Materials in 3D Printing - Discrete Multiple Material Processes, Porous Multiple Material Processes, Blended Multiple Material Processes, Embedded Component 3D Printing, Commercial Applications Using Multiple Materials, Future Directions, Business Opportunities and Future Directions		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the basics of 3D printing.

CO2: Explain different 3D printing Technologies.

CO3: Identify suitable materials for 3D printing.

CO4: Make use of different methods for Post-processing of 3D printing parts.

CO5: Plan 3D printing for medical applications and commercial applications.

TEXT BOOKS:

1. Ian Gibson, David W Rosen and Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", 2nd edition, Springer, 2010.
2. Ben Redwood, Filemon Schoffer and Brian Garret, "The 3D Printing Handbook: Technologies, design and applications", 1st edition, 3DHubs publications, 2017.
3. Dorling Kindersley, "3D printing projects: Amazing ideas to print and make", 1st edition, DK publishing, 2017.

REFERENCES :

1. Chua Chee Kai and Leong Kah Fai, "Rapid Prototyping: Principles &Applications", 3rd edition, World Scientific publisher, 2010.
2. Ali K. Kamrani and EmandAbouel Nasr, "Rapid Prototyping: Theory &Practice", 1st edition, Springer, 2006.
3. D.T. Pham and S.S. Dimov, "Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling", 1st edition, Springer 2012.

21PIT20	EMBEDDED SYSTEM DESIGN	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To infer the architecture and programming of ARM processor.
- To illustrate the design and analysis of embedded computing platform.
- To develop the basic concepts and overview of real time Operating system and the processes involved.
- To compare the general purpose system with real time operating system.
- To apply embedded systems concepts in various domains.

UNIT I	INTRODUCTION TO EMBEDDED COMPUTING AND ARM PROCESSORS	12

Embedded Computing - Complex Systems and Microprocessors, Characteristics of embedded computing applications, Challenges in embedded system design, Embedded system Design process. ARM Processor, Processor and Memory Organization, Data Operations, Flow of Control, TI C55x DSP - Processor and Memory Organization, Addressing Modes, Data Operations, Flow of Control.

Suggested Activities:

- Study of ARM evaluation system

UNIT II	EMBEDDED COMPUTING PLATFORM DESIGN	12

The CPU Bus–Memory devices and I/O devices–Models of programs– Assembly, linking and loading – Basic Compilation Techniques – Program level performance analysis – Software performance optimization – Program level energy and power analysis and optimization – Analysis and optimization of program size– Program validation and testing.

Suggested Activities:

- Interfacing ADC and DAC & Interfacing LED and PWM.

UNIT III	PROCESSES AND OPERATING SYSTEMS	12

Introduction – Kernel, Threads –Multiple tasks and multiple processes – Multirate systems– Preemptive real–time operating systems– Priority based scheduling– Inter process communication mechanisms, Evaluating Operating System Performance, Power Management and Optimization for Processes.

Suggested Activities:

- Interfacing real time clock and serial port.
- Interfacing keyboard and LCD.

UNIT IV	NETWORKS	12

Distributed Embedded Architectures – Networks for embedded systems: I2C, Ethernet, Field bus–Network based Design, Internet Enabled Systems.

Suggested Activities:

- Interfacing of servo motor and DC motor.
- Interfacing stepper motor and temperature sensor.

UNIT V	APPLICATIONS OF EMBEDDED SYSTEMS	12

Telephone Answering Machine - Cell Phones – Compact DISCs and DVDs — Audio Players– Video Accelerator – Digital Still Cameras – Elevator Controller.

Suggested Activities:

- Implementing zigbee protocol with ARM.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the architecture and programming of ARM processor.

CO2: Outline the concepts of embedded systems.

CO3: Make use of system design techniques to develop software for embedded systems.

CO4: Compare the general purpose system with real time operating system.

CO5: Model real-time consumer/industrial applications using system concepts.

TEXT BOOK:

1. Marilyn Wolf, "Computers as Components - Principles of Embedded Computing System Design", 4th edition "Morgan Kaufmann Publisher (An imprint from Elsevier), 2016.
2. Jane W.S.Liu , "Real Time Systems" Pearson Education, 3rd Indian Reprint, 2018.
3. Jonathan W.Valvano, "Embedded Microcomputer Systems Real Time Interfacing", 3rd edition, Cengage Learning, 2012.

REFERENCES:

1. Sriram V Iyer and Pankaj Gupta, "Embedded Real Time Systems Programming", 1st edition, TataMcGrawHill, 2017.
2. Geoffrey Brown, "Discovering the STM32 Micro controller", 1st edition, Indiana University press, 2016.
3. David. E. Simon, "An Embedded Software Primer", 1st edition, Fifth Impression, Addison Wesley Professional, 2007.
4. C.M. Krishna and Kang G. Shin, "Real-Time Systems", 1st edition, Tata McGraw-Hill Education, 2010.
5. K.V.K.K.Prasad, "Embedded Real-Time Systems: Concepts, Design and Programming", 1st edition, Dream Tech Press, 2005.

21PIT21	PRINCIPLES OF QUANTUM COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the foundation of traditional computing.
- To interpret the knowledge on the modeling of quantum circuit.
- To summarize the knowledge of basic quantum algorithms.
- To outline the knowledge of advanced quantum algorithms.
- To interpret the quantum computational complexity and error correction methods.

UNIT I	INTRODUCTION AND BACKGROUND	9

Overview of traditional computing – Computers and the Strong Church–Turing Thesis - The Circuit Model of Computation- A Linear Algebra Formulation of the Circuit Model - Reversible Computation - A Preview of Quantum Physics - Quantum Physics and Computation

UNIT II	DIRAC NOTATION AND QUANTUM MECHANICS	9

The Dirac Notation and Hilbert Spaces - Dual Vectors – Operators - The Spectral Theorem-Functions of Operators - Tensor Products - The Schmidt Decomposition Theorem - Some Comments on the Dirac Notation. The State of a Quantum System - Time-Evolution of a Closed System - Composite Systems - Measurement - Mixed States and General Quantum Operations - Mixed States, Partial Trace, General Quantum Operations.

UNIT III	A QUANTUM MODEL OF COMPUTATION	9

The Quantum Circuit Model - Quantum Gates - 1-Qubit Gates, Controlled-U Gates, Universal Sets of Quantum Gates - Efficiency of Approximating Unitary Transformations - Implementing Measurements with Quantum Circuits.

UNIT IV	INTRODUCTORY QUANTUM ALGORITHMS	9

Probabilistic Versus Quantum Algorithms - Phase Kick-Back - The Deutsch Algorithm - The Deutsch–Jozsa Algorithm - Simon's Algorithm.

UNIT V	QUANTUM ERROR CORRECTION	9

Classical Error Correction - The Error Model, Encoding, Error Recovery - The Classical Three-Bit Code - Fault Tolerance - Quantum Error Correction - Error Models for Quantum Computing, Encoding, Error Recovery.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the foundations of traditional computing

CO2: Interpret the knowledge on the modeling of quantum circuit

CO3: Infer the knowledge of basic quantum computing.

CO4: Extend the knowledge of advanced quantum algorithms.
CO5: Summarize the quantum computational complexity and error correction methods.
TEXT BOOK: 1. Jack Hidary, "Quantum Computing: An Applied Approach", Springer, 2019. 2. Chris Bernhardt "Quantum Computing for Everyone" 1st edition, The MIT Press, 2019. 3. Wolfgang Scherer, "Mathematics of Quantum Computing: An Introduction Hardcover" Springer, 2019.
REFERENCES: 1. Maria Luisa Dalla Chiara, Roberto Giuntini, Roberto Leporini and Giuseppe Sergioli, "Quantum Computation and Logic: How Quantum Computers Have Inspired Logical Investigations", 1st edition, Springer, 2018. 2. Michael A. Nielsen and Issac L. Chuang, "Quantum Computation and Quantum Information", 10th edition, Cambridge University Press, 2010. 3. P. Kaye, R. Laflamme and M. Mosca, "An introduction to Quantum Computing", 1st edition, Oxford University Press, 2007.

21PIT22	AUTONOMOUS GROUND VEHICLE SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the fundamentals of autonomous driving.
- To identify the different ways of sensing internal states of Autonomous Ground Vehicles (AGVs).
- To model the environment perception for autonomous driving.
- To develop the navigation techniques of AGVs.
- To utilize the fundamentals of vehicle control systems and connected vehicles.

UNIT I	INTRODUCTION TO AUTONOMOUS DRIVING	9

Autonomous Driving Technologies Overview – Autonomous Driving Algorithms –Autonomous Driving Client System – Autonomous Driving Cloud Platform – Components of autonomy – Difference between Unmanned and Autonomous Vehicles – Introduction to Unmanned Aerial Vehicles (UAVs).

UNIT II	SENSORS FOR AUTONOMOUS GROUND VEHICLES	9

Sensor Characteristics –Vehicle Internal State Sensing: OEM Vehicle Sensors, GPS, Inertial Measurements, Magnetometer – External World Sensing: RADAR, Lidar, Image Processing Sensors.

UNIT III	ENVIRONMENT PERCEPTION AND MODELING	9

Road Recognition: Basic Mean Shift Algorithm, Mean Shift Clustering, Mean Shift Segmentation, Mean Shift Tracking, Road Recognition Algorithm –Vehicle Detection and Tracking: Generating ROIs, Multi Resolution Vehicle Hypothesis, Vehicle Validation using Gabor Features and SVM, Boosted Gabor Features – Multiple Sensor Based Multiple Object Tracking.

UNIT IV	NAVIGATION FUNDAMENTALS	9

Introduction – Navigation: GNSS Overview, GPS, GLONASS, Galileo, Compass – Inertial Navigation Overview: Inertial Sensor Technology – GNSS/INS Integration Overview – Case Study on Kalman Filtering.

UNIT V	VEHICLE CONTROL AND CONNECTED VEHICLE	9

Vehicle Control: Cruise Control, Antilock Brake Systems, Steering Control and Lane Following, Parking – Connected Vehicles: Vehicle to Vehicle Communication, Vehicle to Infrastructure Communication.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Identify the requirements and design challenges of AGVs.

CO2: Select suitable sensors to sense the internal state and external world of AGVs.

CO3: Make use of lane detection, road detection & vehicle detection algorithms.
CO4: Utilize ground vehicle navigation algorithms.
CO5: Develop ground vehicle control systems.

TEXT BOOK:

1. Shaoshan Liu, Liyun Li, Jie Tang, Shuang Wu and Jean-Luc Gaudiot, "Creating Autonomous Vehicle Systems", 1st edition, Morgan & Claypool, 2018.
2. Umit Ozguner, Tankut Acarman and Keith Redmill, "Autonomous Ground Vehicles", 1st edition , Artech House, 2011.
3. Sumit Ranjan, "Applied Deep Learning and Computer Vision for Self-Driving Cars: Build autonomous vehicles using deep neural networks and behavior-cloning techniques", 1st edition, Packt Publishing, 2020.

REFERENCES:

1. Hong Cheng, "Autonomous Intelligent Vehicles Theory, Algorithms, and Implementation", Springer, 2011.
2. Mohinder S. Grewal, Angus P. Andrews and Chris G. Bartone, "Global Navigation Satellite Systems, Inertial Navigation, and Integration", 3rd edition, John Wiley & Sons, 2013.
3. Thomas Bräunl, "Embedded Robotics: From Mobile Robots to Autonomous Vehicles with Raspberry Pi and Arduino", Springer, 2022.

21PIT23	E-LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the various E-learning approaches and Components.
- To experiment with Design Thinking.
- To identify the types of design models for E-learning.
- To select various E-learning Authoring tools for development.
- To utilize E-learning courseware for evaluation and management solutions.

UNIT I	INTRODUCTION	9

Need for E-Learning – Approaches of E-Learning – Components of E-Learning – Synchronous and Asynchronous Modes of Learning – Quality of E-Learning – Blended Learning: Activities, Team and Technology – Work Flow to Produce and Deliver E-Learning Content – Design Thinking: Introduction – Actionable Strategy – Act to Learn – Leading Teams to Win.

UNIT II	DESIGNING E-LEARNING COURSE CONTENT	9

Design Models of E-Learning – Identifying and Organizing E-Learning Course Content: Needs Analysis – Analyzing the Target Audience – Identifying Course Content – Defining Learning Objectives – Defining the Course Sequence – Defining Instructional Methods – Defining Evaluation and Delivery Strategies – Case Study.

UNIT III	CREATING INTERACTIVE CONTENT	9

Preparing Content: Tips for Content Development and Language Style – Creating Storyboards: Structure of an Interactive E-Lesson – Techniques for Presenting Content – Adding Examples – Integrating Multimedia Elements – Adding Examples – Developing Practice and Assessment Tests – Adding Additional Resources– Courseware Development – Authoring Tools – Types of Authoring Tools – Selecting an Authoring Tool.

UNIT IV	LEARNING PLATFORMS	9

Types of Learning Platforms – Proprietary Vs. Open – Source LMS – LMS Vs LCMS – Internally Handled and Hosted LMS – LMS Solutions – Functional Areas of LMS.

UNIT V	COURSE DELIVERY AND EVALUATION	9

Components of an Instructor-Led or Facilitated Course – Planning and Documenting Activities – Facilitating Learners Activities – E-Learning Methods and Delivery Formats –Using Communication Tools for E-Learning – Course Evaluation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Compare the phases of activities in models of E-learning

CO2: Identify appropriate instructional methods and delivery strategies

CO3: Choose appropriate E-learning Authoring tools.

CO4: Develop interactive E-learning courseware.

CO5: Organize the E-learning courseware.

TEXT BOOK:

1. Raymundo Solak, "E-Learning Techniques: An Inexpensive Software Application for Developing Learning Solutions", 1st edition, 2022.
2. Johnny Schneider, "Understanding Design Thinking, Lean and Agile", 1st edition, O'Reilly Media, 2017.
3. Crews T. B., Sheth S. N and Horne T. M., "Understanding the Learning Personalities of Successful Online Students", 1st edition, Educause Review, 2014.

REFERENCES:

1. Madhuri Dubey, "Effective E–learning Design, Development and Delivery", 1st edition, University Press, 2011.
2. Clark, R. C. and Mayer, R. E., "E-Learning and the Science of Instruction",3rd edition, 2011.
3. Rob Philips, Carmel McNaught and Gregor Kennedy, "Evaluating e-Learning Guiding Research and Practice", 1st edition, Taylor and Francis publishers, 2012.

21PIT24	NEXT GENERATION NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the fundamentals of 5G internet.
- To develop the concept of small cells in 5G mobile networks.
- To interpret the mobile clouds in 5G network context.
- To select the role of cognitive radios in 5G networks.
- To experiment with security issues in 5G networks.

UNIT I	PERVASIVE CONNECTED WORLD AND 5G INTERNET	9

Historical Trend of Wireless Communications – Evolution of LTE Technology to Beyond 4G – 5G Roadmap – Ten Pillars of 5G – Internet of Things and Context Awareness –Networking Reconfiguration and Virtualization Support – Mobility – Quality of Service Control – Emerging Approach for Resource over Provisioning.

UNIT II	SMALL CELLS FOR 5G MOBILE NETWORKS	9

Introduction to Small Cells – Capacity Limits and Achievable Gains with Densification – Mobile Data Demand – Demand vs. Capacity – Small Cell Challenges.

UNIT III	COOPERATION FOR NEXT GENERATION WIRELESS NETWORKS	9

Introduction – Cooperative Diversity and Relaying Strategies: Cooperation and Network Coding, Cooperative ARQ MAC Protocols – PHY Layer Impact on MAC Protocol Analysis: Impact of Fast Fading and Shadowing on Packet Reception for QoS Guarantee, Impact of Shadowing Spatial Correlation – Study: NCCARQ, PHY Layer Impact.

UNIT IV	MOBILE CLOUDS AND COGNITIVE RADIO	9

Introduction – The Mobile Cloud – Mobile Cloud Enablers – Network Coding – Overview of Cognitive Radio Technology in 5G Wireless – Spectrum Optimization using Cognitive Radio – Relevant Spectrum Optimization Literature in 5G – Cognitive Radio and Carrier Aggregation – Energy Efficient Cognitive Radio Technology.

UNIT V	SECURITY AND SELF ORGANISING NETWORKS	9

Overview of Potential 5G Communications System Architecture – Security Issues and Challenges in 5G Communications Systems – Self Organising Networks: Introduction, Self Organising Networks in UMTS and LTE, The Need for Self Organising Networks in 5G, Evolution towards Small Cell Dominant HetNets.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Compare the 5G network with older generations of networks.

CO2: Identify suitable small cells for different applications in 5G networks.

CO3: Explain 5G network scenarios.

CO4: Develop applications to mobile cloud.

CO5: Utilize applications with 5G network support.

TEXT BOOK:

1. Mahmoud Elkhodr, "Enabling Technologies and Architectures for Next-Generation Networking Capabilities", IGI Global, 2019.
2. Athanasios G. Kanatas, Konstantina S. Nikita and Panagiotis (Takis) Mathiopoulos, "New Directions in Wireless Communications Systems: From Mobile to 5G", CRC Press, 2017.
3. Yin Zhang and Min Chen, "Cloud Based 5G Wireless Networks – Springer Briefs in Computer Science", Springer, 2016.

REFERENCES:

1. Thierry Van de Velde, "Value-Added Services for Next Generation Networks", Auerbach Publications, 2019.
2. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", Wiley, 2015.
3. Byrav Ramamurthy, "Next-Generation Internet: Architectures and Protocols", Cambridge University Press, 2011.

VERTICAL 7: COGNITIVE COMPUTING

21PCS25	ETHICS AND ARTIFICIAL INTELLIGENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the need for ensuring ethics in AI.
- To outline ethical issues with the development of AI agents.
- To interpret the ethical considerations in different AI applications.
- To demonstrate the relation of ethics with nature.
- To summarize the risk for Human rights and other fundamental values.

UNIT-I	**INTRODUCTION TO ETHICS AND AI**	**9**

Role of Artificial Intelligence in Human Life, Understanding Ethics, Why Ethics in AI? Ethical Considerations of AI, Current Initiatives in AI and Ethics, Ethical Issues with our relationship with artificial Entities.

UNIT-II	**FRAMEWORK AND MODELS**	**9**

AI Governance by Human-right centered design, Normative models, Role of professional norms, Teaching Machines to be Moral.

UNIT-III	**CONCEPTS AND ISSUES**	**9**

Accountability in Computer Systems, Transparency, Responsibility and AI. Race and Gender, AI as a moral right-holder.

UNIT-IV	**PERSPECTIVES AND APPROACHES**	**9**

Perspectives on Ethics of AI, Integrating ethical values and economic value, Automating origination, AI a Binary approach, Machine learning values, Artificial Moral Agents.

UNIT-V	**CASES AND APPLICATION**	**9**

Ethics of Artificial Intelligence in Transport, Ethical AI in Military, Biomedical research, Patient Care, Public Health, Robot Teaching, Pedagogy, Policy, Smart City Ethics.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the ethical issues in the development of AI agents.

CO2: Illustrate the ethical considerations of AI with perspectives on ethical values.

CO3: Experiment with the ethical policies in AI based applications and Robot development.

CO4: Make use of the AI concepts for addressing societal problems by adapting the legal concepts and securing fundamental rights.

CO5: Choose the AI concepts to overcome the evil genesis.

TEXT BOOKS:

1. Markus D. Dubber, Frank Pasquale and Sunit Das, "The Oxford Handbook of Ethics of AI", 1st Edition, Oxford University Press, 2020
2. Paula Boddington, "Towards a Code of Ethics for Artificial Intelligence", 1st Edition, Springer, 2018
3. S. Matthew Liao, "Ethics of Artificial Intelligence", 1st Edition, Oxford University Press, 2020

REFERENCES:

1. N. Bostrom and E. Yudkowsky. "The ethics of artificial intelligence". In W. M. Ramsey and K. Frankish, editors, The Cambridge Handbook of Artificial Intelligence. Cambridge University Press, Cambridge, 2014.
2. Wallach, W., and Allen, C, "Moral machines: Teaching Robots right from wrong", 1st Edition, Oxford University Press, 2010.
3. Mark Coeckelbergh, "AI Ethics", 1st Edition, MIT Press, 2020.

21PCS26	INTRODUCTION TO KNOWLEDGE ENGINEERING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To illustrate the differences between data, information and knowledge.
- To infer the various techniques for knowledge based systems.
- To demonstrate object oriented knowledge.
- To interpret knowledge organization.
- To contrast knowledge based system design.

UNIT-I	INTRODUCTION	6 +6

Data, Information and Knowledge - Knowledge Engineer Skills - Knowledge-Based Systems Introduction – Knowledge Reuse – Knowledge Engineering Techniques.

SUGGESTED ACTIVITIES:

- Data pre-processing and annotation
- Creation of datasets

UNIT-II	KNOWLEDGE ACQUISITION	6 +6

Knowledge and Intelligence – Applications of Knowledge Reuse – Ethical Model of Knowledge – Stages, challenges, Approaches of Knowledge Acquisition – Techniques

SUGGESTED ACTIVITIES:

- Learn existing datasets
- Implementing Treebank's

UNIT-III	KNOWLEDGE REPRESENTATION	6 +6

Roles of Knowledge Representation – Classification of Knowledge – Relationship Between Attributes – Object Oriented Knowledge Representation – Advanced Knowledge Representation Techniques

SUGGESTED ACTIVITIES:

- Implementation of object oriented representation
- Design the classification of knowledge

UNIT-IV	KNOWLEDGE MANIPULATION	6 +6

Knowledge Organization – Indexed Organization – Knowledge Management Platform –Reasoning – Knowledge Codification – Testing of Knowledge Based Systems

SUGGESTED ACTIVITIES:

- Implementation of Knowledge organization
- Testing of knowledge based systems

UNIT-V	KNOWLEDGE BASED SYSTEM DESIGN	6 +6

Semantic Web - Role Played by Social Networking Site – Representation of Design Knowledge - Knowledge Acquisition and Documentation Structuring - UML Notations in KADS

SUGGESTED ACTIVITIES:

- Representation of UML notations
- Scientific distributions used in python for Knowledge Acquisition.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the concept of Data, Information and knowledge.

CO2: Identify the concepts of knowledge acquisition for an expert system.

CO3: Model the knowledge using object oriented representation for real-world phenomena.

CO4: Make use of knowledge organization to index and design knowledge.

CO5: Construct Semantic Web using the knowledge based system design practices.

TEXT BOOKS:

1. Ela Kumar, "Knowledge Engineering", 1st Edition, I.K International Publishing ,2018.
2. Hamed Fazlallahtabar, "Knowledge Engineering: The Process Paradigm", 1st Edition, CRC Press, 2020.
3. Simon Kendal and Malcolm Creen, "An Introduction to Knowledge Engineering", 1st Edition, Springer, 2007.

REFERENCES:

1. Emilia Mendes, "Practitioner's Knowledge Representation -A Pathway to Improve Software Effort Estimation", 1st Edition, Springer, 2014.
2. Michael Gelfond and YuliaKahi, " Knowledge Representation, Reasoning and the Design of Intelligent Agents", 1st Edition, Cambridge University Press, 2014.
3. Lucja M. Iwariska and Stuart C. Shapiro, "Natural Language Processing and Knowledge Representation Language for Knowledge and Knowledge for Language", 1st Edition, AAAI Press/MIT Press,2000.

21PCS27	PRINCIPLES OF SOFT COMPUTING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize the basic concepts of neural network.
- To compare various techniques in neural networks.
- To outline the basic concepts of fuzzy logic.
- To relate the fuzzy systems and its applications.
- To identify soft computing and integrated soft computing techniques to solve problems.

UNIT-I	NEURAL NETWORKS	6+6

Basic Concepts of Neural network, Model of an artificial neuron, neural Network architecture: single layer and multilayer feed forward networks, recurrent networks, Characteristics, Learning Methods, Applications.

SUGGESTED ACTIVITIES:

- Classify upper case letters and lower case letters using perceptron network

UNIT-II	BACKPROPAGATION NETWORK	6+6

Architecture : perceptron model – solution - single layer artificial neural network - multilayer perception model - back propagation learning methods - effect of tuning parameters - selection of parameters, applications.

SUGGESTED ACTIVITIES:

- Build BPN for training a single hidden layer back propagation network with bipolar sigmoidal units.

UNIT-III	FUZZY LOGIC	6+6

Basic concepts of fuzzy logic - Fuzzy sets and Crisp sets - Fuzzy set theory and operations - Properties of fuzzy sets - Fuzzy and Crisp relations - Fuzzy to Crisp conversion.

SUGGESTED ACTIVITIES:

- Develop fuzzy logic methodology to analyze lading of an aircraft

UNIT-IV	FUZZY SYSTEMS	6+6

Crisp logic - predicate logic - fuzzy logic - fuzzy rule based system – defuzzification - Applications

SUGGESTED ACTIVITIES:

- Construct genetic algorithm to solve a traveling salesman problem.

UNIT-V	GENETIC ALGORITHM	6+6

Fundamentals of genetic algorithm - genetic modeling - Integration of neural network - fuzzy and genetic algorithms.

SUGGESTED ACTIVITIES:

- Use neural network and fuzzy logic to control the motion of an inverted pendulum.

	TOTAL:60 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Identify neural network techniques and their roles in building intelligent machines

CO2: Make use of Backpropagation network for real world problems

CO3. Experiment with fuzzy logic and reasoning to handle uncertainty

CO4: Examine fuzzy systems for solving complex problem

CO5: Compare various soft computing approaches for a given problem

TEXT BOOKS:

1. S. Rajasekaran and GA Vijayalakshmi Pai "Neural Networks, Fuzzy Logic, and Genetic Algorithms synthesis and application", 1st Edition, PHI, 2013.
2. J.S.R.Jang, C.T.Sun and E.Mizutani, "Neuro-Fuzzy and Soft Computing", 1st Edition, PHI, Pearson Education 2004.
3. Vojislav Kecman, "Learning & Soft Computing Support Vector Machines, Neural Networks, and Fuzzy Logic Models", 1st Edition, Pearson Education, 2006.

REFERENCES:

1. Timothy J. Ross, "Fuzzy Logic with Engineering Applications," 3rd Edition, Wiley India, 2004.
2. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", 1st Edition, Addison Wesley, N.Y., 2002.
3. Stamatios V. Kartalopoulos "Understanding Neural Networks and Fuzzy Logic Basic concepts & Applications", 1st Edition, IEEE Press, PHI, New Delhi, 2004.

21PCS28	OPTIMIZATION TECHNIQUES AND APPLICATIONS	L	T	P	C
		2	0	2	3

COURSEOBJECTIVES:

- To describe the basics of Optimization Techniques.
- To relate the knowledge of numerical methods for Liner Programming.
- To utilize the concept of Non-linear programming with Equality and Inequality Constraint.
- To construct dynamic programming models using sequential Optimization.
- To illustrate various meta heuristic solutions for the real time problems.

UNIT-I | **INTRODUCTIONTO OPTIMIZATION TECHNIQUES** | **6+3**

Introduction to Optimization Techniques-Need for Optimization-Historical Perspective-Optimization Parameters-Types of Optimization-Advanced Optimization Techniques-Applications of Optimization Techniques -Limitations of Optimization Techniques -Optimization methods in Engineering.

SUGGESTED ACTIVITIES:

- Evaluate the Optimization function on Optimization Techniques.

UNIT-II | **LINEAR PROGRAMMING** | **5+6**

Formulation - Graphical Method and Simplex Method – Primal vs Dual relationships - Sensitivity Analysis-Dual Simplex Method.

SUGGESTED ACTIVITIES:

- Construct and Solve Linear Programming Problem by Simplex method.
- Construct and Solve Linear Programming Problem by Dual Simplex method.

UNIT-III | **NONLINEAR PROGRAMMING** | **7+10**

Nonlinear Programming (with Equality Constraints) :Lagrangian Multiplier - Equality constrained optimization -Projected Gradient Methods with equality constraints.

Nonlinear Programming (Inequality Constraints): Khun concept - Khun Tucker conditions.

SUGGESTED ACTIVITIES:

- Construct and nonlinear optimization problems by using numerical optimization methods (indirect)-Newtons methods.
- Construct and solve non linear optimization problems using with equality constraints using Lagrangian Multiplier.
- Construct and solve non linear optimization problems using with inequality constraints using usingKhun Tucker conditions.

UNIT-IV | **SEQUENTIAL OPTIMIZATION** | **6+3**

Representation of multi stage decision process -Types of multi stage decision problems- Concept of sub optimization and the principle of optimality- Recursive equations –Forward and backward recursions.

SUGGESTED ACTIVITIES:

- Case study on Multistage Decision Making Under Uncertainty.
- Case study on Principle on Optimality with Forward recursion and Backward Recursion.

UNIT-V	META-HEURISTICOPTIMIZATIONTECHNIQUES	6+8

Classification of heuristic solution techniques Heuristic and Meta Heuristic Programming: Simulated Annealing, Genetic Algorithm, Particle Swarm Optimization algorithm - Applications of optimization problems.

SUGGESTED ACTIVITIES:

- Exemplifying the optimization of real-world problem using Simulated Annealing.
- Exemplifying the optimization of real-world problem using Genetic Algorithm.
- Exemplifying the optimization of real-world problem using Particle Swarm Optimization Algorithm.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the basics of Optimization Techniques.

CO2: Make use of Linear Programming for solving optimization problems.

CO3: Identify the usage of Non Linear Programming for solving optimization problems.

CO4: Express the multi stage decision problems using sequential optimization.

CO5: Develop the knowledge of various metaheuristic algorithms for real world problems.

TEXT BOOKS:

1. Vikrant Sharma, Vinod Kumar Jain and Atul Kumar, "An Introduction to Optimization Techniques", 1st Edition, CRC Press, Taylor and Francis Group, 2021.
2. Rardin, R. L., "Optimization in Operations Research", 2nd Edition, Pearson 2019.
3. Xin-she Yang, "Optimization Techniques and Applications with Examples"1stEdition, Wiley Publishers, 2018.

REFERENCES:

1. Jeeva Jose, "Introduction to Machine Learning", 1st Edition, Khanna Book Publishing, 2020.
2. Nayak, S., "Fundamentals of Optimization Techniques with Algorithms", 1st Edition, Elsevier Science, 2020.
3. Foulds, L. R. "Optimization Techniques: An Introduction". 1st Edition, United States, Springer New York, 2012.

21OMA01	**GRAPH THEORY AND ITS APPLICATIONS** *(Common to all B.E. / B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To discuss the fundamentals of graph theory.
- To calculate the graph coloring, matching and covering number.
- To identify the types of graphs and operation on graphs.
- To explain the concepts of trees.
- To discuss the concepts of directed graphs and its properties.

UNIT I	**INTRODUCTION**	**9**
Basic definitions in graphs – walk – path – circuits - Isomorphism.		
UNIT II	**MATRICES AND COLORING**	**9**
Adjacency matrix and its properties - incidence matrix and its properties - Chromatic number Chromatic partitioning – Chromatic polynomial – Matching –Covering.		
UNIT III	**TYPES OF GRAPHS**	**9**
Connected and disconnected graph – Operation on graphs – Eulerian graph–Hamiltonian graph.		
UNIT IV	**TREES (CONNECTIVITY) PLANARITY**	**9**
Properties of trees – distance and centers in tree –Algorithms (Kruskal's and Dijkstra Algorithm) – Rooted and binary trees – Spanning trees–Planar graphs: Definition and Properties.		
UNIT V	**DIRECTED GRAPHS**	**9**
graphs – Types of directed graphs – digraphs & its properties and binary relations directed paths and connectedness–Euler graphs. (Theorems Statement only)		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate the nature of graphs and illustrate isomorphism on graphs.

CO2: Construct the adjacent matrix and incident matrix for the given graph and also develop the chromatic polynomial for the given graph.

CO3: Apply various types of graphs and determine the existence of Eulerian, Hamiltonian path & circuits.

CO4: Interpret the planarity of graphs and the classes of trees with properties.

CO5: Identify the types of directed graphs with its properties.

TEXT BOOKS: 1. Narsingh Deo, "Graph Theory with Applications to Engineering and Computer Science", 1st Edition, Dover Publications, IAC, 2016. 2. J.A.Bondy and USR.Moorthy, "Graph Theory with Applications", 2nd Edition, Indian Reprint, Springer Publishers, 2015. 3. FrankHarary, "GraphTheory", Narosa Publishers, New Delhi, 2013.
REFERENCES: 1. William Kocay and Donald.L.Kreher,"Graphs,AlgorithmandOptimization",CRT Press,2005. 2. Krishnaiyan and KT Thulasiraman, "Handbook of Graph Theory, Combinatorial Optimization and Algorithms", CRC Press Taylor & Francis Group, 2016. 3. R. Diestel, "Graduate Texts in Mathematics, Graph theory", 5th edition, Springer 2017.

21PCS29	INTRODUCTION TO GAME THEORY	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To summarize the novel concepts of game theory including cooperative games.
- To describe the non-cooperative games.
- To extend the games beyond normal and extensive form.
- To identify the problems in mechanism design.
- To express several auctions in games.

UNIT-I	INTRODUCTION TO GAME THEORY	6+6

Strategic form- Perfect information extensive-form games-Imperfect-information extensive-form games.

SUGGESSTED ACTIVITIES:

CASE STUDY: Game theory Explorer

UNIT-II	NON-COOPERATIVE GAMES	6+6

Self-interested agents-Games in normal form-analysing games-solutions.

SUGGESSTED ACTIVITIES:

Implement the winner Nim-game

UNIT-III	GAMES BEYOND NORMAL AND EXTENSIVE FORMS	6+6

Repeated Games- The Prisoner's Dilemma-Stochastic Games-Bayesian Games-Congestion Games-Graphical Games -Communication Games

SUGGESSTED ACTIVITIES:

Implementation of Tic-Tac-Toe game

UNIT-IV	MECHANISM DESIGN	6+6

Mechanism design with unrestricted preferences - Quasilinear preferences - Efficient mechanisms - VCG Mechanisms

SUGGESSTED ACTIVITIES:

Implement prisoners dilemma

UNIT-V	AUCTIONS	6+6

Auctions, Mechanism design for Sponsored search auctions- Single-good auctions- Multiunit auctions- Combinatorial auctions- Exchanges

SUGGESSTED ACTIVITIES:

Finding the Second price auction

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate the game theory concepts.

CO2: Illustrate the various types of non-cooperative game theory concepts.

CO3: Relate the normal and extensive games.

CO4: Discover the various mechanism design concepts.

CO5: Construct the auctions concepts.

TEXT BOOKS:

1. Yoav Shoham and Kevin Leyton-Brown " Multiagent Systems" , 1st Edition ,Cambridge University Press, 2010.
2. Giacomo Bonanno "Game Theory" University of California 1st Edition 2015.
3. Martin J. Osborne," An Introduction to Game Theory", 1st Edition, The MIT Press, 2003.

REFERENCES:

1. Roger B. Myerson, "Game Theory: Analysis of Conflict, "Harvard University Press, Cambridge, Massachusetts, USA, 1997.
2. Michael Maschler, EilonSolan, and Shmuel Zamir, " Game Theory",1st Edition Cambridge University Press,2013.
3. Y. Narahari, " Game Theory and Mechanism Design",1st Edition , IISc Press and the World Scientific Publishing Company, 2014.

<table>
<tr><td rowspan="2">21PCS30</td><td rowspan="2">COGNITIVE SCIENCE THEORY AND APPLICATIONS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:
• To describe the basics of Cognitive Science.
• To associate the concept of the mind and intelligence, embracing psychology, artificial intelligence, neuro science and linguistics.
• To extend the role of neuro science in the cognitive field.
• To paraphrase advanced analytics with cognitive computing.
• To express various applications of cognitive computing life problems.</td></tr>
<tr><td>UNIT-I</td><td colspan="4">FOUNDATION OF COGNITIVE SCIENCE</td><td>6+3</td></tr>
<tr><td colspan="6">What is Cognitive Science-Cognitive Psychology: The Architecture of the Mind, Cognitive Psychology: Future Explorations, Philosophy: Foundations of Cognitive Science Artificial Intelligence: Knowledge Representation, Artificial Intelligence: Search, Control and Learning.
SUGGESTED ACTIVITIES:
• Experiment with data for calculating reaction time in cognitive system.</td></tr>
<tr><td>UNIT-II</td><td colspan="4">COGNITIVE PSYCHOLOGY</td><td>6+7</td></tr>
<tr><td colspan="6">Cognitive Psychology–The Architecture of the Mind-The Nature of Cognitive Psychology-A Global View of the Cognitive Architecture- Propositional Representation – Schematic Representation-Cognitive Processes, Working Memory, and Attention- The Acquisition of Skill- The Connectionist Approach to Cognitive Architecture.
SUGGESTED ACTIVITIES:
• Experimentation on Short-term Memory for cognitive Analysis.
• Experimentation on Semantic Memory for cognitive Analysis.</td></tr>
<tr><td>UNIT-III</td><td colspan="4">COGNITIVE NEUROSCIENCE</td><td>6+7</td></tr>
<tr><td colspan="6">The Neuroscience Perspective-Methodology in Neuroscience -Techniques for the Study of Brain Image-Evaluating Techniques for the study of Brain Image-Traditional Brain Recording Methods-Modern Brain Imaging Methods-Brain Stimulation Techniques.
SUGGESTED ACTIVITIES:
• Build Neural network models for Cognitive Processes.
• Build Competitive Learning Neural Networks for feature mapping.</td></tr>
<tr><td>UNIT-IV</td><td colspan="4">BIGDATA VS COGNITIVE COMPUTING</td><td>6+7</td></tr>
<tr><td colspan="6">Relationship between Big Data and Cognitive Computing: Dealing with human-generated data, defining big data, architectural foundation, analytical data warehouses, Hadoop, data in motion and streaming data, integration of big data with traditional data.
SUGGESTED ACTIVITIES:
• Build cognitive model to improve mental fitness using big data and game play.</td></tr>
</table>

- Build a Probabilistic Model for handling Big Data.

UNIT-V	COGNITIVE APPLICATIONS	6+6

The process of building a cognitive application: Emerging cognitive platform, defining the objective, defining the domain, understanding the intended users and their attributes, questions and exploring insights, training and testing- Building a cognitive health care application and Smarter cities: Cognitive Computing in Government.

SUGGESTED ACTIVITIES:

- Build a cognitive health care application.
- Build a cognitive based smart city application.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the basics of Cognitive Science using python Libraries.
CO2: Make use of knowledge by individual minds, brains, and machines.
CO3: Utilize the knowledge of neuroscience in the cognitive field.
CO4: Interpret advanced analytics to cognitive computing.
CO5: Illustrate various applications of cognitive computing.

TEXT BOOKS:

1. Jay Friedenberg, Gordon Silverman and Michael James Spivey, "Cognitive Science: an introduction to the study of mind",4th Edition, Sage Publications,2021.
2. Judith H Hurwitz, Marcia Kaufman and Adrian Bowles, "Cognitive computing and Big Data Analytics" , 1st Edition, Wiley, 2015.
3. Vijay Raghvan, VenuGovindaraju and C.R. Rao, "Cognitive Computing: Theory and applications", 1stEdition, Elsevier publications, 2016.

REFERENCES:

1. Jose Luis Bermudez, "Cognitive Science: An Introduction to the Science of the Mind", 1st Edition Cambridge University Press, New York, 2014.
2. Mallick, Pradeep Kumar and Borah Samarjeet, "Emerging Trends and Applications in Cognitive Computing" , IGI Global Publishers, 2019.
3. Neil A.Stillingd, Steven E.Weisler, Christopher H.Chase , Mark H.Feinstein, JayL.Garfield and Edwina L.Rissland, "Cognitive Science An Introduction" 2nd Edition, MIT Press,1998.

21PCS31	STATISTICAL NATURAL LANGUAGE PROCESSING	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To familiarize the concepts and techniques of Natural language Processing for analyzing words based on Morphology and CORPUS.
- To relate mathematical foundations, Probability theory with Linguistic essentials such as syntactic and semantic analysis of text.
- To apply the Statistical learning methods and cutting-edge research models from deep Learning
- To demonstrate the state-of-the-art algorithms and techniques for text-based processing.
- To learn a Statistical Methods for Real World Applications and explore deep learning based NLP

UNIT-I	INTRODUCTION TO NLP	6+6

Introduction to NLP - Various stages of NLP –The Ambiguity of Language: Why NLP Is Difficult Parts of Speech: Nouns and Pronouns, Words: Determiners and adjectives, verbs, Phrase Structure. Statistics Essential Information Theory: Entropy, perplexity, The relation to language, Crossentropy.

SUGGESTED ACTIVITIES:

- Create CORPUS linguistics based on digestive approach (Text Corpus method)

UNIT-II	TEXT PREPROCESSING AND MORPHOLOGY	6+6

Introduction to Corpora, Corpora Analysis. Inflectional and Derivation Morphology, Morphological analysis and generation using Finite State Automata and Finite State transducer

SUGGESTED ACTIVITIES:

- Check a current methods for statistical approaches to machine translation.

UNIT-III	LANGUAGE MODELLING	6+6

Words: Collocations- Frequency-Mean and Variance –Hypothesis testing: The t test, Hypothesis testing of differences, Pearson's chi-square test, Likelihood ratios.

SUGGESTED ACTIVITIES:

- Perform POS tagging for a given natural language and Select a suitable language modelling technique based on the structure of the language.

UNIT-IV	WORD SENSE DISAMBIGUATION	6+6

Dictionary-Based Disambiguation: Disambiguation based on sense, Thesaurusbased disambiguation, Disambiguation based on translations in a second-language corpus.

SUGGESTED ACTIVITIES:

- Demonstrate the state-of-the-art algorithms and techniques for text-based processing of natural language with respect to morphology

UNIT-V	SYNTAX AND SEMANTICS	6+6

Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), WordNet, Thematic Roles, Semantic Role Labelling with CRFs. Statistical Alignment and Machine Translation, Text alignment, Word alignment, Information extraction

SUGGESTED ACTIVITIES:

- Develop a Statistical Methods for Real World Applications and explore deep learning based NLP.

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the principles and Process of Human Languages such as English and other Indian Languages using computers.

CO2:Make use of semantics and pragmatics of English language for text processing

CO3: Develop CORPUS linguistics based on digestive approach to check a current methods for statistical approaches to machine translation.

CO4:Build POS tagging for a given natural language for a suitable language modelling technique based on the structure of the language.

CO5: Develop a Statistical Methods for Real World Applications and explore deep learning based NLP.

TEXT BOOKS:

1. Hobson lane, Cole Howard and Hannes Hapke, "Natural language processing in action" Manning Publications, 2019.
2. Rajesh Arumugam and Rajalingappa Shanmugamani "Hands-on natural language processing with python: A practical guide to applying deep learning architectures to your NLP application". PACKT publisher, 2018.
3. Alexander Clark, Chris Fox and Shalom Lappin, "The Handbook of Computational Linguistics and Natural Language Processing", Wiley-Blackwell, 2012.

REFERENCES:

1. Christopher D. Manning and Hinrich Schutze, "Foundations of Natural Language Processing", 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003.
2. Daniel Jurafsky and James H. Martin "Speech and Language Processing", 3rd Edition, Prentice Hall, 2009.
3. Nitin Indurkhya and Fred J. Damerau "Handbook of Natural Language Processing", 2nd Edition, CRC Press, 2010.

VERTICAL 8: EMERGING TECHNOLOGIES
(OPEN ELECTIVES I & II FOR EEE, CIVIL AND MECH PROGRAMMES)

21OIT01	FUNDAMENTALS OF AUGMENTED REALITY AND VIRTUAL REALITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To summarize the fundamental concepts of augmented and virtual reality methods.
- To understand the scientific, technical and engineering aspects of augmented reality.
- To understand the scientific, technical and engineering aspects of virtual reality.
- To utilize the software involved in development of AR and VR.
- To outline about the applications of AR and VR

UNIT-I	INTRODUCTION	9

Introduction to Augmented-Virtual and Mixed Reality, Cyber Space, Virtuality and the Virtuality Continuum, The Reality Continuum, The Metaverse and the Metaverse Roadmap.

UNIT-II	AUGMENTED REALITY HARDWARE	9

The Two-Step Process of Augmented Reality Applications, Hardware Components for AR - Sensors, Processors, Displays.

UNIT-III	VIRTUAL REALITY HARDWARE	9

Five classic components of VR system, Input Devices: Trackers, Navigation and Gesture Interfaces, Output Devices: Graphics, Three-Dimensional Sound, and Haptic Displays.

UNIT-IV	AR AND VR SOFTWARE DEVELOPMENT	9

Software Involved Directly in the Augmented Reality Application- Environmental Acquisition, Sensor Integration, Application Engine, Rendering Software. VR Programming – Toolkits and Scene graphics, General Haptics Open Software Toolkit (GHOST).

UNIT-V	APPLICATIONS	9

AR Applications – Magic books, Magic Mirrors, Navigation Assistance, Traditional VR applications – Medical Applications of VR, Virtual anatomy, Triage and Diagnostic, Digital Entertainment.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the basic concepts of AR and VR.

CO2: Outline the scientific, technical and engineering aspects of AR.

CO3: Outline the scientific, technical and engineering aspects of VR.

CO4: Experiment with technologies related to AR and VR software development.

CO5: Illustrate the applications of AR and VR Engineering.

TEXT BOOKS:

1. Burdea, G. C. and P. Coffet, "Virtual Reality Technology", 2nd edition, Wiley□IEEE Press, 2006.
2. Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", 1st edition , Morgan Kaufmann, 2013.
3. John Vince, "Virtual Reality Systems", 1st edition, Pearson Education, 2002.

REFERENCES :

1. Alan Craig, William Sherman and Jeffrey Will, "Developing Virtual Reality Application, Foundations of Effective Design", 1st edition, Morgan Kaufmann, 2009.
2. George Mather, "Foundations of Sensation and Perception",3rd edition, Psychology Press, 2009.
3. Chetankumar G Shetty, "Augmented Reality - Theory, Design and Development", 1st edition, McGraw Hill 2020.

21OIT02	FUNDAMENTALS OF ROBOTIC PROCESS AUTOMATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the fundamentals of Robotic Process Automation.
- To model the basics of Robotic Process Automation tool.
- To outline the automation techniques of Robotic Process Automation.
- To experiment with bot using triggering concept.
- To develop and maintain the bot.

UNIT-I	INTRODUCTION TO ROBOTIC PROCESS AUTOMATION	9

History of Automation - What is RPA - RPA vs Automation - Benefits of RPA - Components of RPA - RPA platforms - About UiPath - UiPath Robot - Record and Play-UiPath stack - Learning UiPath Studio.

UNIT-II	RPA TOOL	9

What is a Sequence? - Using activities with workflows – Flowchart - Control Flow, Sequencing the workflow - Control flow, various types of loops, and decision making - Step-by-step example using Sequence and Flowchart.

UNIT-III	DATA MANIPULATION	9

Variables and scope–Collections -Arguments – Purpose and use - Data table usage with examples - Clipboard management - File operation with step-by-step example - CSV/Excel to data table and vice versa.

UNIT-IV	HANDLING USER EVENTS	9

Taking Control of the Controls - Implementing the Attach Window activity -Finding the control - Techniques for waiting for a control - Act on controls – mouse and keyboard activities -Working with UiExplorer - Handling events - Handling events - Screen Scraping.

UNIT-V	HANDLING USER EVENTS AND ASSISTANT BOTS	9

What are assistant bots? - Monitoring system event triggers - Monitoring image and element triggers - Launching an assistant bot on a keyboard event- Common exceptions and ways to handle them - Logging and taking screenshots - Debugging techniques - Collecting crash dumps.

TOTAL :45 PERIODS

COURSE OUTCOMES:

After successful completion of this course, the students should be able to

CO1: Explain the fundamentals of Robotic Process Automation.

CO2: Identify the different Robotic Process Automation tools and its usage.

CO3: Outline the automation techniques of Robotic Process Automation.

CO4: Apply the various triggering concept for monitoring bots.

CO5: Plan, develop and deploy bots.

TEXT BOOKS:

1. Alok Mani Tripathi, "Learning Robotic Process Automation", 1st edition Packt Publishing,

2018.

2. Nandan Mullakara, Arun Kumar and Asokan, "Robotic Process Automation Projects: Build real-world RPA solutions using UiPath and Automation Anywhere", 1st edition, Packt Publishing, 2020.
3. Robert Fantina, Andriy Storozhuk and Kamal Goyal, "Introducing Robotic Process Automation to Your Organization", 1st edition, Apress Publication, 2021.

REFERENCES :

1. Christian Czarnecki and Peter Fettke, "Robotic Process Automation: Management, Technology, Applications", 1st edition, Walter de Gruyter Publishing, 2021.
2. Tom Taulli "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", 1st edition, Apress Publication, 2020.
3. Husan Mahey "Robotic Process Automation with Automation Anywhere", 1st edition, Packt Publishing LTD, 2021.

21OIT03	DEEP LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the theoretical foundations, algorithms and methodologies of Neural Network.
- To explain the data needs of Neural Network and deep learning.
- To develop an application using specific deep learning models.
- To make use of the practical knowledge in handling and analyzing real world applications.
- To summarize the applications of deep learning

UNIT-I	INTRODUCTION	9

History of Deep Learning, McCulloch Pitts Neuron, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Feed Forward Neural Networks, Back propagation

UNIT-II	ACTIVATION FUNCTIONS AND PARAMETERS	9

Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, Parameters v/s Hyper-parameters

UNIT-III	AUTO-ENCODERS AND REGULARIZATION	9

Auto encoders and relation to PCA, Regularization in auto encoders. Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Encoder Decoder Models.

UNIT-IV	DEEP LEARNING MODELS	9

Introduction to CNNs, Architecture, Convolution/pooling layers, CNN Applications- Introduction to RNNs, Back propagation through time (BPTT), Vanishing and Exploding Gradients.

UNIT-V	DEEP LEARNING APPLICATION	9

Image Processing, Natural Language Processing, Speech recognition, Video Analytics

TOTAL:45 PERIODS

COURSE OUTCOMES

At end of the course, learners will be able to:

CO1: Explain the fundamentals of neural networks and deep learning.

CO2: Summarize the concepts of neural network training.

CO3: Experiment with regularization, training optimization, and hyper parameter selection on deep learning models.

CO4: Apply working knowledge of deep learning models for problem solving.

CO5: Outline about deep learning models for processing images or video.

TEXT BOOKS:

1. Ian Goodfellow, YoshuaBengio and Aaron Courville, "Deep Learning", 1st edition, MIT press, 2016.
2. Yoshua Bengio, "Learning deep architectures for AI- Foundations and trends in Machine Learning 2.1", 1st edition, Now Publishers, 2009.
3. Jon Krohn, Beyleveld Grant and BassensAglae, "Deep Learning Illustrated: A Visual, Interactive- Guide to Artificial Intelligence", 1st edition Addison-wesley, 2019.

REFERENCES:

1. Hyatt Saleh, "Applied Deep Learning with PyTorch", 1st edition Packt Publishing, 2019.
2. Pradeep Pujari, Rezaul Karim and Mohit Sewak, "Practical Convolutional Neural Networks", 1st edition Packt Publishing, 2018.
3. Ragav Venkatesan and Baoxin Li, "Convolutional Neural Networks in Visual Computing (Data Enabled Engineering)", 1st edition, CRC Press, 2017.

21PIT18	CYBER SECURITY ESSENTIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the basics of cyber security.
- To outline the security aspects of operating systems and networks.
- To make use of cryptographic techniques in network security.
- To explain the privacy principles and policies.
- To illustrate the security management and incidents.

UNIT-I	INTRODUCTION TO CYBER SECURITY	9

Introduction -Computer Security - Threats -Harm - Vulnerabilities - Controls – Authentication Access Control and Cryptography - Web-User Side - Browser Attacks - Web Attacks- Targeting Users - Obtaining User or Website Data - Email Attacks.

UNIT-II	SECURITY IN OPERATING SYSTEM & NETWORKS	9

Security in Operating Systems - Security in the Design of Operating Systems -Rootkit - Network security attack- Threats to Network Communications - Wireless Network Security - Denial of Service - Distributed Denial-of-Service

UNIT-III	DEFENCES: SECURITY COUNTER MEASURES	9

Cryptography in Network Security - Firewalls - Intrusion Detection and Prevention Systems - Network Management - Databases - Security Requirements of Databases - Reliability and Integrity - Database Disclosure - Data Mining and Big Data.

UNIT-IV	PRIVACY IN CYBERSPACE	9

Privacy Concepts -Privacy Principles and Policies -Authentication and Privacy - Data Mining - Privacy on the Web - Email Security - Privacy Impacts of Emerging Technologies.

UNIT-V	MANAGEMENT AND INCIDENTS	9

Security Planning - Business Continuity Planning - Handling Incidents - Risk Analysis - Dealing with Disaster - Emerging Technologies - The Internet of Things - Economics - Electronic Voting - Cyber Warfare- Cyberspace and the Law – Information and Laws - Cyber crime - Cyber Warfare and Home Land Security.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the basic concepts of computer security.

CO2: Illustrate methods for Security in operating system and networks.

CO3: Identify the various security counter measures.

CO4: Summarize the privacy principles and policies.

CO5: Interpret the management strategies of cyber space.

TEXT BOOKS:

1. Charles P. Pfleeger, Shari Lawrence Pfleeger and Jonathan Margulies, "Security in

Computing", 5th edition , Pearson Education , 2015.
2. Martti Lehto and Pekka Neittaanmäki, "Cyber Security: Analytics, Technology and Automation edited", Springer International Publishing Switzerland, 2015.
3. George K. Kostopoulous, "Cyber Space and Cyber Security", 2nd edition, CRC Press, 2017.

REFERENCES :

1. Jan L.Harrington, "Network Security A Practical Approach", 1st edition, Morgan Kaufmann Publishers, 2005.
2. Edward Amoroso, "Cyber Security", 1st edition, Silicon Press, 2006.
3. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", 1st edition, CBS publishers, New Delhi, 2004.

21OIT04	FUNDAMENTALS OF BLOCKCHAIN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the fundamental concept of blockchain.
- To explain concept of cryptocurrency and Bitcoin.
- To experiment with the Ethereum programming languages.
- To demonstrate the basics of Hyperledger and Web3.
- To summarize the detail of alternative blockchain technologies.

UNIT-I	INTRODUCTION TO BLOCK CHAIN	9

History of Blockchain – Types of Blockchain – Consensus – Decentralization using Blockchain – Blockchain and Full Ecosystem Decentralization – Platforms for Decentralization.

UNIT-II	INTRODUCTION TO CRYPTOCURRENCY	9

Bitcoin – Digital Keys and Addresses – Transactions – Mining – Bitcoin Networks and Payments – Wallets – Alternative Coins – Theoretical Limitations – Bitcoin Limitations – Name Coin – Prime Coin – Zcash – Smart Contracts – Ricardian Contracts.

UNIT-III	ETHEREUM	9

The Ethereum Network – Components of Ethereum Ecosystem – Ethereum Programming Languages: Runtime Byte Code, Blocks and Blockchain, Fee Schedule – Supporting Protocols – Solidity Language.

UNIT-IV	WEB3 AND HYPERLEDGER	9

Introduction to Web3 – Contract Deployment – POST Requests – Development frameworks – Hyperledger as a protocol – The Reference Architecture – Hyperledger Fabric – Distributed Ledger – Corda.

UNIT-V	EMERGING TRENDS IN BLOCK CHAIN TECHNOLOGIES	9

Kadena – Ripple- Rootstock – Quorum – Tendermint – Scalability – Privacy – Other Challenges – Blockchain Research – Notable Projects – Miscellaneous tools.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain about fundamental concept of blockchain.

CO2: Summarize the concept of cryptocurrency and Bitcoin.

CO3: Identify the components of Ethereum and Ethereum Programming Languages.

CO4: Outline the basics of Hyperledger and its development framework.

CO5: Compare different blockchain technologies.

TEXT BOOKS:

1. Imran Bashir, "Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained", Second Edition, Packt Publishing, 2018.
2. Arshdeep Bahga, Vijay Madisetti, "Blockchain Applications: A Hands on Approach", VPT,

2017.

3. A. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, "Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction", Princeton University Press, 2016.

REFERENCES :

1. Andreas Antonopoulos, Satoshi Nakamoto, "Mastering Bitcoin", O'Reilly, 2014.
2. Roger Wattenhofer, "The Science of the Blockchain" CreateSpace Independent Publishing, 2016.
3. Alex Leverington, "Ethereum Programming" Packt Publishing, 2017.

21OIT05	GAME DEVELOPMENT FOR NOVICE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the basic concepts of game programming.
- To explain about 3D graphics.
- To understand the terminologies like sound, physics and cameras.
- To infer the knowledge about user interfaces and scripting.
- To develop simple games.

UNIT I	INTRODUCTION TO GAME PROGRAMMING	9

Game Programming Overview: Evolution of Video Game Programming - The Game Loop - Time and Games – Game Objects. 2D Graphics: 2D Rendering Foundations - Sprites – Scrolling - Tile Maps. Linear Algebra for Games.

UNIT II	3D GRAPHICS	9

Basics - Coordinate spaces - Lighting and shading – visibility - World transform, Revisited - Input devices - Event-based input systems - Mobile input.

UNIT III	SOUND, PHYSICS AND CAMERAS	9

Basic sound - 3D sound - Digital Signal Processing - Planes, Rays, and Line Segments. - Collision Geometry - Collision Detection - Physics-based Movement - Types of Cameras - Perspective Projections - Camera implementations - Camera support algorithms.

UNIT IV	USER INTERFACES AND SCRIPTING	9

Menu systems - HUD Elements - Other UI considerations - Scripting languages - Implementing a Scripting language - Data formats.

UNIT V	GAME DEVELOPMENT	9

Side-Scroller for iOS - Tower defense for PC/Mac - Sudoku game - Tetris game - Tic Tac Toe game.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the basic concepts of game programming.

CO2: Summarize about 3D graphics.

CO3: Infer about sound, physics and cameras in game development.

CO4: Outline about user interfaces and scripting.

CO5: Make use of gaming concepts to develop simple games.

TEXT BOOKS:

1. Sanjay Madhav, "Game Programming Algorithms and Techniques: A Platform Agnostic Approach", Addison-Wesley Professional, 2nd edition, 2014.
2. K. Patinson, "Game Development: Gaming Design and Programming", Code Academy Publishers, 1st edition, 2021.
3. James R Parker and J R Parker, "Introduction to Game Development:", Mercury Learning &

Information Publishers, 1st edition, 2015.

REFERENCES:

1. Will McGugan, "Beginning Game Development with Python and Pygame: From Novice to Professional", Apress Publishers, 1st edition, 2007.
2. Paul Vincent Craven, "Program Arcade games", Apress Publishers, 4th edition, 2016.
3. Steve Rabin, "Introduction to Game Development", Charies River Media Publishers, 2nd edition, 2009.

21OIT06	INTRODUCTION TO 3D PRINTING AND DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the importance of 3D printing in manufacturing.
- To compare the different 3D printing technologies.
- To plan suitable methods for 3D print.
- To experiment with different methods for Post-processing of 3D printing parts.
- To develop applications related to 3D printing.

UNIT-I	INTRODUCTION AND BASIC PRINCIPLES	9

3D Printing, Generic 3D Printing Process, Benefits of 3D Printing, Distinction Between 3D Printing and CNC Machining, Other Related Technologies Development of 3D Printing Technology: Introduction, Computers, Computer-Aided Design Technology.

UNIT-II	3D PRINTING PROCESS CHAIN & PHOTOPOLYMERIZATION PROCESSES	9

Eight Steps in Additive Manufacture, Variations from One 3D Printing Machine to Another, Metal Systems, Maintenance of Equipment, Materials Handling Issues, design for 3D printing. Introduction to Photopolymerization Processes: Photopolymerization Materials, Reaction Rates, Vector Scan SL, SL Resin Curing Process, SL Scan Patterns, Vector Scan Micro stereolithography, Mask Projection Photopolymerization Technologies and Processes, Two-Photon SL.

UNIT-III	POWDER BED FUSION PROCESSES & EXTRUSION-BASED SYSTEMS	9

Powder Bed Fusion Processes: Introduction, SLS Process Description, Powder Handling, Approaches to Metal and Ceric Part Creation, Variants of Powder Bed Fusion Processes, Process Par 3D Printingeters, Applied Energy Correlations and Scan Patterns, Typical Materials and Applications, Materials - Capabilities and Limitations. Extrusion-Based Systems: Introduction, Basic Principles, Plotting and Path Control, Materials, Limitations of FDM, Bioextrusion, Other Systems.

UNIT-IV	DESIGN, GUIDELINES FOR PROCESS SELECTION	9

Design for 3D Printing - Design for Manufacturing and Assembly, Core DFM for 3D Printing Concepts and Objectives, 3D Printing Unique Capabilities, Exploring Design Freedoms, Design Tools for 3D Printing. Guidelines for Process Selection - Selection Methods for a Part, Challenges of Selection, Preliminary Selection, Production Planning and Control.

UNIT-V	MEDICAL APPLICATIONS & FUTURE DIRECTIONS	9

Medical Applications for 3D Printing - Use of 3D Printing to Support Medical Applications, Software Support for Medical Applications, Limitations of 3D Printing for Medical applications, Further Development of Medical 3D Printing Applications. Commercial Applications using Multiple Materials, business opportunities and, Future directions.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the basics of 3D printing.

CO2: Explain different 3D printing Technologies. CO3: Identify suitable materials for 3D printing. CO4: Make use of different methods for Post-processing of 3D printing parts. CO5: Plan 3D printing for medical applications and commercial applications.
TEXT BOOKS: 1. Ian Gibson, David W Rosen and Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", 2nd edition, Springer, 2010. 2. Ben Redwood, Filemon Schoffer and Brian Garret, "The 3D Printing Handbook: Technologies, design and applications", 1st edition, 3DHubs publications, 2017. 3. Dorling Kindersley, "3D printing projects: Amazing ideas to print and make", 1st edition, DK publishing, 2017.
REFERENCES : 1. Chua Chee Kai and Leong Kah Fai, "Rapid Prototyping: Principles &Applications", 2nd edition, World Scientific, 2003. 2. Ali K. Kamrani and Emand Abouel Nasr, "Rapid Prototyping: Theory &Practice", 1st edition, Springer, 2006. 3. D.T. Pham and S.S. Dimov, "Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling", 1st edition, Springer 2001.

21OIT07	FUNDAMENTALS OF MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the fundamental concepts of machine learning.
- To explain the classification technique using decision tree.
- To make use of SVM for classification in ML.
- To summarize the concept of unsupervised learning in ML.
- To demonstrate Reinforcement Learning.

UNIT-I	INTRODUCTION	9

Introduction. Types of Machine Learning Systems: Supervised/Unsupervised Learning, Batch and Online Learning, Instance-Based Versus Model-Based Learning, Main Challenges of Machine Learning, Testing and Validating.

UNIT-II	SUPERVISED LEARNING	9

Training and Visualizing a Decision Tree, Making Predictions, Estimating Class Probabilities, The CART Training Algorithm, Computational Complexity, Regularization Hyper parameters, Regression, Instability.

UNIT-III	BAYESIAN LEARNING AND SVM	9

Bayesian Learning: introduction, Bayes Theorem and concept Learning, Bayes Optimal Classifier, Naïve Bayes Classifier. Support Vector Machine: Linear SVM Classification, Nonlinear SVM Classification, SVM Regression.

UNIT-IV	UNSUPERVISED LEARNING	9

Clustering, K-Means, Limits of K-Means, Using clustering for image segmentation, Using Clustering for Preprocessing, Using Clustering for Semi-Supervised Learning, DBSCAN and other Clustering Algorithms, Gaussian Mixtures.

UNIT-V	REINFORCEMENT LEARNING	9

Single State Case: K-Armed Bandit, Elements of Reinforcement Learning, Model-Based Learning, Temporal Difference Learning, Generalization, Partially Observable States.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Summarize the fundamental concept of machine learning.

CO2: Explain the concept of decision Tree for classification in ML.

CO3: Make use of SVM for classification in ML.

CO4: Outline the concept of unsupervised learning for classification in ML.

CO5: Explain the concept of Reinforcement Learning to make best decision.

TEXT BOOKS:

1. Aurelien Geron, "Hands-On Machine Learning with Scikit-Learn, Keras, and Tensor Flow", 2nd edition, Reilly Media, September 2019.

2. Tom Mitchell ,"Machine Learning", 1st edition, McGraw- Hill, 1997.
3. Alpaydin, Ethem. "Introduction to machine learning", 2nd edition, MIT press, 2020.
4. ShaiShalev-Shwartz and Shai Ben-David," Understanding Machine Learning: From Theory to Algorithms", 2nd edition, Cambridge University Press, 2014.

REFERENCES :

1. Mohri Mehryar, Afshin Rostamizadeh, and Ameet Talwalkar. "Foundations of machine learning",1st edition, MIT press, 2018.
2. Müller Andreas C and Sarah Guido. "Introduction to Machine Learning with Python: A Guide for Data Scientists", 1st edition, O'Reilly, 2016.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 1st edition, MIT Press, 2012.
4. Christopher Bishop, "Pattern Recognition and Machine Learning" Springer, 2007.

<table>
<tr><td rowspan="2">21OIT08</td><td rowspan="2">INTERNET OF THINGS CONCEPTS AND APPLICATIONS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td colspan="6">COURSE OBJECTIVES:
• To explain the fundamentals of Internet of Things (IoT).
• To summarize the basics of IoT protocols.
• To understand about IoT design and development.
• To experiment with the knowledge about data analytics for IoT.
• To apply the concept of Internet of Things in the real world scenario.</td></tr>
<tr><td>UNIT I</td><td colspan="4">INTRODUCTION TO IoT</td><td>9</td></tr>
<tr><td colspan="6">IoT and Digitization – IoT Impact – Convergence of IT and OT – IoT Challenges. IoT Network Architecture and Design: Comparing IoT Architectures – A Simplified IoT Architecture.</td></tr>
<tr><td>UNIT II</td><td colspan="4">ENGINEERING IoT</td><td>9</td></tr>
<tr><td colspan="6">Sensors, Actuators, and Smart Objects – Sensor Networks. Connecting Smart Objects: Communication Criteria – IoT Access Technologies: IEEE802.15.4 – IEEE1901.2a.</td></tr>
<tr><td>UNIT III</td><td colspan="4">PROTOTYPING EMBEDDED DEVICES</td><td>9</td></tr>
<tr><td colspan="6">Embedded Computing Basics – Arduino – Raspberry Pi – BeagleBone Black – Electric Imp-Other Notable Platforms.</td></tr>
<tr><td>UNIT IV</td><td colspan="4">DATA ANALYTICS FOR IoT</td><td>9</td></tr>
<tr><td colspan="6">Data Analytics Overview and Challenges - Structured vs Unstructured Data - Data in Motion vs Data at Rest – Role of Machine Learning: Supervised Learning – Unsupervised Learning – Data Analytics Tools and Technology: Introduction to NoSQL Databases , Hadoop ,Apache Kafka.</td></tr>
<tr><td>UNIT V</td><td colspan="4">CASE STUDIES / INDUSTRIAL APPLICATIONS</td><td>9</td></tr>
<tr><td colspan="6">Manufacturing – Smart and Connected Cities – Transportation – Mining – Public Safety.</td></tr>
<tr><td colspan="2"></td><td colspan="4">TOTAL: 45 PERIODS</td></tr>
<tr><td colspan="6">COURSE OUTCOMES:
At the end of the course, learners will be able to
CO1: Explain about the fundamentals of Internet of Things (IoT).
CO2: Interpret the knowledge about the basics of Engineering IoT.
CO3: Summarize about IoT Design and Development.
CO4: Experiment with the information using data analytics for IoT.
CO5: Make use of IoT technologies for real world problems.</td></tr>
<tr><td colspan="6">TEXT BOOK:
1. David Hanes and Ganzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols and Use cases for Internet of Things", 1st edition, Pearson education, 2017.
2. Adrain McEwen and Hakim Cassimally, "Designing the Internet of Things" , 1st edition, Wiley , 2014.
3. Arshdeep Bahga and Vijay Madisetti , "Internet of Things – A hands on approach", 1st edition, University press , 2015.</td></tr>
</table>

REFERENCES:

1. Dieter Uckelmann, Mark Harrison and Michahelles, Florian (Eds), "Architecting the Internet of Things", 1st edition, Springer, 2011.
2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 1st edition, 2012.
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand and David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", 1st edition, Academic Press, Elsevier, 2014.
4. Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things – Key applications and Protocols", Wiley, 2nd edition, 2012.

21IT301	FOUNDATIONS OF DATA SCIENCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline data preparatory and preprocessing steps.
- To explain the statistical methods for data science.
- To make use of the packages in Python for data science.
- To summarize the regression techniques.
- To utilize the visualization techniques for interpreting data.

UNIT-I	INTRODUCTION	9

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT-II	DESCRIBING DATA I	9

Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked data – describing variability – range – variance – standard deviation – degrees of freedom – inter quartile range – variability for qualitative and ranked data.

UNIT-III	PYTHON FOR DATA HANDLING	9

Basics of Numpy arrays – aggregations – computations on arrays – comparisons, masks, Boolean logic – fancy indexing – structured arrays – data manipulation with Pandas – data indexing and selection – operating on data – missing data – hierarchical indexing – combining datasets – aggregation and grouping – pivot tables.

UNIT-IV	DESCRIBING DATA II	9

Normal distributions – z scores – normal curve problems – finding proportions – finding scores – more about z scores – correlation – scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean.

UNIT-V	PYTHON FOR DATA VISUALIZATION	9

Visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings and density – three dimensional plotting – geographic data – data analysis using statsmodels and seaborn – graph plotting using Plotly – interactive data visualization using Bokeh.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to CO1: Explain the methods for data inspecting and cleansing. CO2: Compare the statistical methods for data science. CO3: Make use of the packages in Python for data science. CO4: Outline the prediction techniques using regression models. CO5: Experiment with different visualization techniques.
TEXT BOOKS: 1. John S. Witte and Robert S.Witte , "Statistics", 11th edition, John Wiley and sons inc., 2021. 2. Jake Vander Plas, "Python Data Science Handbook", 1st edition, O'Reilly, 2016. 3. David Cielen, Arno D. B. Meysman and Mohamed Ali, "Introducing Data Science", 1st edition, Manning Publications, 2016.
REFERENCES: 1. Allen B. Downey, "Think Stats: Exploratory Data Analysis in Python", 2nd edition, O'Reilly, 2015. 2. Allen B. Downey, "Think Stats: Probability and Statistics for Programmers", 1st edition, Green Tea Press, 2011. 3. Avirm Blum, John Hopcroft and Ravindran kanan, "Foundations of Data Science", 1st edition,Cambridge University press, 2020.

21OCIT01	AUTOMATION TOOL	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To plan test cases and test scripts using Selenium.
- To experiment with Selenium tool towards web application testing.

- Introduction - About testing- Different type of testing – Manual testing- Introduction to Automation- Features of selenium
- Identifying Web Elements using Selenium : Using ID – Using Name – Using Link Text – Using Partial Link Text – Using Class Name –Using Tag Name – Using XPath – Using CSS Selector
- Verifying Web Elements using Selenium –Using Get Title – Using Current URL – Using Get Text – Using Get Attribute
- Validation –Using Is Selected – Using Is Enabled –Using Is Displayed
- Switch Web Elements – Using Alert –Using Window
- Synchronization Commands – Explicit Wait – Implicit Wait
- Operations with Web Table and Web Calendar
- Testing Frameworks – Introduction – Create Test Suite – Create Test NG Annotations

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO 1: Utilize Selenium testing tool for writing test cases and test scripts.

CO 2: Develop test plan using Selenium tool for web application.

REFERENCES :

1. Nageshwar Rao Pusuluri , "Software Testing Concepts and Tools", Dream tech Press, 2006.
2. Alan John Richardson , "Selenium Simplified: Selenium-RC, Java & JUnit, 2nd edition , Compendium Developments , 2012.

21OCIT02	AZURE CLOUD ESSENTIALS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To outline the fundamentals of Azure cloud.
- To experiment with cloud computing concepts for building a solution.

- Cloud concepts
- Cloud computing Fundamentals
- Cloud benefits
- Cloud service types
- Azure architecture and services
- Azure architectural components
- Compute and Networking
- Storage, Identity, Access, and Security
- Core Azure Services (Workloads)
- Create a virtual machine in the portal
- Create a Web App
- Deploy Azure Container Instances
- Create a virtual network.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the fundamental concept of Azure cloud.

CO2: Make use of cloud concepts to deploy an application.

REFERENCES :

1. Michael Collier and Robin Shahan, " Fundamentals of Azure", 2nd edition, Microsoft Press, 2016.
2. https://docs.microsoft.com/en-us/certifications/exams/az-900.

<table>
<tr><td rowspan="2">21OCIT03</td><td rowspan="2">MONGO DB BASICS</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td></tr>
</table>

COURSE OBJECTIVES:

- To compare relational and Non-relational database.
- To develop a database for manipulating unstructured data using MongoDB.

- Modern General Purpose Database
- Relational vs. Non-Relational Databases
- Non-Relational Database Types
- When to Use Non-Relational Databases
- The Document Model and MongoDB
- MongoDB: A Developer Data Platform
- MongoDB Architecture
- MongoDB Atlas
- Querying in Relational and Non-Relational Databases
- MongoDB Query Language (MQL)
- Querying Complex Data in MongoDB with MQL
- Querying Data with Operators and Compound Conditions
- Inserting and Updating Data in MongoDB
- Deleting Data in MongoDB
- Sharding in MongoDB
- Indexing in MongoDB

TOTAL :15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO 1: Infer the difference between and Non-relational database.

CO 2: Build database for manipulating unstructured data using MongoDB.

REFERENCES :

1. Shannon,Eoin Brazil and Kristina,"MongoDB: The Definitive Guide: Powerful and Scalable Data Storage",3rd edition, O'Reilly Media,2019.
2. Rick Copeland, "MongoDB Applied Design Patterns: Practical Use Cases with the Leading NoSQL Database",1st edition, O'Reilly Media, 2013.

21MCC01	CONSTITUTION OF INDIA	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- To explain the basic features and fundamental principles of Constitution of India.
- To explain the salient features and characteristics of the Constitution of India
- To explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers
- To explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India
- To explain the Local Self Government – Constitutional Scheme in India

SYLLABUS

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States.
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India.
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the meaning of the constitution law and constitutionalism and Historical perspective of the Constitution of India.

CO2: Explain the salient features and characteristics of the Constitution of India, scheme of the fundamental rights and the scheme of the Fundamental Duties and its legal status.

CO3: Explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers between the Union and the States, and Parliamentary Form of Government in India.

CO4: Explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India, and Emergency Provisions.

CO5: Explain the Local Self Government – Constitutional Scheme in India, Scheme of the Fundamental Right to Equality.
TEXT BOOKS: 1. Durga Das Basu,"Introduction to the Constitution of India", LexisNexis Butterworths Wadhwa, 20th edition, Reprint 2011. 2. Web link: https://www.india.gov.in/my-government/ constitution-india.

21MCC02	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- To explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge.
- To explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.
- To explain about the use of Traditional Knowledge to meet the basic needs of human being.
- To explain the rich biodiversity materials and knowledge preserved for practicing traditional lifestyle.
- To explain the use of Traditional Knowledge in Manufacturing and Industry.

UNIT-I	TRADITIONAL AND MODERN KNOWLEDGE	3

Two Worlds of Knowledge - Phase of Explorers, Sir Arthur Cotton and Irrigation, Smallpox Vaccination, Late Nineteenth Century, Voelcker, Howard and Agriculture, Havell and Indian Art; Indians at the Encounter - Gaekwad of Baroda and Technical Education, Science Education and Modern Industries, Hakim Ajmal Khan and Ayurveda, R. N. Chopra and Indigenous Drugs, Gauhar Jaan and Indian Classical Music; Linking Science and the Rural - Tagore's Sriniketan Experiment, Marthandam, the YMCA Model, Gandhi's Thoughts on Development, Nehru's View of Growth; Post- Independence Era - Modernization and Traditional Knowledge, Social Roots of Traditional Knowledge Activism, Global Recognition for Traditional Knowledge.

UNIT-II	PROTECTION AND SHARING	3

For Recognition and Protection - United Nations Educational, Scientific and Cultural Organization (UNESCO), World Health Organization (WHO), International Labour Organization (ILO), UN Working Group on Indigenous Populations, Evolution of Other Organizations; Norms of Sharing - United Nations Environment Programme (UNEP), World Intellectual Property Organization (WIPO), World Trade Organization (WTO); IPR and Traditional Knowledge - Theoretical Background, Positive Protections of TK, Defensive Strategies, IPR Facilitation for TK.

UNIT-III	TRADITIONAL KNOWLEDGE FOR BASIC NEEDS	3

Indian Midwifery Tradition—The Dai System, Surface Flow Irrigation Tanks, Housing - A Human Right, Changing Priorities—Niyamgiri.

Biodiversity and Genetic Resources: Jeevani - The Wonder Herb of Kanis, A Holistic Approach - FRLHT, Basmati - In the New Millennium, AYUSH-Based Cosmetics.

UNIT-IV	TRADITIONAL KNOWLEDGE IN MANUFACTURING	3

Drug Discovery, A Sweetener of Bengal, The Sacred Ring of Payyanur, Channapatna Toys.

UNIT-V	TRADITIONAL CULTURAL EXPRESSIONS	3

Banarasi Saree, Music, Built and Tangible Heritage, Modern Yoga, Sanskrit and Artificial Intelligence, Climate Change and Traditional Knowledge.

TOTAL :15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge.

CO2: Explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.

CO3: Explain about the use of Traditional Knowledge to meet the basic needs of human being.

CO4: Explain the rich biodiversity materials and knowledge preserved for practicing traditional lifestyle.

CO5: Explain the use of Traditional Knowledge in Manufacturing and Industry.

TEXT BOOKS:

1. Nirmal Sengupta "Traditional Knowledge in Modern India Preservation, Promotion, Ethical Access and Benefit Sharing Mechanisms" Springer, 2019.

2. Amit Jha,"Traditional Knowledge System in India", Atlantic Publishers and Distributors Pvt Ltd, 2009.

3. Basanta Kumar Mohanta, Vipin Kumar Singh "Traditional Knowledge System and Technology in India", Pratibha Prakashan, 2012.

4. Kapil Kapoor, Michel Danino "Knowledge Traditions and Practices of India", Central Board of Secondary Education, 2012.

WEB REFERENCES :

1.NPTEL video lecture on "Ayurvedic Inheritance of India", Video link: https://nptel.ac.in/courses/121/106/121106003/#.

2.Youtube video on "Introduction to Indian Knowledge Systems", Video link: https://www.youtube.com/watch?v=LZP1StpYEPM.

3.Youtube video on "12 Great achievements of Indian Civilization", Video link: https://www.youtube.com/watch?v=xmogKGCmclE.

VELAMMAL

COLLEGE OF ENGINEERING & TECHNOLOGY, MADURAI – 625 009

(Autonomous)

(Accredited by NAAC with 'A' Grade and by NBA for 5 UG Programmes)

(Approved by AICTE and affiliated to Anna University, Chennai)

DEPARTMENT OF CIVIL ENGINEERING

B.E. CIVIL ENGINEERING

CURRICULUM and SYLLABUS

(I to VIII Semesters)

VELAMMAL COLLEGE OF ENGINEERING & TECHNOLOGY, MADURAI - 625009

(Autonomous)

REGULATIONS – 2021

B. E. CIVIL ENGINEERING (CBCS)

CURRICULUM FOR SEMESTERS I TO VIII

SEMESTER-I

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21IP101	Induction Programme *(Common to all B.E./B.Tech. Programmes)*	-	0	0	0	0
		THEORY					
2.	21EN101	Professional English – I *(Common to all B.E./B.Tech. Programmes)*	HS	3	2	0	4
3.	21MA101	Matrices and Calculus *(Common to all B.E./B.Tech. Programmes)*	BS	3	2	0	4
4.	21PH101	Engineering Physics *(Common to all B.E./B.Tech. Programmes)*	BS	3	0	0	3
5.	21CH101	Engineering Chemistry *(Common to all B.E./B.Tech. Programmes)*	BS	3	0	0	3
6.	21CS101	Problem Solving and Python Programming *(Common to all B.E./B.Tech. Programmes)*	ES	3	0	0	3
7.		Cambridge Course*	EE	1	0	0	1
		PRACTICAL COURSES					
8.	21CS102	Problem Solving and Python Programming Laboratory *(Common to all B.E./B.Tech. Programmes)*	ES	0	0	4	2
9.	21PC101	Physics and Chemistry Laboratory *(Common to all B.E./B.Tech. Programmes)*	BS	0	0	4	2
		Total Credits					**22**

***Naan Mudhalvan Scheme Course**

J.P. Anie

SEMESTER-II

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21EN102	English – II *(Common to all B.E./B.Tech. Programmes)*	HS	3	0	0	3
2.	21MA102	Vector Calculus and Complex Variables *(Common to B.E. Civil Engg., EEE & Mechanical Engg.)*	BS	3	2	0	4
3.	21PH102	Physics for Civil Engineering	BS	3	0	0	3
4.	21ME101	Engineering Graphics *(Common to all B.E./B.Tech. Programmes)*	ES	2	0	2	3
5.	21CE101	Construction Materials and Techniques	PC	3	0	0	3
THEORY WITH PRACTICAL COURSE							
6.	21EE103	Basic Electrical and Electronics Engineering *(Common to B.E. Civil Engg. & Mechanical Engg.)*	ES	3	0	2	4
PRACTICAL COURSES							
7.	21EM101	Engineering Practices laboratory *(Common to all B.E./B.Tech. Programmes)*	ES	0	0	4	2
8.	21CE102	Computer Aided Building Drawing laboratory	ES	0	0	4	2
Total Credits							**24**

SEMESTER-III

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21MA201	Transforms and Partial Differential Equations *(Common to B.E. Civil Engg., ECE & Mechanical Engg.)*	BS	3	2	0	4
2.	21CE201	Engineering Geology	ES	3	0	0	3
3.	21CE202	Mechanics of Solids	ES	3	0	0	3
4.	21CE203	Water Supply Engineering	PC	3	0	0	3
5.		Microsoft Office Fundamentals*	EE	2	0	0	1
THEORY WITH PRACTICAL COURSES							
6.	21CE204	Fluid Mechanics	PC	3	0	2	4
7.	21CE205	Surveying and Geomatics	PC	3	0	2	4
PRACTICAL COURSES							
8.	21CE206	Strength of Materials laboratory	ES	0	0	4	2
9.	21CE207	Internship (1 week) + Seminar #	EE	0	0	0	0
Total Credits							**24**

 # Will be done during summer vacation

J.P. [signature]
BoS Chairman

SEMESTER-IV

S.No.	Course Code	Course Title	Category	L	T	P	C
		THEORY					
1.	21MA204	Probability, Statistics and Numerical Methods *(Common to B.E. Civil Engg. & Mechanical Engg.)*	BS	3	2	0	4
2.	21CH103	Environmental Science *(Common to all B.E./B.Tech. Programmes)*	BS	2	0	0	2
3.	21CE208	Strength of Materials	ES	3	0	0	3
4.	21CE209	Wastewater Engineering	PC	3	0	0	3
		THEORY WITH PRACTICAL COURSES					
5.	21CE210	Hydraulics and Hydraulic Machinery	PC	3	0	2	4
6.	21CE211	Concrete Technology & Construction Equipments	PC	3	0	2	4
7.	21CE212	Soil Mechanics	PC	3	0	2	4
		PRACTICAL COURSES					
8.	21CE213	Survey Camp (2 weeks) &	EE	0	0	2	1
9.	21CE214	Water and Wastewater Analysis Laboratory	PC	0	0	4	2
		Total Credits					**27**

***Naan Mudhalvan Scheme Course**

&Will be done during winter vacation

J.P. [signature]
BoS Chairman

SEMESTER-V

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21CE301	Structural Analysis - I	PC	2	2	0	3
2.	21CE302	Design of Reinforced Cement Concrete Elements	PC	2	2	0	3
3.	21CE303	Foundation Engineering	PC	3	0	0	3
4.	21PCEXX	Professional Elective - I	PE	3	0	0	3
5.	21PCEXX	Professional Elective - II	PE	3	0	0	3
6.		Naan Mudhalvan Scheme Course*	EE	2	0	0	2
7.	21MCC01	Constitution of India	MC	1	0	0	0
THEORY WITH PRACTICAL COURSE							
8.	21CE304	Highway and Railway Engineering	PC	3	0	2	4
PRACTICAL COURSES							
9.	21EN301	Professional Communication Laboratory *(Common to all B.E./B.Tech. Programmes)*	HS	0	0	2	1
10.	21CE305	Internship (2 weeks) + Seminar#	EE	0	0	0	1
Total Credits							**21**

SEMESTER-VI

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21CE306	Structural Analysis – II	PC	2	2	0	3
2.	21CE307	Design of Steel Structural Elements	PC	2	2	0	3
3.	21CE308	Estimation, Costing and Valuation Engineering	PC	3	0	0	3
4.	21CE309	Irrigation Engineering	PC	3	0	0	3
5.	21PCEXX	Professional Elective - III	PE	3	0	0	3
6.	21XXXXX	Open Elective – I	OE	3	0	0	3
7.		Naan Mudhalvan Scheme Course*	EE	2	0	0	2
8.	21MCC02	Essence of Indian Traditional Knowledge	MC	1	0	0	0
PRACTICAL COURSE							
9.	21CE310	Computer Aided Structural Design and Drawing laboratory	PC	0	0	4	2
Total Credits							**20**

***Building Information Modeling/Design and Construction of Steel Buildings/High Rise Building Design/Transportation Infrastructure-Airports, Metros & Seaports**

 # Will be done during summer vacation

J.P. [signature]

SEMESTER-VII

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21XXXXX	Open Elective – II	OE	3	0	0	3
2.	21XXXXX	Open Elective – III	OE	3	0	0	3
3.	21XXXXX	Open Elective – IV	OE	3	0	0	3
4.		Naan Mudhalvan Scheme Course*	EE	2	0	0	2
PRACTICAL COURSES							
5.	21CE401	Project Work – I	EE	0	0	4	2
6.	21CE402	Comprehension	PC	0	0	2	1
7.	21OCCEXX	One Credit Course	EE	0	0	2	1
8.	21CE403	Internship (4 weeks) + Seminar #	EE	0	0	0	2
Total Credits							**15**

SEMESTER-VIII

S.No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1.	21PCEXX	Professional Elective – IV	PE	3	0	0	3
2.	21PCEXX	Professional Elective - V	PE	3	0	0	3
PRACTICAL COURSE							
3.	21CE404	Project Work – II	EE	0	0	20	10
Total Credits							**16**
							169

****Building Information Modeling/Design and Construction of Steel Buildings/High Rise Building Design/Transportation Infrastructure-Airports, Metros & Seaports**

 # Will be done during summer vacation

J.P. [signature]

SEMESTERWISE CREDIT DISTRIBUTION

	I	II	III	IV	V	VI	VII	VIII	Total Credits
HS	4	3	-	-	1	-	-	-	8
BS	12	7	4	6	-	-	-	-	29
ES	5	11	8	3	-	-	-	-	27
PC	-	3	11	17	13	14	1	-	59
PE	-	-	-	-	6	3	-	6	15
OE	-	-	-	-	-	3	9	-	12
EE	1	-	1	1	1+2*	2*	5+2*	10	19
MC (Non Credit)	-	-	-	-	1	1	-	-	-
TOTAL	**22**	**24**	**24**	**27**	**21**	**20**	**15**	**16**	**169**

*** Naan Mudhalvan Scheme Courses-***Subject to guidelines be provided by Government of Tamil Nadu*

S.No.	Topic
1	Humanities and Social Science including Management(HS)
2	Basic Sciences (BS)
3	Engineering Sciences including Workshop, Drawing, Basics of Civil/Electrical/Mechanical/Computer etc., (ES)
4	Professional Core Courses (PC)
5	Professional Electives: Courses relevant to chosen specialization/branch (PE)
6	Open Electives : Electives from other technical and/or emerging Courses (OE)
7	Project Work , Seminar and Internship in Industry – Employability Enhancement Courses (EE)
8	Mandatory Courses (MC)

PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL-I: CONSTRUCTION MANAGEMENT AND GEO INFORMATICS

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21PCE01	Advanced Surveying	PE	3	0	0	3
2.	21PCE02	Remote Sensing and Geographic Information System	PE	3	0	0	3
3.	21PCE03	Engineering Materials for Sustainability	PE	3	0	0	3
4.	21PCE04	Construction Planning and Scheduling	PE	3	0	0	3
5.	21PCE05	Housing Planning and Management	PE	3	0	0	3
6.	21PCE06	Infrastructure Planning and Management	PE	3	0	0	3
7.	21PCE07	Green Building Concepts	PE	3	0	0	3

VERTICAL-II: GEOTECHNICAL

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21PCE08	Geo Synthetics in Civil Engineering	PE	3	0	0	3
2.	21PCE09	Ground Improvement Techniques	PE	3	0	0	3
3.	21PCE10	Soil Dynamics and Machine Foundation	PE	3	0	0	3
4.	21PCE11	Reinforced Earth Structures	PE	3	0	0	3
5.	21PCE12	Rock Engineering	PE	3	0	0	3
6.	21PCE13	Tunneling Engineering	PE	3	0	0	3
7.	21PCE14	Pile Foundation	PE	3	0	0	3

VERTICAL-III: ENVIRONMENT

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21PCE15	Industrial Wastewater Management	PE	3	0	0	3
2.	21PCE16	Air and Noise Pollution Control Engineering	PE	3	0	0	3
3.	21PCE17	Solid and Hazardous Waste Management	PE	3	0	0	3
4.	21PCE18	Environmental Impact Assessment	PE	3	0	0	3
5.	21PCE19	Environment, Health and Safety	PE	3	0	0	3
6.	21PCE20	Disaster Management	PE	3	0	0	3
7.	21OCH01	Climate Change and its Impact	PE	3	0	0	3

VERTICAL-IV: STRUCTURES

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21PCE21	Prestressed Concrete Structures	PE	3	0	0	3
2.	21PCE22	Repair and Rehabilitation of Structures	PE	3	0	0	3
3.	21PCE23	Prefabricated Structures	PE	3	0	0	3
4.	21PCE24	Introduction to Finite Element Method	PE	3	0	0	3
5.	21PCE25	Steel Concrete Composite Structures	PE	3	0	0	3
6.	21PCE26	Bridge Engineering	PE	3	0	0	3
7.	21PCE27	Structural Dynamics and Aseismic Design	PE	3	0	0	3

VERTICAL-V: WATER RESOURCES

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21PCE28	Ground Water Engineering	PE	3	0	0	3
2.	21PCE29	Hydrology and Water Resources Engineering	PE	3	0	0	3
3.	21PCE30	Participatory Water Resources Management	PE	3	0	0	3
4.	21PCE31	Integrated Water Resources Management	PE	3	0	0	3
5.	21PCE32	River Engineering	PE	3	0	0	3
6.	21PCE33	Coastal Engineering	PE	3	0	0	3
7.	21PCE34	Watershed Conservation and Management	PE	3	0	0	3

VERTICAL-VI: TRANSPORTATION

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21PCE35	Airports, Docks and Harbor Engineering	PE	3	0	0	3
2.	21PCE36	Pavement Engineering	PE	3	0	0	3
3.	21PCE37	Transportation Planning	PE	3	0	0	3
4.	21PCE38	Urban Planning and Development	PE	3	0	0	3
5.	21PCE39	Intelligent Transport System	PE	3	0	0	3
6.	21PCE40	Planning of Smart Cities	PE	3	0	0	3
7.	21PCE41	Traffic Engineering and Management	PE	3	0	0	3

ONE CREDIT COURSES

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	21OCCE01	STAADPRO – C Cube CADD Academy, Madurai	EE	0	0	2	1
2.	21OCCE02	REVIT ARCHITECTURE – C Cube CADD Academy, Madurai	EE	0	0	2	1
3.	21OCCE03	PRIMAVERA – C Cube CADD Academy, Madurai	EE	0	0	2	1
4.	21OCCE04	GPS Surveying – NPTEL IIT, Roorkee	EE	1	0	0	1
5.	21OCCE05	Visual Communication Design for Digital Media - NPTEL IIT, Roorkee	EE	1	0	0	1
6.	21OCCE06	Design Thinking - A Primer - NPTEL IIT, Madras	EE	1	0	0	1
7.	21OCCE07	Innovation by Design - NPTEL IIT, Bombay	EE	1	0	0	1
8.	21OCCE08	TEKLA STRUCTURES – C Cube CADD Academy, Madurai	EE	0	0	2	1
9.	21OCCE09	ANSYS – C Cube CADD Academy, Madurai	EE	0	0	2	1

J.P. Anil

VELAMMAL COLLEGE OF ENGINEERING & TECHNOLOGY, MADURAI - 625009

(Autonomous)

REGULATIONS – 2021

B. E. CIVIL ENGINEERING

(CHOICE BASED CREDIT SYSTEM)

SYLLABUS FOR SEMESTERS I TO VIII

SEMESTER-I

21IP101	INDUCTION PROGRAMME *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	0	0

This is a mandatory 2 week programme to be conducted as soon as the students enter the institution. Normal classes start only after the induction program is over.

The induction programme has been introduced by AICTE with the following objective:

"Engineering colleges were established to train graduates well in the branch/department of admission, have a holistic outlook, and have a desire to work for national needs and beyond. The graduating student must have knowledge and skills in the area of his/her study. However, he/she must also have broad understanding of society and relationships. Character needs to be nurtured as an essential quality by which he/she would understand and fulfil his/her responsibility as an engineer, as a citizen and as a human being. Besides the above, several meta-skills and underlying values are needed."

"One will have to work closely with the newly joined students in making them feel comfortable, allow them to explore their academic interests and activities, reduce competition and make them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and build character".

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

(i) Physical Activity

This would involve a daily routine of physical activity with games and sports, yoga, gardening, etc.

(ii) Creative Arts

Every student would choose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it every day for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, grow into engineering design later.

(iii) Universal Human Values

This is the anchoring activity of the Induction Programme. It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting stay in the hostel and department, be sensitive to others, etc. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing.

Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It would be effective that the faculty mentor assigned is also the faculty advisor for the student for the full duration of the UG programme.

(iv) Literary Activity

Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.

(v) Proficiency Modules

This would address some lacunas that students might have, for example, English, computer familiarity etc.

(vi) Lectures by Eminent People

Motivational lectures by eminent people from all walks of life should be arranged to give the students exposure to people who are socially active or in public life.

(vii) Visits to Local Area

A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

(viii) Familiarization to Dept./Branch & Innovations

They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & other facilities.

(ix) Department Specific Activities

About a week can be spent in introducing activities (games, quizzes, social interactions, small experiments, design thinking etc.) that are relevant to the particular branch of Engineering/Technology/Architecture that can serve as a motivation and kindle interest in building things (become a maker) in that particular field. This can be conducted in the form of a workshop. For example, CSE and IT students may be introduced to activities that kindle computational thinking, and get them to build simple games. ECE students may be introduced to building simple circuits as an extension of their knowledge in Science, and so on. Students may be asked to build stuff using their knowledge of science.

Induction Programme is totally an activity based programme and **therefore there shall be no tests / assessments** during this programme.

REFERENCE:

Guide to Induction Program from AICTE.

21EN101	**PROFESSIONAL ENGLISH - I** *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To develop learners skills in listening and responding effectively.
- To apply basic grammar for better communication.
- To employ reading passages for understanding vocabulary.
- To construct logical sentences and participate in pair presentation, extempore.

• To organize ideas for various compositions in writing.		
UNIT I	**INTRODUCTION TO FUNDAMENTALS OF COMMUNICATION**	**15**
Listening – Listening for general information - Specific details - Conversation: Introduction to classmates - Audio / video (formal & informal); Telephone conversation; Listening to voicemail & messages; Listening and filling a form; **Speaking** - Self Introduction; Introducing a friend; Conversation - Politeness strategies; Telephone conversation; Leave a voicemail; Leave a message with another person; asking for information to fill details in a form; **Reading** - Reading brochures (technical context), telephone messages / social media messages relevant to technical contexts and emails; **Writing** - Writing emails / letters introducing oneself; **Grammar** - Present Tense (simple, continuous); Question types: Wh/ Yes or No/ and Tags **Vocabulary** - Synonyms; One word substitution; Abbreviations & Acronyms (as used in technical contexts).		
UNIT II	**NARRATION AND SUMMATION**	**15**
Listening - Listening to podcast, anecdotes / stories / event narration; documentaries and interviews with celebrities; **Speaking** - Narrating personal experiences / events; Interviewing a celebrity; Reporting / and summarizing of documentaries / podcasts/ interviews; **Reading** - Reading biographies, travelogues, newspaper reports, Excerpts from literature, and travel & technical blogs; **Writing** - Guided writing - Paragraph writing Short Report on an event (field trip etc.); **Grammar** - Past tense (Simple, continuous); Subject-Verb Agreement; and Prepositions; **Vocabulary** - Word forms (prefixes& suffixes); Synonyms and Antonyms. Phrasal verbs.		
UNIT III	**DESCRIPTION OF A PROCESS / PRODUCT**	**15**
Listening - Listen to a product and process descriptions; a classroom lecture; and advertisements about a products; **Speaking** - Picture description; Giving instruction to use the product; Presenting a product; and Summarizing a lecture; **Reading** - Reading advertisements, gadget reviews; user manuals; **Writing** - Writing definitions; instructions; and Product /Process description; **Grammar** - Imperatives; Adjectives; Degrees of comparison; Present & Past Perfect, Present and past perfect continuous tenses; **Vocabulary** - Compound Nouns, Homonyms; and Homophones, discourse markers (connectives & sequence words).		
UNIT IV	**CLASSIFICATION AND RECOMMENDATIONS**	**15**
Listening - Listening to TED Talks; Scientific lectures; and educational videos; **Speaking** – Small Talk; Mini presentations and making recommendations; **Reading** - Newspaper articles; Journal reports - Non Verbal Communication (tables, pie charts etc,) **Writing** - Note-making / Note-taking (*Study skills to be taught, not tested); Writing recommendations; Transferring information from non verbal (chart, graph etc, to verbal mode) **Grammar** - Articles; Pronouns - Possessive & Relative pronouns; **Vocabulary** - Collocations; Fixed / Semi fixed expressions.		
UNIT V	**EXPRESSION**	**15**
Listening - Listening to debates/ discussions; different viewpoints on an issue; and panel discussions; **Speaking** - Group discussions, Debates, and Expressing opinions through Simulations & Role-play; **Reading** - Reading editorials; and Opinion Blogs; **Writing** - Essay Writing (Descriptive or narrative); **Grammar** - Future Tenses, Punctuation; Negation (Statements & Questions); and Simple, Compound & Complex Sentences; **Vocabulary** - Cause & Effect		

Expressions - Content vs. Function words.

TOTAL : 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Listen and comprehend complex academic texts.

CO2: Read and infer the denotative and connotative meanings of technical texts.

CO3: Write definitions, descriptions, narrations and essays on various topics.

CO4: Speak fluently and accurately in formal and informal communicative contexts.

CO5: Express their opinions effectively in both oral and written medium of communication.

TEXT BOOKS:

1. Dr. Veena Selvam, Dr. Sujatha Priyadarshini, Dr. Deepa Mary Francis, Dr. KN. Shoba, and Dr. Lourdes Joevani, Department of English, Anna University. English for Science & Technology. Cambridge University Press, 2021
2. Board of Editors, Department of English, Anna University. English for Engineers & Technologists. Orient Blackswan Private Ltd, 2020.
3. Board of Editors, Department of English, Anna University. Using English Orient Blackswan Private Ltd, 2017.

REFERENCES:

1. Meenakshi Raman & Sangeeta Sharma. Technical Communication – Principles And Practices Oxford University Press, New Delhi, 2016
2. Lakshminarayanan K.R. A Course Book On Technical English. SciTech Publications (India) Pvt. Ltd., 2012
3. Ayesha Viswamohan. English For Technical Communication (With CD). McGraw Hill Education, ISBN: 0070264244. 2008.
4. Kulbhusan Kumar, RS Salaria, Effective Communication Skill. Khanna Publishing House. First Edition, 2018.
5. Dr. V. Chellammal. Learning to Communicate. Allied Publishing House, New Delhi, 2003.

21MA101	MATRICES AND CALCULUS *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
- To explain the students about differential calculus.
- To demonstrate the functions of several variables technique to solve problems in many engineering branches.
- To demonstrate the various techniques of integration.
- To prepare the student to use mathematical tools in evaluating multiple integrals and their applications.

UNIT I	MATRICES	12
Eigenvalues and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigenvalues and Eigenvectors – Cayley - Hamilton theorem – Diagonalization of matrices by orthogonal transformation – Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms – Applications: Stretching of an elastic membrane.		
UNIT II	**DIFFERENTIAL CALCULUS**	**12**
Representation of functions - Limit of a function - Continuity - Derivatives - Differentiation rules (sum, product, quotient, chain rules) - Implicit differentiation - Logarithmic differentiation - Applications : Maxima and Minima of functions of one variable.		
UNIT III	**FUNCTIONS OF SEVERAL VARIABLES**	**12**
Partial differentiation – Homogeneous functions and Euler's theorem – Total derivative – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables – Applications : Maxima and minima of functions of two variables and Lagrange's method of undetermined multipliers.		
UNIT IV	**INTEGRAL CALCULUS**	**12**
Definite and Indefinite integrals - Substitution rule - Techniques of Integration: Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration of rational functions by partial fraction, Integration of irrational functions - Improper integrals - Applications: Hydrostatic force and pressure, moments and centres of mass.		
UNIT V	**MULTIPLE INTEGRALS**	**12**
Double integrals – Change of order of integration – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals – Volume of solids – Change of variables in double and triple integrals – Applications: Moments and centres of mass, moment of inertia.		
		TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use the matrix algebra methods for solving engineering problems.

CO2: Apply differential calculus tools in solving various application problems.

CO3: Make use of differential calculus ideas on several variable functions.

CO4: Identify suitable methods of integration in solving practical problems.

CO5: Solve practical problems of areas, volumes using multiple integrals.

TEXT BOOKS:

1. Kreyszig.E, "Advanced Engineering Mathematics", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
3. James Stewart, "Calculus: Early Transcendentals", 8th Edition, Cengage Learning, New Delhi, 2015.

REFERENCES:

1. Bali. N., Goyal. M. and Watkins. C., "Advanced Engineering Mathematics", 7th Edition,

Firewall Media (An imprint of Lakshmi Publications Pvt., Ltd.,), New Delhi, 2009.
2. Jain. R.K. and Iyengar. S.R.K., "Advanced Engineering Mathematics", 5th Edition, Narosa
3. Publications, New Delhi, 2016.
4. Ramana. B.V., "Higher Engineering Mathematics", 6th Edition, McGraw Hill Education Pvt. Ltd, New Delhi, 2010.
5. Thomas. G. B., Hass. J and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson India, 2018.

21PH101	ENGINEERING PHYSICS *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the students effectively to achieve an understanding of mechanics.
- To infer the students to gain knowledge of electromagnetic waves and its applications.
- To explain the basics of oscillations, optics and lasers.
- To outline the importance of quantum physics.
- To relate the students towards the applications of quantum mechanics.

UNIT I | **MECHANICS** | 9

Multi-particle dynamics: Center of mass (CM) – CM of continuous bodies – motion of the CM – kinetic energy of system of particles. Rotation of rigid bodies: Rotational kinematics – rotational kinetic energy and moment of inertia - theorems of M .I –moment of inertia of continuous bodies – M.I of a diatomic molecule - torque – rotational dynamics of rigid bodies – conservation of angular momentum – rotational energy state of a rigid diatomic molecule - gyroscope - torsional pendulum– double pendulum –Introduction to nonlinear oscillations.

UNIT II | **ELECTROMAGNETIC WAVES** | 9

The Maxwell's equations - wave equation; Plane electromagnetic waves in vacuum, Conditions on the wave field - properties of electromagnetic waves: speed, amplitude, phase, orientation and waves in matter - polarization - Producing electromagnetic waves - Energy and momentum in EM waves: Intensity, waves from localized sources, momentum and radiation pressure - Cell-phone reception. Reflection and transmission of electromagnetic waves from a non-conducting medium vacuum interface for normal incidence.

UNIT III | **OSCILLATIONS, OPTICS AND LASERS** | 9

Simple harmonic motion - resonance –analogy between electrical and mechanical oscillating systems - waves on a string - standing waves - traveling waves - Energy transfer of a wave – sound waves - Doppler effect. Reflection and refraction of light waves - total internal reflection - interference– Michelson interferometer –Theory of air wedge and experiment. Theory of laser - characteristics - Spontaneous and stimulated emission - Einstein's coefficients - population inversion - Nd-YAG laser, CO2 laser, semiconductor laser –Basic applications of lasers in industry.

UNIT IV | **BASIC QUANTUM MECHANICS** | 9

A.P. Prabakar Sainrsun
BoS Chairman

Photons and light waves - Electrons and matter waves –Compton effect - The Schrodinger equation (Time dependent and time independent forms) - meaning of wave function - Normalization –Free particle - particle in an infinite potential well: 1D,2D and 3D Boxes- Normalization, probabilities and the correspondence principle.		
UNIT V	**APPLIED QUANTUM MECHANICS**	**9**
The harmonic oscillator(qualitative)- Barrier penetration and quantum tunneling(qualitative)- Tunneling microscope - Resonant diode - Finite potential wells (qualitative)- Bloch's theorem for particles in a periodic potential –Basics of Kronig-Penney model and origin of energy bands.		
		TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the importance of mechanics.

CO2: Extend their knowledge in electromagnetic waves.

CO3: Illustrate a strong foundational knowledge in oscillations, optics and lasers.

CO4: Interpret the importance of quantum physics.

CO5: Summarize quantum mechanical principles towards the formation of energy bands.

TEXT BOOKS:

1. D.Kleppner and R.Kolenkow, "An Introduction to Mechanics", First Edition, McGraw Hill Education, 2017.
2. E.M.Purcell and D.J.Morin, "Electricity and Magnetism", Third Edition, Cambridge University Press, 2013.
3. Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury, "Concepts of Modern Physics", Seventh Edition, McGraw-Hill, 2017.

REFERENCES:

1. R.Wolfson. "Essential University Physics", Volume 1 & 2. , 1st Edition (Indian Edition) Pearson Education, 2009.
2. Paul A. Tipler, "Physics" - Volume 1 & 2, 1st Edition (Indian Edition), CBS Publishers & Distributors, 2004.
3. K.Thyagarajan and A.Ghatak. "Lasers: Fundamentals and Applications", 2nd Edition, Laxmi Publications, (Indian Edition), 2019.
4. D.Halliday, R. Resnick and J. Walker, "Principles of Physics". 10th Edition (Indian Edition), Wiley, 2015.
5. N.Garcia, A.Damask and S.Schwarz, "Physics for Computer Science Students", 1st Edition, Springer Verlag, 2012.

21CH101	ENGINEERING CHEMISTRY *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To inculcate sound understanding of water quality parameters and water treatment techniques.
- To impart knowledge on the basic principles and preparatory methods of nanomaterials.
- To introduce the basic concepts and applications of phase rule and composites.
- To facilitate the understanding of different types of fuels, their preparation, properties and combustion characteristics.
- To familiarize the students with the operating principles, working processes and applications of energy conversion and storage devices.

UNIT I	WATER AND ITS TREATMENT	9

Water: Sources and impurities, **Water quality parameters:** Definition and significance of-colour, odour, turbidity, pH, hardness, alkalinity, TDS, COD and BOD, fluoride and arsenic. **Municipal water treatment:** primary treatment and disinfection (UV, Ozonation, break-point chlorination).**Desalination of brackish water**: Reverse Osmosis. **Boiler troubles:** Scale and sludge, Boiler corrosion, Caustic embrittlement, Priming & foaming. **Treatment of boiler feed water**: Internal treatment (phosphate, colloidal, sodium aluminate and calgon conditioning) and External treatment – Ion exchange demineralization and zeolite process.

UNIT II	NANOCHEMISTRY	9

Basics: Distinction between molecules, nanomaterials and bulk materials; **Size-dependent properties** (optical, electrical, mechanical and magnetic); **Types of nanomaterials**: Definition, properties and uses of – nanoparticle, nanocluster, nanorod, nanowire and nanotube. **Preparation of nanomaterials:** sol-gel, solvothermal, laser ablation, chemical vapour deposition, electrochemical deposition and electro spinning. **Applications** of nanomaterials in medicine, agriculture, energy, electronics and catalysis.

UNIT III	PHASE RULE AND COMPOSITES	9

Phase rule: Introduction, definition of terms with examples. One component system - water system; Reduced phase rule; Construction of a simple eutectic phase diagram - Thermal analysis; Two component system: lead-silver system - Pattinson process.

Composites: Introduction: Definition & Need for composites; Constitution: Matrix materials (Polymer matrix, metal matrix and ceramic matrix) and Reinforcement (fiber, particulates, flakes and whiskers). **Properties and applications of**: Metal matrix composites (MMC), Ceramic matrix composites and Polymer matrix composites. **Hybrid composites** - definition and examples.

UNIT IV	FUELS AND COMBUSTION	9

Fuels: Introduction: Classification of fuels; **Coal and coke**: Analysis of coal (proximate and ultimate), Carbonization, Manufacture of metallurgical coke (Otto Hoffmann method). **Petroleum and Diesel:** Manufacture of synthetic petrol (Bergius process), Knocking - octane number, diesel oil - cetane number; **Power alcohol and biodiesel.**

Combustion of fuels: Introduction: Calorific value - higher and lower calorific values, Theoretical calculation of calorific value; **Ignition temperature**: spontaneous ignition temperature, Explosive range; **Flue gas analysis** - ORSAT Method. **CO_2 emission and carbon foot print.**

UNIT V	ENERGY SOURCES AND STORAGE DEVICES	9

Stability of nucleus: mass defect (problems), binding energy; Nuclear energy: light water nuclear power plant, breeder reactor. **Solar energy conversion:** Principle, working and applications of solar cells; **Recent developments in solar cell materials. Wind energy; Geothermal energy; Batteries:** Types of batteries, Primary battery - dry cell, Secondary battery - lead acid battery and lithium-ion-battery; **Electric vehicles-working principles; Fuel cells:** H_2-O_2 fuel cell, microbial fuel cell; **Supercapacitors:** Storage principle, types and examples.

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Infer the quality of water from quality parameter data and propose suitable treatment methodologies to treat water.

CO2: Identify and apply basic concepts of nanoscience and nanotechnology in designing the synthesis of nanomaterials for engineering and technology applications.

CO3: Apply the knowledge of phase rule and composites for material selection requirements.

CO4: Recommend suitable fuels for engineering processes and applications.

CO5: Recognize different forms of energy resources and apply them for suitable applications in energy sectors.

TEXT BOOKS:

1. P. C. Jain and Monica Jain, "Engineering Chemistry", 17th Edition, DhanpatRai Publishing Company (P) Ltd, New Delhi, 2018.
2. Sivasankar B., "Engineering Chemistry", 1st Edition, Tata McGraw-Hill Publishing Company Ltd, NewDelhi, 2008.
3. S.S. Dara, "A text book of Engineering Chemistry", 12th Edition, S. Chand Publishing, 2018.

REFERENCES:

1. B. S. Murty, P. Shankar, Baldev Raj, B.B. Rath and James Murday, "Text book of nanoscience and nanotechnology", 1st Edition, Universities Press-II M Series in Metallurgy and Materials Science, 2018.
2. O.G. Palanna, "Engineering Chemistry" 2nd Edition, McGraw Hill Education (India) Private Limited, 2017.
3. Friedrich Emich, "Engineering Chemistry", 1st Edition, Scientific International PVT, LTD, New Delhi, 2014.
4. Shikha Agarwal, "Engineering Chemistry-Fundamentals and Applications", 2nd Edition, Cambridge University Press, Delhi, 2019
5. O.V. Roussak and H.D. Gesser, "Applied Chemistry-A Text Book for Engineers and Technologists", 2nd Edition, Springer Science Business Media, New York, 2013.

21CS101	PROBLEM SOLVING AND PYTHON PROGRAMMING *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

UNIT I	COMPUTATIONAL THINKING AND PROBLEM SOLVING	9

Fundamentals of Computing – Identification of Computational Problems -Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.

UNIT II	DATA TYPES, EXPRESSIONS, STATEMENTS	9

Python interpreter and interactive mode, debugging; values and types: int, float, boolean, string, and list; variables, expressions, statements, tuple assignment, precedence of operators, comments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

UNIT III	CONTROL FLOW, FUNCTIONS, STRINGS	9

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-else-if-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope, function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

UNIT IV	LISTS, TUPLES, DICTIONARIES	9

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing - list comprehension; Illustrative programs: simple sorting, histogram, Students marks statement, Retail bill preparation.

UNIT V	FILES, MODULES, PACKAGES	9

Files and exceptions: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file, Voter's age validation, Marks range validation (0-100).

TOTAL :45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of design approaches to solve computational problems.

CO2: Develop and execute basic Python programs using expressions and input/output statements.
CO3: Utilize strings, functions and control statements to develop real world problems.
CO4: Construct programs using Python data types like lists, tuples and dictionaries.
CO5: Prepare a Python application by incorporating files and exceptions.

TEXT BOOKS:

1. Allen B. Downey, "Think Python: How to Think like a Computer Scientist", 2nd Edition, O'Reilly Publishers, 2016.
2. Karl Beecher,"Computational Thinking: A Beginner's Guide to Problem Solving and Programming", 1st Edition, BCS Learning & Development Limited, 2017.
3. Martin C. Brown, "Python: The Complete Reference", 4th Edition, Mc- Graw Hill, 2018.

REFERENCES:

1. Paul Deitel and Harvey Deitel, "Python for Programmers", 1st Edition, Pearson Education, 2021.
2. G Venkatesh and Madhavan Mukund, "Computational Thinking: A Primer for Programmers and Data Scientists", 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data", 3rd Edition, MIT Press, 2021.
4. Eric Matthes, "Python Crash Course, A Hands - on Project Based Introduction to Programming", 2nd Edition, No Starch Press, 2019.

21CS102	PROBLEM SOLVING AND PYTHON PROGRAMMING LABORATORY *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To describe the basics of algorithmic problem solving.
- To solve problems using Python conditionals and loops.
- To illustrate Python functions and use function calls to solve problems.
- To make use of Python data structures - lists, tuples, and dictionaries to represent complex data.
- To explain input/output with files in Python.

LIST OF EXPERIMENTS

1. Identification and solving of simple real life or scientific or technical problems, and developing flow charts for the same. (Electricity Billing, Retail shop billing, Sin series, weight of a motorbike, Weight of a steel bar, compute Electrical Current in Three Phase AC Circuit, etc.,)
2. Python programming using simple statements and expressions (exchange the values of two variables, circulate the values of n variables, distance between two points).
3. Scientific problems using Conditionals and Iterative loops. (Number series, Number Patterns, pyramid pattern)
4. Implementing real-time/technical applications using Lists, Tuples (Items present in a

library/Components of a car/ Materials required for construction of a building –operations of list & tuples).

5. Implementing real-time/technical applications using Sets, Dictionaries. (Language, components of an automobile, Elements of a civil structure, etc.,- operations of Sets & Dictionaries)
6. Implementing programs using Functions. (Factorial, largest number in a list, area of shape)
7. Implementing programs using Strings. (reverse, palindrome, character count, replacing characters)
8. Implementing programs using written modules and Python Standard Libraries (pandas, numpy, Matplotlib, scipy)
9. Implementing real-time/technical applications using File handling. (copy from one file to another, word count, longest word)
10. Implementing real-time/technical applications using Exception handling. (divide by zero error, voter's age validity, student mark range validation)
11. Exploring Pygame tool.
12. Developing a game activity using Pygame like bouncing ball, car race etc.,

TOTAL :60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Develop algorithmic solutions to simple computational Problems.

CO2: Illustrate and execute basic Python programs using simple statements.

CO3: Build program for scientific problems using strings, functions and control statements.

CO4: Utilize compound data types lists, tuples and dictionaries for real-time applications.

CO5: Experiment the python packages, files and exceptions for developing software applications.

21PC101	PHYSICS AND CHEMISTRY LABORATORY *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

PHYSICS LABORATORY

COURSE OBJECTIVES:

- To explain the proper use of various kinds of physics laboratory equipment.
- To extend how data can be collected, presented and interpreted in a clear and concise manner.
- To infer problem solving skills related to physics principles and interpretation of experimental data.
- To summarize error in experimental measurements and techniques used to minimize such error.
- To translate the student as an active participant in each part of all lab exercises.

LIST OF EXPERIMENTS (Any 7 Experiments)

1. Torsional pendulum - Determination of rigidity modulus of wire and moment of inertia of regular and irregular objects.
2. Simple harmonic oscillations of cantilever.
3. Non-uniform bending - Determination of Young's modulus
4. Uniform bending – Determination of Young's modulus
5. Laser- Determination of the wave length of the laser using grating
6. Air wedge - Determination of thickness of a thin sheet/wire
7. a) Optical fibre -Determination of Numerical Aperture and acceptance angle
   b) Compact disc- Determination of width of the groove using laser.
8. Acoustic grating- Determination of velocity of ultrasonic waves in liquids.
9. Ultrasonic interferometer – determination of the velocity of sound and compressibility of liquids
10. Post office box -Determination of Band gap of a semiconductor.
11. Photoelectric effect
12. Michelson Interferometer.
13. Melde's string experiment
14. Experiment with lattice dynamics kit.

TOTAL:30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:.Explain the functioning of various physics laboratory equipment.

CO2: Relate the graphical models to analyze laboratory data.

CO3: Interpret mathematical models as a medium for quantitative reasoning and describing physical reality.

CO4: Explain Access, process and analyze scientific information.

CO5: Translate students to solve problems individually and collaboratively.

REFERENCES :

1. Department of Physics, "Physics Laboratory Manual", Velammal College of Engineering & Technology, Madurai, 2021.
2. P. Mani, "Physics Laboratory", Dhanam Publications, 2021.

CHEMISTRY LABORATORY

COURSE OBJECTIVES:

- To inculcate experimental skills to test basic understanding of water quality parameters such as acidity, alkalinity, hardness, DO, chloride and copper.
- To induce the students to familiarize with electro analytical techniques such as pH metry, potentiometry and conductometry in the determination of impurities in aqueous solutions.
- To demonstrate the analysis of metals and alloys.
- To demonstrate the synthesis of nanoparticles.
- To analyze the quality of coal sample using proximate analysis.

LIST OF EXPERIMENTS (Any 7 Experiments)

1. Preparation of Na_2CO_3 as a primary standard and estimation of acidity of a water sample using

the primary standard

2. Determination of types and amount of alkalinity in water sample.
3. Determination of total, temporary & permanent hardness of water by EDTA method.
4. Determination of DO content of water sample by Winkler's method.
5. Determination of chloride content of water sample by Argentometric method.
6. Estimation of copper content of the given solution by Iodometry.
7. Estimation of TDS of a water sample by gravimetry.
8. Determination of strength of given hydrochloric acid using pH meter.
9. Determination of strength of acids in a mixture of acids using conductivity meter.
10. Conductometric titration of barium chloride against sodium sulphate (precipitation titration)
11. Estimation of iron content of the given solution using potentiometer.
12. Estimation of sodium /potassium present in water using flame photometer.
13. Preparation of nanoparticles (TiO_2/ZnO/CuO) by Sol-Gel method.
14. Estimation of Nickel in steel
15. Proximate analysis of Coal

TOTAL :30 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able to

CO1: Analyse the quality of water samples with respect to their acidity, alkalinity, hardness and DO.

CO2: Determine the amount of metal ions through volumetric and spectroscopic techniques.

CO3: Analyse and determine the composition of alloys.

CO4: Learn simple method of synthesis of nanoparticles.

CO5: Quantitatively analyse the impurities in solution by electro analytical techniques.

TEXT BOOK:

1. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas and B. Sivasankar, "Vogel's Textbook of Quantitative Chemical Analysis", 2009.

SEMESTER-II

21EN102	ENGLISH – II *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop strategies and skills to enhance their ability to read and comprehend engineering and technology texts.
- To prepare and write convincing job applications and effective reports.
- To demonstrate their speaking skills to make technical presentations and participate in group discussions.
- To apply their Listening skill which will help them comprehend lectures and talks in their areas of specialization
- To choose appropriate soft skills to suit the situation.

UNIT I	INTRODUCTION TO TECHNICAL ENGLISH	9

Listening - Factual and Academic speeches; **Speaking** - Asking for and giving directions - **Reading** - Technical texts from - Newspapers /websites; **Writing** - Statements - Definitions - issue based writing instructions - Checklists - Recommendations; **Vocabulary Development**- technical vocabulary; **Grammar** - Error spotting - Compound words; **Soft skills** - Leadership Skills.

UNIT II	READING AND STUDY SKILLS	9

Listening - Listening to longer technical talks and completing exercises based on them; **Speaking** - Describing a general process; **Reading** - Reading longer technical texts - Identifying the various transitions in a text - Paragraphing; **Writing** - Interpreting charts, graphs; **Vocabulary Development** - Vocabulary used in formal letters/emails and reports **Grammar** - Impersonal passive voice, numerical adjectives - **Soft skills** – Teamwork.

UNIT III	TECHNICAL WRITING AND GRAMMAR	9

Listening - Listening to classroom lectures, talks on engineering /technology; **Speaking** - introduction to technical presentations; **Reading** - longer texts both general and technical, practice in speed reading; **Writing** - Describing a technical process; **Vocabulary Development** - Sequence words - Misspelled words; **Grammar** - Embedded sentences ; **Soft skills** - Decision making.

UNIT IV	JOB APPLICATIONS	9

Listening - Listening to documentaries and making notes. **Speaking** - Mechanics of presentations; **Reading** - Reading for detailed comprehension; **Writing** - Email etiquette - job application - Cover Letter - Resume preparation(via email and hard copy) - Analytical essay writing - **Vocabulary Development** - finding suitable synonyms - paraphrasing; **Grammar** - clauses - If conditionals - **Soft skills** - Time Management.

UNIT V	GROUP DISCUSSION AND REPORT WRITING	9

S.Jomathy
BoS Chairman

Listening - TED talks; **Speaking** - Participating in a group discussion - **Reading** - Reading and understanding technical articles; **Writing** - Writing reports - Survey report, accident report and minutes of a meeting - **Vocabulary Development** - Verbal analogies; **Grammar** - reported speech; **Soft skills** - Conflict Resolution.

	TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret by reading information in technical texts.

CO2: Choose appropriate language to write convincing job applications, resume and reports.

CO3: Formulate the technical ideas effectively in spoken and written forms.

CO4: Analyze and understand spoken language in lectures and talks.

CO5: Demonstrate basic soft skills in life.

TEXT BOOKS:

1. Board of Editors, "Fluency in English-A Course Book for Undergraduate Engineers and Technologist", 2nd Edition, Orient BlackSwan Pvt Ltd; Hyderabad, 2018.
2. Jawahar, Jewelcy & Rathna.P. Communicative English Workbook. VRB Publishers Pvt Ltd. Chennai. 2018.
3. Board of Editors, Department of English, Anna University. Chennai, "Mindscapes-English for Technologists and Engineers", 1st Edition, Orient BlackSwan Pvt Ltd; Chennai, 2012.

REFERENCES:

1. Verma, Shalini. Technical Communication for Engineers. Vikas Publishing House Pvt Ltd. New Delhi. 2015
2. Raman, Meenakshi & Sharma, Sangeeta. Technical Communication English Skills for Engineers. Oxford University Press. 2008.
3. Rizvi, Ashraf.M. Effective Technical Communication. MC Graw Hill Education Pvt Ltd. New Delhi. 2016.

21MA102	**VECTOR CALCULUS AND COMPLEX VARIABLES** *(Common to B.E. Civil Engg., EEE & Mechanical Engg.)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To explain the students with the concepts of vector calculus needed for problem solving in all engineering disciplines.
- To choose the effective mathematical methods for finding the solutions of partial differential equations.
- To identify and develop the standard techniques of complex variables.
- To apply with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow of electric current.
- To prepare the student to acquire sound knowledge of techniques in solving ordinary

differential equations that model engineering problems.		
UNIT I	**VECTOR CALCULUS**	**12**
Gradient , Divergence and Curl – Directional derivation – Irrotational and solenoidal vector fields – Vector integration – Greens theorem in a plane , Gauss Divergence theorem and Stoke's theorem (excluding proof) – Simple applications involving cubes and rectangular parallelepiped.		
UNIT II	**PARTIAL DIFFERENTIAL EQUATIONS**	**12**
Formation of partial differential equations – Solutions of standard types of first order PDE : f(p, q) = 0, f(z ,p,q)=0, z=px+ qy + f(p,q), f(x, p) = f(y, q) – Lagrange's linear equations – linear partial differential equations of second and higher order with constant coefficients of homogeneous type.		
UNIT III	**ANALYTIC FUNCTIONS**	**12**
Analytic functions – necessary and sufficient conditions for analyticity-properties – Harmonic conjugates- construction of analytic function – conformal mapping –Mapping by functions- Bilinear transformation $w = c + z, az, \frac{1}{z}, z^2$.		
UNIT IV	**COMPLEX INTEGRATION**	**12**
Complex Integration – Cauchy's integral theorem and integral formula (excluding proof)-Taylor series and Laurent's series –Residues – Cauchy's residue Theorem (excluding proof) – Application of Residue theorem to evaluate real integrals around unit circle and semi- circle (excluding poles on the real axis).		
UNIT V	**ORDINARY DIFFERENTIAL EQUATIONS**	**12**
Linear equations of second order with constant and variable coefficients-Homogeneous equations of Euler type – Equations reducible to homogeneous form –Variation of parameters-Simultaneous first order with constant coefficients.		
		TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the concept of vector calculus which naturally arises in many engineering Problems.

CO2: Solve the Partial Differential Equations by using various techniques.

CO3: Construct an analytic function using the properties of analytic function.

CO4: Apply suitable formula to evaluate the given integral.

CO5: Use a suitable method, solve the given differential equation of first & second order.

TEXT BOOKS:

1. Kreyszig Erwin, "Advanced Engineering Mathematics ", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. James Stewart, " Calculus: Early Transcendentals", 8th Edition, Cengage Learning New Delhi, 2015.
3. Thomas. G. B., Hass. J, and Weir. M.D, "Thomas Calculus", 14th Edition, Pearson Education, 2018.

REFERENCES:

A. P. Pushpalai
BoS Chairman

1. B.S.Grewal, "Higher Engineering Mathematics", 43rd Edition, Khanna Publishers, 2015.
2. P. Kandasamy, Thilagavathy and K.Gunavathy, "Engineering Mathematics Vol-II", 3rd Edition, S. Chand Limited, 2015.
3. P. Kandasamy, Thilagavathy and K.Gunavathy, "Engineering Mathematics Vol-III", 3rd Edition, S. Chand Limited, 2015.

21PH102	PHYSICS FOR CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basics of heat transfer through different materials, thermal performance of building and various thermal applications.
- To interpret knowledge on the ventilation and air conditioning of buildings.
- To illustrate the concepts of sound insulation and lighting designs.
- To summarize the processing and applications of new engineering materials.
- To translate awareness on natural disasters and safety measures.

UNIT I	THERMAL APPLICATIONS	9

Principles of heat transfer, steady state of heat flow, conduction through compound media-Series and parallel- Conductivity of rubber tube and powder materials - Heat transfer through fenestrations, thermal insulation and its benefits - Heat gain and heat loss estimation - Factors affecting the thermal performance of buildings, thermal measurements, thermal comfort, indices of thermal comfort, climate and design of solar radiation, shading devices - Central heating.

UNIT II	VENTILATION AND REFRIGERATION	9

Requirements, principles of natural ventilation - Ventilation measurements, design for natural ventilation - Window types and packaged air conditioners - Chilled water plant - Fan coil systems - Water piping - Cooling load - Air conditioning systems for different types of buildings - Protection against fire to be caused by A.C. systems.

UNIT III	ACOUSTICS AND LIGHTING DESIGNS	9

Acoustics: Introduction - Reverberation - Growth and decay of sound - Sabine's formula for reverberation time - Determination of sound absorption coefficient - Factors affecting acoustics of buildings - Visual field glare, colour - Day light calculations - Day light design of windows, measurement of day-light and use of models and artificial skies, principles of artificial lighting - Electro chromic windows.

UNIT IV	NEW ENGINEERING MATERIALS	9

Composites - Definition and classification - Fiber reinforced plastics (FRP) and fiber reinforcedmetals (FRM) - Metallic glasses - Shape memory alloys - Ceramics - Classification - Crystalline -Non Crystalline materials - Properties - thermal, mechanical, electrical and chemical ceramic fibres - Ferroelectric and ferromagnetic ceramics - High Aluminum ceramics

UNIT V	NATURAL DISASTERS	9

Seismology and Seismic waves - Earth quake ground motion - Basic concepts and estimation techniques - site effects - Probabilistic and deterministic Seismic hazard analysis - Cyclone and flood hazards - Fire hazards and fire protection, fire-proofing of materials, fire safety regulations and firefighting equipment - Prevention and safety measures.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate the heat transfer through different materials, thermal performance of building and thermal insulation.

CO2: Extend knowledge on the ventilation and air conditioning of buildings.

CO3: Illustrate the acoustic properties of buildings.

CO4: Summarize the processing and applications of composites, metallic glasses, shape memory alloys and ceramics.

CO5: Translate awareness on natural disasters such as earth quake, cyclone, fire and safety measures.

TEXT BOOKS:

1. Marko Pinteric, "Building Physics", Springer 2017.
2. D.S.Mathur, "Elements of Properties of Matter", 11th Edition, S Chand & Company, 2010.
3. Hugo Hens, "Building Physics: Heat, Air and Moisture", 1st Edition, Wiley, 2017.

REFERENCES:

1. W.R. Stevens, "Building Physics: Lighting", 1st Edition, Pergamon Press, 2013.
2. Hugo Hens, "Applied Building Physics", 2nd Edition, Wiley, 2016.
3. K.G. Budinski and M.K. Budinski, "Engineering Materials: Properties and Selection", 9th Edition, Pearson Education, 2016.
4. Peter A. Claisse, "Civil Engineering Materials", 1st Edition, Elsevier, 2016.
5. Patrick L. Abbott, "Natural Disasters", 11th Edition, McGraw-Hill, 2017.

21ME101	ENGINEERING GRAPHICS *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		2	0	2	3

COURSE OBJECTIVES:

- To sketch the projection of points, lines and planes.
- To sketch the projection of simple solids.
- To sketch the projection of sectioned solids and development of lateral surfaces.
- To sketch the projection isometric and perspective projections of simple solids.
- To sketch the orthographic projection of various objects using freehand.

UNIT I	PROJECTIONS OF POINTS, LINES AND PLANE SURFACE	12

Importance of graphics in engineering applications – Use of drafting instruments - Lettering and dimensioning.

Introduction to Orthographic projections - Principles -Principal planes-First angle projection. Projection of points located in all quadrants. Projection of straight lines inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method.
Projection of planes (regular polygonal and circular surfaces) inclined to both the principal planes by rotating object method. (Not for Examination)

UNIT II	PROJECTION OF SOLIDS	12

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method.

UNIT III	PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES	12

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones.

UNIT IV	ISOMETRIC AND PERSPECTIVE PROJECTIONS	12

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

UNIT V	FREEHAND SKETCHING	12

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Freehand sketching of multiple views from pictorial views of objects.
Introduction to drafting packages and demonstration. (Not for examination).

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, the learners will be able to

CO1: Construct the orthographic projections of points, straight lines and plane surfaces.
CO2: Sketch the orthographic projections in simple solids.
CO3: Sketch the orthographic projections in sectional solids and lateral surfaces of the solids.
CO4: Construct the isometric projections and perspective projections of simple solids.
CO5: Construct the orthographic projection of objects using free hand.

TEXT BOOKS:

1. Natarajan K.V., "A text book of Engineering Graphics", 31st Edition, Dhanalakshmi Publishers, Chennai, 2018.
2. Venugopal K. and Prabhu Raja V., "Engineering Graphics", 15th Edition, New Age International (P) Limited, 2018.
3. Bhatt N.D. and Panchal V.M., "Engineering Drawing", 53rd Edition, Charotar Publishing House, 2014.

REFERENCES:
1. Basant Agarwal and Agarwal C.M., "Engineering Drawing", 2nd Edition, Tata McGraw Hill Publishing Company Limited, 2013.
2. Parthasarathy N. S. and Vela Murali, "Engineering Graphics", 2nd Edition, Oxford University, Press, New Delhi, 2015.
3. Shah M.B. and Rana B.C., "Engineering Drawing", 2nd Edition, Pearson, 2009.

21CE101	CONSTRUCTION MATERIALS AND TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To show various materials used in construction.
- To explain the various practices in brick masonry and stone masonry construction, flooring and roofing.
- To compare the different kinds of structural systems and to know energy efficient buildings.
- To identify the various construction techniques and to plan the requirements for substructure construction.
- To plan the methods and techniques of superstructure construction.

UNIT I	STONE – BRICKS - TIMBER	9

Stone as building material – Criteria for selection – Tests on stones – Deterioration and Preservation of stone work – Bricks – Classification – Manufacturing of clay bricks – Tests on bricks – Compressive Strength – Water Absorption – Efflorescence – Bricks for special use –Refractory bricks – Concrete blocks – Lightweight concrete blocks - Timber – Market forms – Industrial timber– Plywood – Veneer.

UNIT II	CONSTRUCTION PRACTICES	9

Specifications, details and sequence of activities and construction co-ordination – Site Clearance – marking – Earthwork - masonry – stone masonry – Bond in masonry - concrete hollow block masonry – flooring – damp proof courses – construction joints – movement and expansion joints – Building foundations – basements – centering and shuttering – slip forms – scaffoldings –weather and water proof – roof finishes – acoustics and fire protection.

UNIT III	CONSTRUCTION TECHNIQUES	9

Structural systems - Load Bearing Structure - Framed Structure - Load transfer mechanism –floor system - Development of construction techniques - High rise Building Technology – Seismic effect - Environmental impact of materials – responsible sourcing - Eco Building (Green Building) - Materials used - Construction methods - Natural Buildings - Passive buildings – Intelligent (Smart) buildings - Meaning - Building automation - Energy efficient buildings for various zones.

UNIT IV	SUBSTRUCTURE CONSTRUCTION	9

Techniques of Box jacking – Pipe Jacking -under water construction of diaphragm walls and basement -Tunnelling techniques – Piling techniques - well and caisson - sinking cofferdam – driving diaphragm walls, sheet piles - shoring for deep cutting – well points - Dewatering and stand by Plant equipment for underground open excavation.

UNIT V	SUPERSTRUCTURE CONSTRUCTION	9

Launching girders, bridge decks, off shore platforms – special forms for shells - techniques for heavy decks – in-situ prestressing in high rise structures, Material handling - erecting light weight components on tall structures - Support structure for heavy Equipment and conveyors - Erection of articulated structures, braced domes and space decks.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Compare the properties of most common and advanced building materials.

CO2: Outline the various practices in brick masonry and stone masonry construction, flooring and roofing.

CO3: Classify the different kinds of structural systems and to know energy efficient buildings.

CO4: Illustrate the various construction techniques and to plan the requirements for substructure construction.

CO5: Explain the methods and techniques of superstructure construction.

TEXT BOOKS:

1. Varghese.P.C, "Building Materials", 2nd Edition, PHI Learning Pvt. Ltd, New Delhi, 2015.
2. Schexnayder, Clifford J.; Shapira, Aviad; Schmitt, Robert; Peurifoy, Robert, "Construction Planning, Equipment and Methods", 9th Edition, McGraw Hill, Singapore, 2021.
3. Arora S.P. and Bindra S.P., "A Textbook of Building Construction", 2nd Edition, Dhanpat Rai and Sons, 2014.
4. Varghese, P.C. "Building construction", 2nd Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2016.

REFERENCES:

1. Jagadish.K.S, "Alternative Building Materials Technology", 2nd Edition, New Age International, 2017.
2. Jha J and Sinha S.K., "Construction and Foundation Engineering", Khanna Publishers, 2008.
3. Sharma S.C. "Construction Equipment and Management", 2nd Edition, Khanna Publishers New Delhi, 2019.

21EE103	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING** (Theory with Practical Course) *(Common to B.E., Civil Engg. & Mechanical Engg.)*	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

J.P. [signature]

- To outline the basics of electric circuits and analysis.
- To classify wires and domestic wiring.
- To summarize the working principles and application of electrical machines.
- To outline the characteristics of semiconductor devices.
- To explain the functional elements and working of transducers.

UNIT I	ELECTRICAL CIRCUITS	9

DC Circuits: Circuit Components: Conductor, Resistor, Inductor, Capacitor – Ohm's Law - Kirchhoff's Laws – Simple problems- Nodal Analysis, Mesh analysis with Independent sources only (Steady state)

Introduction to AC Circuits and Parameters: Waveforms, Average value, RMS Value, Instantaneous power, real power, reactive power and apparent power, power factor.

UNIT II	MAGNETIC CIRCUITS AND ELECTRICAL INSTALLATIONS	9

Magnetic circuits-definitions-MMF, flux, reluctance, magnetic field intensity, flux density, fringing, self and mutual inductances-simple problems.

Domestic wiring, types of wires and cables, earthing, protective devices- switch, fuse unit - safety precautions and First Aid.

UNIT III	ELECTRICAL MACHINES	9

Construction and Working principle- DC Separately and Self excited Generators, Types and Applications. Working Principle of DC motors, Types and Applications. Construction, Working principle and Applications of Transformer, working of Three phase Alternator and Three Phase Induction Motor.

UNIT IV	ANALOG & DIGITAL ELECTRONICS	9

Resistor, Inductor and Capacitor in Electronic Circuits- Silicon &Germanium – PN Junction Diodes, Zener Diode –Characteristics Applications – Bipolar Junction Transistor-Biasing, Rectifier.

Review of number systems, binary codes, Combinational logic - representation of logic functions.

UNIT V	INSTRUMENTATION SYSTEM	9

Classification of instruments – Operating Principles of indicating Instruments and Digital Energy meter. Strain gauge, LVDT, differential pressure transducer, optical and digital transducers, Smart sensors, Thermal Imagers.

TOTAL: 45 PERIODS

PRACTICAL COURSE	15

List of Experiments

1. Verification of Ohms Laws
2. Verification of Kirchhoff's Laws
3. Residential Wiring
4. Load test on DC Shunt Motor
5. Characteristics of PN Diode
6. Characteristics of Zener Diode
7. Ripple factor calculation for half wave rectifier
8. Measurement of displacement of LVDT

	TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1. Summarize the electric circuit parameters for simple problems.

CO2: Outline the safety precautions in electrical installation.

CO3. Explain the working principle and applications of electrical machines.

CO4. Show VI characteristics of semiconductor devices.

CO5. Demonstrate the types and operating principles of sensors and transducers.

TEXT BOOKS:

1. Kothari DP and I.J Nagrath, "Basic Electrical and Electronics Engineering", 2nd Edition,McGraw Hill Education, 2020
2. S.K.Bhattacharya "Basic Electrical and Electronics Engineering", 2nd Edition, Pearson Education, 2017.
3. Sedha R.S., "A textbook book of Applied Electronics", S. Chand & Co., 2008
4. James A .Svoboda, Richard C. Dorf, "Dorf's Introduction to Electric Circuits", Wiley, 2018.
5. A.K. Sawhney, Puneet Sawhney 'A Course in Electrical & Electronic Measurements &Instrumentation', Dhanpat Rai and Co, 2015.

REFERENCES:

1. Kothari DP and I.J Nagrath, "Basic Electrical Engineering", 4th Edition, McGraw HillEducation, 2019.
2. Thomas L. Floyd, "Digital Fundamentals", 11th Edition, Pearson Education, 2017.
3. Albert Malvino, David Bates, "Electronic Principles", 7th Edition, McGraw Hill Education, 2017.
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGrawHill, 2002.
5. H.S. Kalsi, 'Electronic Instrumentation', Tata McGraw-Hill, New Delhi, 2010

21EM101	**ENGINEERING PRACTICES LABORATORY** *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To draw pipe line plan; laying and connecting various pipe fittings used in common household plumbing work; Sawing; planing; making joints in wood materials used in common household wood work.
- To demonstrate the basic switch board wiring, fluorescent lamp wiring and stair case wiring using various electrical components.
- To choose various joints in steel plates using arc welding work and machining various simple processes like turning, drilling, tapping in parts
- To build a tray out of metal sheet using sheet metal work.
- To develop electronic circuit and testing for soldering and desoldering using PCB board.

LIST OF EXPERIMENTS

GROUP – A (CIVIL & ELECTRICAL)

PART I

CIVIL ENGINEERING PRACTICES

PLUMBING WORK:

- Connecting various basic pipe fittings like valves, taps, coupling, unions, reducers, elbows and other components which are commonly used in household.
- Preparing plumbing line sketches.
- Laying pipe connection to the suction side of a pump.
- Laying pipe connection to the delivery side of a pump.
- Connecting pipes of different materials: Metal, plastic and flexible pipes used in household appliances.

WOOD WORK:

- Sawing.

Planning and Making joints like T-Joint, Cross lap and Dovetail joint.

PART II

ELECTRICAL ENGINEERING PRACTICES

- Introduction to switches, fuses, indicators and lamps - Basic switch board wiring with lamp, fan and three pin socket.
- Staircase wiring.
- Fluorescent Lamp wiring with introduction to CFL and LED types.
- Energy meter wiring and related calculations/ calibration.
- Study of Iron Box wiring and assembly.
- Study of Fan Regulator (Resistor type and Electronic type using Diac/Triac/quadrac).
- Measurement of resistance to earth of electrical equipment.

GROUP – B (MECHANICAL & ELECTRONICS)

PART III

MECHANICAL ENGINEERING PRACTICES

WELDING WORK:

- Welding of Butt Joints, Lap Joints, and Tee Joints using arc welding.
- Practicing gas welding.

BASIC MACHINING WORK:

- Usage of Spanners and screw drivers
- Facing and Turning.
- Taper Turning.

ASSEMBLY WORK:

- Assembling a centrifugal pump.
- Assembling a household mixer.
- Assembling an air conditioner.

SHEET METAL WORK:

- Making of a square tray.

FOUNDRY WORK:

- Demonstrating basic foundry operations.

PART IV

ELECTRONIC ENGINEERING PRACTICES

SOLDERING WORK:

- Soldering simple electronic circuits and checking continuity.

ELECTRONIC ASSEMBLY AND TESTING WORK:

- Assembling and testing electronic components on a small PCB.

ELECTRONIC EQUIPMENT STUDY:

- Study elements of smart phone.
- Assembly and dismantle of computer / laptop.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build various plumbing joints.

CO2: Develop various carpentry joints.

CO3: Construct various wiring electrical joints in common household electrical wire work.

CO4: Construct various welded joints, sheet metal and basic machining operations.

CO5: Develop the electronic circuit for soldering and testing using PCB board.

21CE102	COMPUTER AIDED BUILDING DRAWING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To sketch the plan of the Load bearing Buildings.
- To construct the plan of Multi-storey Buildings.
- To develop the 3D view of Residential Buildings.
- To plan the elevation and cross section of doors windows and staircase.
- To prepare the elevation and sectional views of the Industrial Buildings.

LIST OF EXPERIMENTS

Drafting using AutoCAD software

1. Single storey residential building (load bearing wall structure and framed structure) - Plan, Elevation and Section.
2. Multi-storey residential building (load bearing wall structure and framed structure) - Plan, Elevation and Section.
3. 3D view of a residential building.
4. Fully panelled door / partly glazed and wooden panelled door – Elevation and cross section.
5. Fully panelled window / fully glazed window – Elevation and cross section.
6. Dog legged staircase – Plan and Elevation.

7. Elevation of different types of roof truss members (King post and Queen post).
8. Residential building- Plan, Elevation and Section.
9. Multi-storey building with roof truss member - Plan, Elevation and Section.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: construct the detailed building plan, elevation and sectional views of the Load bearing structure of buildings.

CO2: plan the detailed building plan, elevation and sectional views of the framed buildings.

CO3: develop the detailed elevation and sectional views of the Panelled Door and Window.

CO4: sketch the detailed elevation and sectional views of the Dog legged staircase.

CO5: outline the detailed building plan, elevation and sectional views of the industrial structures.

TEXT BOOKS:

1. Bhat N. D. and Panchal V. M., "Engineering Drawing Plane and Solid Geometry", 53rd Edition, Charotar Publishing House, 2019.
2. Ashit Bajaj and Mamta Kataria., "Building Drawing (Civil Engineering Drawing-I)", 1st Edition, North Publication, 2020.
3. Bhavikatti S.S and Chitawadagi M.V., "Building Planning and Drawing", 1st Edition, Dreamtech Press India Pvt. Ltd, 2019.

REFERENCES:

1. Rangwala., "Civil Engineering Drawing", 3rd Edition, Charotar Publishing House Pvt. Ltd.; 2019.
2. Jeyapoovan T., "Engineering Drawing & Graphics Using Autocad", 3rd Edition, Vikas Publishing House Pvt Ltd, 2019.
3. Sikka V.B., "A Course in Civil Engineering Drawing", 4th Edition, S.K.Kataria and Sons, 2015.

SEMESTER-III

21MA201	TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS *(Common to B.E. Civil Engg., ECE & Mechanical Engg.)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To use various methods of Laplace transforms for efficiently solving the problems that occur in various branches of engineering disciplines.
- To identify Fourier series which is essential to many applications in engineering.
- To explain the mathematical tools for the solutions of partial differential equations that model several physical processes.
- To explain the student with Fourier transform techniques used in wide variety of situations.
- To develop Z transform techniques to solve difference equations for discrete time systems.

UNIT I	LAPLACE TRANSFORM	12

Laplace transform- conditions for existence –Transform of elementary functions –Basic properties – First shifting theorem –Transform of derivatives on $t\,f(t), f(t)/t$ and periodic functions- Transform of unit step function and impulse functions. Inverse Laplace transform by partial function method and convolution theorem (excluding proof)-Initial and finial value theorems-Solutions of linear ODE of second order with constant coefficients using Laplace transform techniques.

UNIT II	FOURIER SERIES	12

Dirichlet's conditions – General Fourier series odd and even functions – Half range sine series – half range cosine series – Parseval's identity – Harmonic Analysis.

UNIT III	APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS	12

Classifications of PDE – Solutions of one dimensional wave equations – one dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV	FOURIER TRANSFORMS	12

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transform – Properties – Transforms of simple functions – convolution theorem – Parseval's identity.

UNIT V	Z - TRANSFORMS AND DIFFERENCE EQUATIONS	12

Z- Transforms – Elementary properties – Inverse Z- Transforms (Using partial fractions and residues) – Convolution theorem – Formation of difference equations – Solution of difference equations using Z-transforms.

TOTAL : 60 PERIODS

OUTCOMES:

At the end of the course, learners will be able to

CO1: Calculate Laplace transform and inverse Laplace transform of different functions.

CO2: Express the Fourier series expansion to represent the given function in the given interval.

CO3: Classify the second order PDE and to know about solving initial and final value problems.

CO4: Apply Fourier transform techniques to evaluate the given integral.

CO5: Solve the given difference equations using Z-transforms.

A. P. Pushpalai
BoS Chairman

TEXT BOOKS:

1. Kreyszig Erwin, "Advanced Engineering Mathematics ", 10th Edition, John Wiley and Sons, New Delhi, 2016.
2. Peter V.O. Neil "Advanced Engineering Mathematics", 7th Edition, Cengage, New Delhi, 2012.
3. Glyn James, "Advanced Modern Engineering Mathematics", 4th Edition, Pearson Education, 2016.

REFERENCES:

1. Grewal.B.S. "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, New Delhi, 2018.
2. Wylie C. R. and Barrett L. C "Advanced Engineering Mathematics", 6th Edition, Tata McGraw-Hill, New Delhi, 2012.
3. Datta K.B., "Mathematical Methods of Science and Engineering", 2nd Edition, Cengage Learning India Pvt Ltd, Delhi, 2013.

21CE201	ENGINEERING GEOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To use the importance of geological knowledge and the action of various geological agencies.
- To explain the properties of minerals.
- To classify the types of rocks, their distribution and uses.
- To illustrate the study of geophysical methods on geological structure.
- To identify the application of geological investigation in Civil Engineering projects.

UNIT I	PHYSICAL GEOLOGY	9

Geology in civil engineering – branches of geology – structure of earth and its composition – weathering of rocks – scale of weathering – soils - landforms and processes associated with river, wind, groundwater and sea – relevance to civil engineering. Plate tectonics – Earth quakes – Seismic zones in India.

UNIT II	MINERALS OF THE EARTH'S CRUST	9

Physical properties of minerals – Quartz group, Feldspar group, Pyroxene - hypersthene and augite, Amphibole – hornblende, Mica – muscovite and biotite, Calcite, Gypsum and Clay minerals.

UNIT III	ROCKS OF THE EARTH'S CRUST	9

Classification of rocks, distinction between Igneous, Sedimentary and Metamorphic rocks. Engineering properties of rocks. Description, occurrence, engineering properties, distribution and uses of Granite, Dolerite, Basalt, Sandstone, Limestone, Laterite, Shale, Quartzite, Marble, Slate, Gneiss and Schist.

UNIT IV	STRUCTURAL GEOLOGY AND GEOPHYSICAL METHOD	9

Geological maps – attitude of beds, study of structures – folds, faults and joints – relevance to civil engineering. Geophysical methods – Seismic and electrical methods for subsurface investigations.

UNIT V	GEOLOGY FOR ENGINEERING PROJECTS	9

Remote sensing for civil engineering applications; Geological conditions necessary for design and construction of Dams, Reservoirs, Tunnels, and Road cuttings - Hydrogeological investigations and mining - Coastal protection structures. Investigation of Landslides, causes and mitigation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the importance of geological knowledge and the action of various geological agencies.

CO2: Interpret the properties of minerals.

CO3: Compare the types of rocks, their distribution and uses.

CO4: Outline the geological structure by using geophysical methods.

CO5: Make use of the application of geological investigation in projects such as dams, tunnels, bridges, roads, airport and harbour and the remote sensing applications in Civil Engineering.

TEXT BOOKS:

1. Varghese, P.C., "Engineering Geology for Civil Engineers", 1st Edition, Prentice Hall of India Learning Private Limited, New Delhi, 2012.
2. Venkat Reddy. D "Engineering Geology", 2nd Edition, Vikas Publishing House Pvt. Ltd, 2017.
3. Bangar K.M, "Principles of Engineering Geology", 1st edition, McGraw Hill Education, 2017.
4. Parbin Singh. A "Text book of Engineering and General Geology", 8th Edition, S.K. Kataria & Sons 2022.

REFERENCES:

1. Blyth F.G.H. and de Freitas M.H., "A Geology for Engineers", 7th Edition, Edward Arnold, London, 2010.
2. Bell .F.G. "Fundamentals of Engineering Geology", B.S. Publications, Hyderabad, 2011.
3. Chenna Kesavulu N. "Textbook of Engineering Geology", 2nd Edition, Macmillan India Ltd., 2009.

21CE202	MECHANICS OF SOLIDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To calculate resultant, resolve several concurrent forces and also to apply equilibrium concepts.
- To solve the friction and the effects by the laws of friction and rigid body kinetics.
- To relate fundamental concepts of Stress, Strain and deformation of solids.
- To identify the mechanism of load transfer in beams, the induced stress resultants and deformations.
- To interpret complex two dimensional state of stress and plane trusses.

UNIT I	BASICS OF STATICS	9

Forces – Systems of forces - Concurrent forces in plane and space - Resultant - Problems involving the equilibrium of a particle-free body diagram-equilibrium of particle in space - Varignon's theorem, external and internal forces, free body diagram, requirements of equilibrium of a rigid body.

UNIT II	FRICTION AND RIGID BODY KINETICS	9

Laws of friction - coefficient of friction - problems involving dry friction - wedge & ladder friction – Newton's II law – D'Alembert's principle - Energy - potential energy - kinetic energy - conservation of energy - Work done by a force - work energy method.

UNIT III	SIMPLE STRESSES AND STRAINS	9

Stress and strain due to axial force – Elastic limit – Hooke's law – Factor of safety – Stepped bars - uniformly varying sections – composite bar – stresses due to temperature - Stress-strain diagram for mild - steel - Lateral strain – Poisson's ratio – Volumetric strain – changes in dimensions and volume – shear stress – shear strain – Relationship between elastic constants – changes in dimensions and volume.

UNIT IV	DETERMINATE STRUCTURE	9

Relationship between load, shear force and bending moment – shear force and bending moment diagrams for cantilever, simply supported and overhanging beams under concentrated loads, uniformly distributed loads, uniformly varying loads and moment - Maximum bending moment and point of contraflexure - Force in members of a truss by Method of Joints, Method of Sections - Tension coefficient method.

UNIT V	GEOMETRIC PROPERTIES, SHEAR AND BENDING IN BEAMS	9

Centroid of areas, composite areas, determination of moment of inertia of plane figures, polar moment of inertia - radius of gyration – mass moment of inertia of simple solids - Bending stresses in various sections (Rectangular, circular, flanged, angle, and channel cross-sections) - Flitched beams - Shear stress in various sections (Rectangular, circular, flanged, angle, and channel cross-sections).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Calculate resultant, resolve several concurrent forces and also to apply equilibrium concepts.

CO2: Solve the friction and the effects by the laws of friction and rigid body kinetics.

CO3: Calculate simple stresses and strains in bars and composite materials.

CO4: Construct shear force and bending moment diagrams in determinate structure.

CO5: Make use of geometric properties of sections and to determine the shear stress, bending stress and plot its variation across the section.

TEXT BOOKS:

1. Vela Murali, "Engineering Mechanics", 2nd Edition, Oxford University Press (2018).
2. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
3. Rajput R.K. "Strength of Materials (Mechanics of Solids)", 7th Edition, S.Chand & company Ltd., New Delhi, 2018.

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4. Rattan.S.S., "Strength of Materials", 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2017.
5. Bansal. R.K. "Strength of Materials (Mechanics of Solids)", 6th Edition, Laxmi Publications Pvt. Ltd., New Delhi, 2020.

REFERENCES:

1. Bhavikatti S.S, "Engineering Mechanics", 7th edition, New Age Publishers Pvt Ltd., 2019.
2. Khurmi R. S., "Engineering Mechanics", 22nd edition, S Chand & Co Ltd., 2019.
3. Gambhir.M.L, "Fundamentals of Solid Mechanics", 1st edition, PHI Learning Private Limited., New Delhi, 2009.
4. Hibbeler R.C, "Mechanics of Materials", 9th Edition, Pearson Education., 2018.
5. Mubeen Abdul, "Mechanics of Solids", 2nd Edition, Pearson Education India, 2011.
6. Vaishwanar R and Shashi Bhushan Jha, "Mechanics of Solids", 8th Edition, science technology, 2020.

21CE203	WATER SUPPLY ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To calculate the total water demand for a town/city.
- To identify suitable sources of water to meet the demand and to design the conduits for transportation of water.
- To use the characteristics of different sources of water and to design an appropriate treatment system for the water available at the source.
- To relate the recent advances in water treatment units.
- To construct a water distribution system for a community.

UNIT I	WATER DEMAND ESTIMATION	9

Importance and need for planned water supplies - water demand – types and factors affecting per capita demand - variation in demand – Design periods - population forecasting – different methods.

UNIT II	SOURCES OF WATER, INTAKES AND TRANSPORT OF WATER	9

Sources of water - Surface sources - ponds, lakes, streams, rivers - Ground water sources - occurrence, aquifers and their types – Wells - open wells, Tube wells - springs and their types - Infiltration galleries - Infiltration wells - Intakes and their types. Transport of water - hydraulic design of pressure pipe - Pipe materials - pipe joints - pipe appurtenances, testing of pipe line - Pumps for lifting water – types.

UNIT III	QUALITY ASSESSMENT AND WATER TREATMENT	9

Quality of water – Physical quality, chemical quality and biological quality – significance - water borne diseases -Water quality standards – Case Studies - Screening - Sedimentation – theory, types of settling, Stokes law - Coagulation - flocculation - Jar test – design of sedimentation tank - Filtration – removal mechanisms, filter media, types, slow sand, rapid sand and pressure filters, filter design. Disinfection – methods. Chlorination – action, factors influencing, free chlorination,

combined chlorination – ozonation, UV radiation.		
UNIT IV	**ADVANCED WATER TREATMENT**	**9**
water softening – Desalination – Reverse Osmosis - demineralization – Adsorption - Ion exchange – Membrane Systems - RO Reject Management - Iron and Manganese removal - Defluoridation - Construction and Operation & Maintenance aspects -- Recent advances - MBR process - water treatment practices in rural areas.		
UNIT V	**WATER DISTRIBUTION AND SUPPLY**	**9**
Distribution systems – requirements, layouts and methods - Distribution reservoirs – storage capacity, mass curve method - Leak detection - Analysis of distribution network - Hardy Cross method - Water supply system in buildings – house service connection, pipe fittings & fixtures, storage tanks, piping systems – Systems of plumbing.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Calculate the total water demand for a town/city.

CO2: Identify suitable sources of water to meet the demand and design the conduits for transportation of water from the source to treatment plant and to the city.

CO3: Make use of the physical, chemical and biological characteristics of different sources of water and design appropriate treatment systems.

CO4: Demonstrate the recent advances in water treatment units.

CO5: Plan a water distribution system for an individual building and for a community.

TEXT BOOKS:

1. Garg, S.K. "Environmental Engineering, Vol I", 35th Edition, Khanna Publishers, New Delhi, 2021.
2. Modi, P.N., "Water Supply Engineering, Vol.I", 6th Edition, Standard Book House, New Delhi, 2018.
3. Punmia, B.C., Ashok Jain and Arun Jain, "Water Supply Engineering", 2nd Edition, Laxmi Publications (P) Ltd., New Delhi, 2014.

REFERENCES:

1. Manual on Water Supply and Treatment, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
2. IS10500:2012, "Water Quality Standards", New Delhi 2012.
3. IS SP 35, "Handbook on water supply and drainage (with special emphasis on plumbing)", 1987
4. Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 3rd Edition, Pearson New International Edition, 2013.
5. Steel E.W., "Water Supply and sewerage", 5th Edition, McGraw Hill Publishers, New Delhi, 2013.
6. Peavy, Rowe, Tchobanoglous, "Environmental Engineering", 1st Edition, McGraw Hill Publishers, New Delhi, 2017.

J.P. Anil

21CE204	FLUID MECHANICS (Theory with Practical Course)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To develop knowledge on fluids in static, kinematic and dynamic equilibrium.
- To analyze the kinematics of fluid flow and problems related to equation of motion.
- To illustrate dimensional and model analysis.
- To categorize types of flow and losses of flow in pipes.
- To solve the boundary layer problems.

UNIT I	FLUID PROPERTIES AND FLUID STATICS	9

Fluid – definition, distinction between solid and fluid - Units and dimensions - Properties of fluids - density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension - Fluid statics: concept of fluid static pressure, absolute and gauge pressures - pressure measurements by manometers-forces on planes – centre of pressure – buoyancy and floatation.

UNIT II	FLUID KINEMATICS AND DYNAMICS	9

Fluid Kinematics – Classification and types of flow - velocity field and acceleration – continuity equation (one and three dimensional differential forms)- stream line-streak line-path line- stream function - velocity potential function - flow net. Fluid dynamics - equations of motion -Euler's equation along a streamline - Bernoulli's equation – applications - venturi meter, orifice meter and Pitot tube- linear momentum equation and its application to pipe bend.

UNIT III	DIMENSIONAL ANALYSIS AND MODEL STUDIES	9

Fundamental dimensions - dimensional homogeneity - Rayleigh's method and Buckingham Pitheorem- dimensionless parameters - similitudes and model studies - distorted models.

UNIT IV	FLOW THROUGH PIPES	9

Reynold's experiment - laminar flow through circular pipe (Hagen poiseulle's) - hydraulic and energy gradient – flow through pipes - Darcy - Weisbach's equation - pipe roughness -friction factor- Moody's diagram- major and minor losses of flow in pipes - pipes in series and in parallel.

UNIT V	BOUNDARY LAYER	9

Boundary layer – definition- boundary layer on a flat plate – laminar and turbulent boundary layer displacement, energy and momentum thickness – Momentum integral equation-Boundary layer separation and control – drag on flat plate.

TOTAL : 45 PERIODS

PRACTICAL COURSE	30

List of Experiments

A. Flow Measurement

1. Calibration of Rotameter
2. Calibration of Venturimeter / Orificemeter
3. Bernoulli's Experiment
4. Calibration of Pitot Tube

B. Losses in Pipes

J.P. [signature]
BoS Chairman

5. Determination of friction factor in pipes
6. Determination of minor losses

C. Determination of Metacentric height

7. Determination of Metacentric height of floating bodies

TOTAL : 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the basic knowledge of fluids in static, kinematic and dynamic equilibrium.

CO2: Solve problems related to kinematics of fluid flow and equation of motion.

CO3: Identify and solve dimensional and model analysis on fluid flow problems.

CO4: Associate the types of flow and estimate losses of flow in pipes.

CO5: Use the boundary layer problems in fluid flow.

TEXT BOOKS:

1. Modi P.N and Seth "Hydraulics and Fluid Mechanics including Hydraulic Machines", 21st Edition, Standard Book House New Delhi, 2017.
2. Jain.A.K.., "Fluid Mechanics" (Including Hydraulic Machines), 12th Edition, Khanna Publishers, 2016.
3. Subramanya.K, "Fluid Mechanics and Hydraulic Machines", 2nd Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2019.
4. Rajput.R.K. "Fluid Mechanics", 5th Edition, S.Chand and Co, New Delhi, 2014.

REFERENCES:

1. Streeter, V.L., and Wylie, E.B., "Fluid Mechanics", 9th Edition, McGraw Hill, 2003.
2. Fox W.R. and McDonald A.T. Mitchell W.J., Introduction to Fluid Mechanics", 10th Edition, Wiley, America, 2021.
3. White, F.M., "Fluid Mechanics", Tata McGraw Hill, 5th Edition, New Delhi, 2017.
4. Bansal.R.K., "Fluid Mechanics and Hydraulic Machines", 10th Edition, Laxmi Publications Pvt. Ltd., New Delhi, 2019.

21CE205	SURVEYING AND GEOMATICS (Theory with Practical Course)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To explain the fundamental concepts and to plot by conventional surveying.
- To identify the elevation of various points and its applications.
- To analyze the horizontal and vertical measurements by tachometer.
- To compare the various methods of geodetic control surveying.
- To examine the advanced surveying practices.

UNIT I	FUNDAMENTALS OF CONVENTIONAL SURVEYING	9

Classifications and basic principles of surveying - Equipment and accessories for ranging and chaining - Methods of ranging-Obstacles in chaining and errors in chaining - Compass - Types of

Compass - Basic Principles- Bearing – Types - True Bearing - Magnetic Bearing - Local attraction and magnetic declination - Computation of compass traverse. Study of accessories and setting up of plane table-Radiation and intersection method - Three point and two point problem.		
UNIT II	**LEVELLING AND ITS APPLICATIONS**	**9**
Levelling- Principles and theory of Levelling – Datum- - Bench Marks – Temporary and Permanent Adjustments- Methods of Levelling- Booking – Reduction - Sources of errors in Levelling - Curvature and refraction-Longitudinal and cross sectioning-Contour – Contouring – Characteristics of contours – Methods of contouring -Drawing contours and uses of contour maps-Calculation of areas and volumes by mid-ordinate, average ordinate trapezoidal and Simpson's methods.		
UNIT III	**THEODOLITE AND TACHEOMETRIC SURVEYING**	**9**
Components of transit theodolite and its adjustments- Horizontal and vertical angle measurements - Heights and distances by trigonometry-Tacheometer - Stadia Constants - Analytic Lens -Tangential and Stadia Tacheometry –Tacheometric contouring.		
UNIT IV	**CONTROL SURVEYING AND ADJUSTMENTS**	**9**
Horizontal and vertical control – Methods – specifications – triangulation- baseline – satellite stations – reduction to centre- trigonometrical levelling – single and reciprocal observations – traversing – Gale's table. Errors Sources- precautions and corrections – classification of errors – true and most probable values - weighed observations – method of equal shifts – principle of least squares - normal equation – correlates- level nets- adjustment of simple triangulation networks.		
UNIT V	**GEOMATICS**	**9**
Total Station: Advantages - Fundamental quantities measured - Parts and accessories - working principle - On board calculations - Field procedure - Errors and Good practices in using Total Station. GPS Surveying: Different segments - space, control and user segments - satellite configuration - signal structure - Orbit determination and representation - Anti Spoofing and Selective Availability. Introduction to GIS - Basic spatial concepts - Coordinate Systems - GIS and Information Systems – Definitions – History of GIS - Components of a GIS – Hardware, Software, Data, People. Introduction to Drone Surveying.		
		TOTAL : 45 PERIODS
PRACTICAL COURSE		**30**

List of Experiments:

S.No.	Experiment	Conventional method	Modern Method
1	Determination of area of an enclosed boundary	Chain offset and Compass surveying	Total Station
2	Determination of elevation of points on the ground	Dumpy level	Total Station
3	Determination of elevation of tower	Theodolite –Single lane method	Total Station
4	Determination of gradient between two points	Stadia and Tangential tacheometry	Total Station

TOTAL : 75 PERIODS

J.P. Ani

BoS Chairman

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: prepare the map by understanding the concept of chain surveying, compass surveying and plane table surveying.

CO2: sketch the relative position of points on the earth surface using levelling principles and its application.

CO3: compare distance, elevation and gradient between inaccessible objects using tacheometric principle.

CO4: explain the concept of geodetic surveying and its application in Civil engineering field.

CO5: survey the importance of advanced techniques in contemporary surveying practice.

TEXT BOOKS:

1. Kanetkar.T.P and Kulkarni.S.V, "Surveying and Levelling", Parts 1, 1st Edition, Pune Vidyarthi Griha Prakashan, Pune, 2006.
2. Kanetkar.T.P and Kulkarni.S.V, "Surveying and Levelling", Parts 2, 1st Edition, Pune Vidyarthi Griha Prakashan, Pune, 2008.
3. Punmia.B.C., Ashok K.Jain and Arun K Jain , "Surveying Vol. I & II", 17th edition, Lakshmi Publication Pvt Ltd, New Delhi, 2016.
4. Bannister and S. Raymond, "Surveying", 7th Edition, Longman 2004.
5. Satheesh Gopi, Ra.Sathishkumar and N. Madhu, "Advanced Surveying: Total Station, GPS, GIS & Remote Sensing", 2nd Edition, Pearson education, 2017.

REFERENCES:

1. Alfred Leick, "GPS satellite surveying", 3rd Edition, John Wiley & Sons Inc., 2004.
2. Guocheng Xu, "GPS Theory, Algorithms and Applications", 3rd edition, Springer – Berlin, 2018.
3. Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India.2010.
4. James M. Anderson and Edward M. Mikhail, "Surveying, Theory and Practice", 7th Edition, McGraw Hill, 2001.

21CE206	STRENGTH OF MATERIALS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To examine the tension and compression strength of different materials.
- To analyze the shear and torsion value of mild steel rod.
- To compare the impact and hardness value of different materials.
- To estimate modulus of elasticity of metal beam by deflection test.
- To test for the compression and deflection value of springs.

LIST OF EXPERIMENTS

1. Tension test on steel rod
2. Compression test on wood
3. Double shear test on metal

J.P. [signature]

4. Torsion test on mild steel rod
5. Impact test on metal specimen (Izod and Charpy)
6. Hardness test on metals (Rockwell and Brinell Hardness Tests)
7. Deflection test on metal beam
8. Compression test on helical spring
9. Deflection test on carriage spring

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: examine the tension and compression strength of different materials.

CO2: calculate the shear and torsion value of mild steel rod.

CO3: point out the impact and hardness value of different materials.

CO4: interpret modulus of elasticity of metal beam by deflection test.

CO5: demonstrate the compression and deflection value of springs.

REFERENCE:

1. IS1786-2008 "High strength deformed bars and wires for concrete reinforcement – Specification", (Fourth Revision, Reaffirmed 2013).

21CE207	INTERNSHIP+SEMINAR (During II Semester Summer Vacation for 1 week)	L	T	P	C
		0	0	0	0

COURSE OBJECTIVES:

- To take part in field work so as to have a firsthand knowledge of practical problems in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.

STRATEGY:

- The students individually undertake training in Construction Sites on basic material testing & properties and good construction practices in the field for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Relate implementation textbook knowledge into practice.

CO2: Identify the concepts of developments and implementation of new techniques.

SEMESTER IV

21MA204	PROBABILITY, STATISTICS AND NUMERICAL METHODS *(Common to B.E., Civil Engg. & Mechanical Engg.)*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To describe the necessary basic concepts in probability
- To explain the concept of testing of hypothesis for small and large samples which plays an important role in real life problems.
- To discuss the basic concepts of solving algebraic and transcendental equations and numerical techniques of integration which plays an important role in engineering and technology disciplines.
- To describe various techniques and methods of solving ordinary differential equations.
- To explain various techniques and methods of solving partial differential equations.

UNIT I	PROBABILITY	12
Introduction-Sample Spaces and Events-Axioms of Probability-Interpretations and Properties of Probabilities-Conditional Probabilities-Baye's theorem- Independence.		
UNIT II	**TESTING OF HYPOTHESIS**	**12**
Large sample test based on Normal distribution for single mean and difference of means – Tests based on t, $\chi 2$ and F distributions for testing means and variances – Contingency table (Test for Independency) – Goodness of fit.		
UNIT III	**SOLUTION OF EQUATIONS AND NUMERICAL INTEGRATION**	**12**
Newton Raphson method – Solution of linear system of equations: Gauss elimination method – Pivoting – Gauss Jordan method – Gauss Seidel method – Numerical integration by Trapesoidal and Simpon's rule.		
UNIT IV	**NUMERICAL SOLUTIONS OF ORDINARY DIFFERENTIAL EQUATIONS**	**12**
Taylor's series method – Euler's method – Modified Euler's method – Fourth order Runge-Kutta method for solving first order equation – Milne's Predictor and Corrector method – Adam's Bashforth predictor – corrector method for solving first order equation.		
UNIT V	**BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS**	**12**
Finite difference methods for solving second order two-point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat flow equation by explicit methods – One dimensional wave equation by explicit method.		
		TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use the basic concepts of Probability and Random variables.

CO2: Explain the test of hypothesis for small and large samples by using various tests like t-test, F-

test, Z-test and $\chi 2$ test.
CO3: Apply a suitable method to solve algebraic and transcendental equations.
CO4: Explain the knowledge of various techniques and methods for solving first and second order ordinary differential equations.
CO5: Solve the partial and ordinary differential equations with initial and boundary conditions by using certain techniques with engineering applications.

TEXT BOOKS:

1. JAY.L. Devore, "Probability and Statistics for Engineering and the Science", 8th Edition, Cengage Learning, 2012.
2. Gerald. C.F. and Wheatley. P.O. "Applied Numerical Analysis", 7th Edition, Pearson Education, Asia, New Delhi, 2006.
3. Johnson, R.A., Miller, I and Freund J, "Probability and Statistics for Engineers", 8th Edition, Pearson Education, Asia, 2015.

REFERENCES:

1. S.C.Gupta, V.K.Kapoor, "Fundamentals of Mathematical Statistics", 11th Edition, Sultan Chand & Sons, 2015.
2. Chapra. S.C. and Canale. R.P, "Numerical Methods for Engineers", 5th Edition, Tata McGraw Hill, New Delhi, 2007.
3. S.K.Gupta, "Numerical Methods for Engineers", 7th Edition, New age international private Ltd publishers, 2015.

21CH103	ENVIRONMENTAL SCIENCE *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		2	0	0	2

COURSE OBJECTIVES:

- To describe the structure and function of an ecosystem and biodiversity
- To interpret the environmental impacts of natural resources.
- To demonstrate causes, effects and control measures of different types of pollution.
- To manipulate the importance of disaster management, environmental ethics and values.
- To dramatize the important social issues and sustainable practices.

UNIT I — ENVIRONMENT, ECOSYSTEM AND BIODIVERSITY — 6

Multidisciplinary nature of environmental studies - ecosystem- general structure and function of an ecosystem- ecological succession-biodiversity-types-values of biodiversity- endangered and endemic species-red data book- hot spots of biodiversity-criteria- hot spots in India-threats to biodiversity(man-animal conflicts, habitat loss, poaching)-case studies-conservation of biodiversity-in-situ and ex-situ conservation.

UNIT II — NATURAL RESOURCES AND ITS ENVIRONMENTAL IMPACTS — 6

Natural resources-forest resource-ecological functions – causes, effects and control measures of deforestation-water resource-sources-conflict over water-dams benefits and problems-food resource-overgrazing- impacts of over grazing- impacts of modern agriculture-energy resource-environmental impacts of wind mills and solar panels- role of an individual in conservation of natural resources.

UNIT III	ENVIRONMENTAL POLLUTION AND CONTROL	6
Air pollution-causes, effects and control methods - water pollution- causes, effects-waste water treatment-soil pollution-causes, effects-solid waste management–e-waste- causes, effects and management-Pollution control acts-air(prevention and control of pollution) act,1981-water(prevention and control of pollution) act,1974- wildlife (protection) act,1972 - e-waste management rules,2016-case studies - role of an individual in control of pollution.		
UNIT IV	**DISASTER MANAGEMENT AND ENVIRONMENTAL ETHICS**	**6**
Disaster management-causes, effects and management of- flood, landslide, earthquake and tsunami-case studies- environmental ethics- value education-traditional value systems in India-water conservation-rain water harvesting-watershed management.		
UNIT V	**SOCIAL ISSUES AND SUSTAINABLE PRACTICES**	**6**
Unsustainable development- social issues-climate change-causes, effects and control measures-global warming-causes, effects and control measures-Acid rain-causes, effects and control measures-ozone layer depletion-causes, effects and control measures-nuclear accident and holocausts-EIA-Sustainable development-goals-target- green buildings- ISO 14000 series.		
	TOTAL : 30 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will able to

CO1: Explain the concept, structure and function of an ecosystem and biodiversity.

CO2: Demonstrate the environmental impacts of natural resources.

CO3: Illustrate the suitable management method for pollution control.

CO4: Relate the proper way of managing disaster with environmental ethics.

CO5: Apply social issues and adopt suitable sustainable practices.

TEXT BOOKS:

1. Kaushik,A & Kaushik.C.P, "Environmental Science and Engineering", 6th Edition, New Age International, 2018.
2. Garg S.K & Garg, Ecological and Environmental studies, Khanna Publishers, 2015.
3. Wright & Nebel, Environmental science towards a sustainable future, 12th Editon, Prentice Hall of India Ltd, 2015.

REFERENCES:

1. Erach Bharucha, "Text book of Environmental studies for Undergraduate courses", 3rd Edition, UGC, 2021.
2. Ravi P. Agrahari, "Environmental ecology, Biodiversity, climatic change & Disaster management", 1st Edition, McGraw Hill, 2020
3. Benney Joseph, "Environmental Science and Engineering", 1st Edition, McGraw Hill Education (India) Pvt Ltd, New Delhi, 2017.

BoS Chairman

21CE208	STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To calculate principal stresses and planes for an element in three dimensional state of stress and theory of failures.
- To calculate the slope and deflection of beams by different methods.
- To show load carrying capacity of columns and stresses induced in cylinders.
- To interpret the behavior of members under pure torsion and shear and springs.
- To demonstrate unsymmetrical bending of various sections.

UNIT I	STATE OF STRESS AND THEORIES FAILURES	9

Plane Stress and Plane Strain Principal stresses and strains, Analytical method – Mohr's circle method, Stress tensor at a point – Stress invariants, Theories of failure - Maximum Principal stress theory – Maximum Principal strain theory – Maximum shear stress theory – Total Strain energy theory – Maximum distortion energy theory.

UNIT II	DEFLECTION OF BEAMS	9

Elastic curve – Governing differential equation - Double integration method – Macaulay's method - Area moment method - conjugate beam method for computation of slope and deflection of determinant beams.

UNIT III	COLUMNS AND CYLINDERS	9

Theory of columns – members subjected to axial load and bending moment – Euler's theory for long columns – assumptions and limitations – Rankine's formula - Thin and thick cylinders – Lame's equation - compound cylinders.

UNIT IV	TORSION AND SPRINGS	9

Torsion of Circular and Hollow Shafts – Elastic Theory of Torsion – Stresses and Deflection in Circular Solid and Hollow Shafts – combined bending moment and torsion of shafts - strain energy due to torsion - Modulus of Rupture – Power transmitted to shaft - Shaft in series and parallel – Closed and Open Coiled helical springs – Leaf Springs – Springs in series and parallel – Design of buffer springs.

UNIT V	UNSYMMETRICAL BENDING	9

Unsymmetrical bending of beams of symmetrical and unsymmetrical sections – Shear Centre - curved beams – Winkler Bach formula – stresses in hooks.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Calculate principal stresses and planes for an element in three dimensional state of stress and solve problems using theory of failures.

CO2: Estimate the slope and deflection of beams by different methods.

CO3: Relate long and short columns and estimate stresses induced in cylinders.

CO4: Interpret the behaviour of members under pure torsion and shear and analysis of springs.

CO5: Apply the concepts in beams subjected to unsymmetrical bending.

TEXT BOOKS:
1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", 7th Edition, S.Chand & company Ltd., New Delhi, 2018. 2. Rattan.S.S., "Strength of Materials", 3rd Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2017. 3. Gupta J.K, Gupta S.K, "Strength of Materials: Mechanics of Solids", 1st Edition, Cengage Learning India Pvt. Ltd., 2019. 4. Punmia.B.C., Ashok Kumar Jain and Arun Kumar Jain, SMTS –I Strength of materials, 2nd Edition, Laxmi publications., New Delhi, 2015.
REFERENCES:
1. Subramanian R, "Strength of Materials", 3rd Edition, Oxford HED, 2016. 2. Chanda Abhijit, "Strength of Materials", 3rd Edition, Wiley India Pvt. Ltd., 2016. 3. Bhavikatti S. S, "Strength of Materials", 5th Edition, Vikas Publishing House Pvt Ltd., 2022. 4. Sadhu Singh, "Strength of Materials", 1st Edition, Khanna Book Publishing Company, 2016. 5. Morrow H.W., "Statics and Strength of Materials", 7th Edition, Pearson Education India, 2013. 6. Jindal J.C., "Strength of Materials", 2nd Edition, Pearson Education India, 2017.

21CE209	WASTEWATER ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the characteristics of wastewater.
- To calculate wastewater and storm drainage generation and know about the collection and transportation of sewage.
- To construct a suitable Primary treatment system.
- To select an appropriate Secondary treatment system.
- To prepare the suitable mode of disposal for the treated wastewater and sludge.

UNIT I	CHARACTERIZATION OF SEWAGE	9

Characteristics of sewage, decomposition – aerobic and anaerobic decomposition- physical and chemical quality of sewage – BOD and their testing– BOD equation – problems – population equivalent – Biological quality of sewage.

UNIT II	COLLECTION AND TRANSPORATION OF SEWAGE	9

Systems of sanitation– Estimating quantity of sewage – dry weather flow – estimating storm run-off by rational formula – Sewerage – separate, combined and partially separate system – hydraulic design of sewers. Sewer materials - laying and testing of sewer - sewer appurtenances, cleaning and ventilation of sewers- pumping of sewage.

UNIT III	PRIMARY TREATMENT OF SEWAGE	9

T.P. Anu

Objective – selection of treatment processes – principles, functions, design and drawing of units - onsite sanitation - septic tank with dispersion - grey water harvesting – primary treatment – principles, functions design and drawing of screen, grit chambers and primary sedimentation tanks – construction, operation and maintenance aspects.

UNIT IV	SECONDARY TREATMENT OF SEWAGE	9

Biological treatment of sewage – aerobic treatment - activated sludge process – process mechanism, design parameters, design – modifications in ASP - Trickling filters – process mechanism, types, design parameters and design. Hybrid system – SBR, MBR, MBBR (basics only) - Natural systems - Ponds and Lagoons - Anaerobic systems – UASB, anaerobic filters and natural systems.

UNIT V	SLUDGE TREATMENT AND IMPACT OF DISPOSAL OF SEWAGE	9

Sludge digestion – characteristics- digestion tanks, design - disposal of digested sludge - advances in sludge treatment and disposal - Impact of disposal of treated sewage – Impact on river – self purification – oxygen sag curve – Streeter Phelps equation – Impact on lakes – Eutrophication – Impact on sea - Land irrigation – sewage farming, sewage sickness - Recycling of treated sewage. Disposal of sewage in isolated buildings, plumbing system – types; Sanitary practices in rural areas. ECOSAN, Introduction to DEWATS.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Show the characteristics of wastewater generated from a town/ city.

CO2: Calculate the quantity of wastewater and storm run-off generated from the town/ city and designs a suitable collection system for the generated wastewater.

CO3: Prepare the necessary Primary treatment units for the wastewater collected from the town/city.

CO4: Plan the Secondary treatment units for the wastewater collected from the town/city.

CO5: Identify the suitable mode of disposal for the treated wastewater and sludge without endangering the environment.

TEXT BOOKS:

1. Garg, S.K., Environmental Engineering Vol. II, 41st Edition, Khanna Publishers, New Delhi, 2021.
2. Duggal K.N., "Elements of Environmental Engineering", 3rd Edition, S.Chand and Co. Ltd., New Delhi, 2014.
3. Punmia, B.C., Jain, A.K., and Jain.A.K.., Environmental Engineering, Vol.II, 2nd Edition, Laxmi Publications, 2016.

REFERENCES:

1. Manual on Sewerage and Sewage Treatment Systems Part A, B and C, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2013.
2. Metcalf and Eddy, "Wastewater Engineering–Treatment and Reuse", 4th Edition, Tata McGraw-Hill Company, New Delhi, 2012.
3. Syed R. Qasim, "Wastewater Treatment Plants", 2nd Edition, CRC Press, Washington D.C., 2017.

4. Peavy, Rowe, Tchobanoglous, "Environmental Engineering", 1st Edition, McGraw Hill Publishers, New Delhi, 2017.
5. Mark J. Hammer, Mark J. Hammer, Jr, "Water and Wastewater Technology", 7th Edition, Prentice Hall of India Pvt. Ltd. New Delhi, 2011.

21CE210	HYDRAULICS AND HYDRAULIC MACHINERY (Theory with Practical Course)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To apply their knowledge of fluid mechanics in addressing problems in open channels.
- To analyze problems in gradually varied flows in steady state conditions.
- To solve problems in rapidly varied flows in steady state conditions.
- To differentiate the principles, working and application of turbines.
- To categorize the principles, working and application of pumps.

UNIT I — UNIFORM FLOW — 9

Definition and differences between pipe flow and open channel flow - Types of Flow - Properties of open channel - Velocity distribution in open channel - Steady uniform flow: Chezy equation, Manning equation - Best hydraulic sections for uniform flow – Wide open channel - Specific energy and specific force – Critical flow .

UNIT II — GRADUALLY VARIED FLOW — 9

Dynamic equations of gradually varied flows – Types of flow profiles - Classifications: Computation by Direct step method and Standard step method – Control section – Break in Grade – Computation.

UNIT III — RAPIDLY VARIED FLOW — 9

Application of the momentum equation for RVF - Hydraulic jumps - Types - Energy dissipation – Celerity – Rapidly varied unsteady flows (positive and negative surges)

UNIT IV — TURBINES — 9

Impact of Jet on flat, curved plates, Stationary and Moving –Classification of Turbines – Pelton wheel – Francis turbine – Kaplan turbine - Specific speed – Characteristic Curves of Turbines- Draft tube and cavitation.

UNIT V — PUMPS — 9

Classification of Pumps - Centrifugal pumps – Work done - Minimum speed to start the pump - NPSH - Multistage pumps – Characteristics curve - Reciprocating pumps - Negative slip - Indicator diagrams and its variations – Air vessels - Savings in work done.

TOTAL : 45 PERIODS

PRACTICAL COURSE — 30

T. P. Anu

List of Experiments

A. Pumps

1. Characteristics of Centrifugal pumps
2. Characteristics of Reciprocating pump

B. Turbines

3.Impact of Jet on vanes

4.Characteristics of Pelton wheel turbine

5. Characteristics of Francis turbine/Kaplan turbine

C. Flow Measurements

6. Determination of Coefficient of discharge of the triangular notch.

TOTAL : 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify and solve problems under uniform flow in open channels.

CO2: Solve gradually varied flows in steady state conditions.

CO3: Illustrate rapidly varied flows in steady state conditions.

CO4: Analyse the working and application of turbines.

CO5: Examine the working and application of pumps.

TEXT BOOKS:

1. Subramanya.K, "Flow in open channels", 5th Edition, Tata McGraw Hill, New Delhi, 2019.
2. Modi P.N and Seth.S.M, "Hydraulics and Fluid Mechanics including Hydraulic Machines", 22nd Edition, Standard Book House New Delhi, 2018.
3. Chandramouli P.N, "Applied Hydraulic Engineering", Yes Dee Publishing Pvt. Ltd., 2022.

REFERENCES:

1. VenTe Chow, "Open Channel Hydraulics", McGraw Hill, New York, 2009.
2. Hanif Chaudhry.M, "Open Channel Flow", 2nd Edition, Springer, 2007.
3. Jain.A.K. "Fluid Mechanics" (Including Hydraulic Machines), Khanna Publishers, 12th Edition, 2016.
4. Subramanya.K. "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Education Private Limited, New Delhi, 2018.

21CE211	CONCRETE TECHNOLOGY AND CONSTRUCTION EQUIPMENTS (Theory with Practical Course)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To analyze the basic properties of cement and aggregates.
- To explain the concept and procedure of mix design as per IS method.
- To classify the properties of concrete at fresh and hardened state and know the Non-destructive testing of concrete.

- To show the importance and application of special concretes.
- To choose the equipments used in the building construction sites.

UNIT I	**CEMENT – MORTAR - AGGREGATES**	9
Cement – Composition – Properties – Types and uses – Tests on cement – Lime, Gypsum – Cement Mortar – Classification – Properties of good mortar – Uses of mortar – Admixtures – Fine aggregate – Coarse aggregates – Properties and tests.		
UNIT II	**PROPORTIONING OF CONCRETE MIX**	9
Principles of Mix Proportioning - Properties of concrete related to Mix Design - Physical properties of materials required for Mix Design - Design Mix and Nominal Mix - BIS Method of Mix Design - Mix Design Examples.		
UNIT III	**FRESH AND HARDENED PROPERTIES OF CONCRETE**	9
Workability - Tests for workability of concrete - Segregation and Bleeding - Determination of strength Properties of Hardened concrete - Compressive strength – split tensile strength – Flexural strength - Stress-strain curve for concrete - Modulus of elasticity – durability of concrete – water absorption – permeability – corrosion test – acid resistance – Non Destructive Testing of concrete.		
UNIT IV	**SPECIAL CONCRETES**	9
Light weight concretes - foam concrete- self compacting concrete – vacuum concrete – High strength concrete - Fibre reinforced concrete – Ferrocement - Ready mix concrete – SIFCON - Shotcrete – polymer concrete - High performance concrete - Geopolymer Concrete.		
UNIT V	**CONSTRUCTION EQUIPMENT**	9
Selection of equipment for earth work - earth moving operations - types of earthwork equipment - tractors, motor graders, scrapers, front end waders, earth movers – Equipment for foundation and pile driving. Equipment for compaction, batching, mixing and concreting - Equipment for material handling and erection of structures – types of cranes - Equipment for dredging, trenching, tunneling.		
	TOTAL : 45 PERIODS	
PRACTICAL COURSE		30

List of Experiments

I. TEST ON CEMENT

1. Specific Gravity
2. Initital and Final Setting time
3. Consistency
4. Soundness

II. TEST ON FINE AGGREGATES

1. Grading of fine aggregates
2. Test for specific gravity and test for bulk density
3. Compacted and loose bulk density of fine aggregate

III. TEST ON COARSE AGGREGATE

1. Determination of impact value of coarse aggregate

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2. Determination of elongation index
3. Determination of flakiness index
4. Determination of aggregate crushing value of coarse aggregate

IV. TEST ON CONCRETE

1. Test for Slump
2. Test for Compaction factor
3. Test for Compressive strength - Cube & Cylinder

TOTAL : 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Appraise the basic properties of cement and aggregates.

CO2: Apply the concept and procedure of mix design as per IS method and determine the mix proportion of concrete.

CO3: Compare the properties of concrete at fresh and hardened state and know the Non-destructive testing of concrete.

CO4: Illustrate the importance and application of special concretes.

CO5: Explain the equipments used in the building construction sites.

TEXT BOOKS:

1. Gupta.B.L and Amit Gupta, "Concrete Technology", 4th Edition, Jain Book Agency, 2010.
2. Shetty,M.S, "Concrete Technology", 8th Edition, S.Chand and Company Ltd, New Delhi, 2019.
3. Bhavikatti.S.S, "Concrete Technology", I.K.International Publishing House Pvt. Ltd., New Delhi, 2015.
4. Santhakumar. A.R., "Concrete Technology", 2nd Edition, Oxford University Press India, 2018.

REFERENCES:

1. Neville, A.M and Brooks J.J, "Concrete Technology", 2nd Edition, Pearson, 2019.
2. Gambhir, M.L; "Concrete Technology Theory and Practice", 5th Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2017.
3. IS10262-2009 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998.

21CE212	SOIL MECHANICS (Theory with Practical Course)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To classify the soil and assess the index properties of soil.
- To compare the stress concepts in soils and estimate the permeability of soil.
- To identify the settlement in soils.
- To analyze the shear strength of soil.
- To relate both finite and infinite slopes.

UNIT I	SOIL CLASSIFICATION AND COMPACTION	9

J. P. Anie

History – Formation and types of soil–Composition - Index properties – clay mineralogy structural arrangement of grains – description – Classification – BIS – US – phase relationship – Compaction – theory –factors influencing compaction.		
UNIT II	**EFFECTIVE STRESS AND PERMEABILITY**	**9**
Soil – Water – Static pressure in water - Effective Stress concept in soil – Capillary phenomena - Permeability – Darcy's law – Factors influencing permeability of soils – Seepage - Two dimensional flow – Laplace's equation – Simple problems Sheet pile and weir.		
UNIT III	**STRESS DISTRIBUTION AND SETTLEMENT**	**9**
Stress distribution in homogeneous and isotropic medium - Boussinesq's theory (point load, line load and udl)–Use of Newmark's influence chart – Settlement and its Components – Factors influencing settlement – Terzaghi's one dimensional consolidation theory – Computation of rate of settlement. – $\sqrt{t}$ and log t methods – e log p relationship consolidation settlement N-C clays – OC clays - Computation.		
UNIT IV	**SHEAR STRENGTH**	**9**
Shear strength of cohesive and cohesion less soils – Mohr-Coulomb failure theory – shear strength - Direct shear, Triaxial compression, UCC and Vane shear tests – Pore pressure parameters – Factors influences shear strength of soil.		
UNIT V	**STABILITY OF SLOPES**	**9**
Infinite slopes and finite slopes — Friction circle method – Use of stability number –Guidelines for location of critical slope surface in cohesive and c - soil – Slope protection measures – case studies on slope stability failures.		
		TOTAL : 45 PERIODS
PRACTICAL COURSE		**30**
List of Experiments **A. Determination of Index Properties:** 1. Special gravity of soil solids 2. Grain size distribution – Sieve analysis 3. Grain size distribution Hydrometer analysis 4. Liquid limit test 5. Plastic limit test 6. Shrinkage limit 7. Field density Test (Sand replacement method) 8. Determination of moisture – density relationship using standard Proctor compaction test. 9. Core cutter method 10. Relative density **B. Determination of Engineering Properties:** 11. Permeability determination (constant head and falling head methods) 12. Direct shear test in cohesion-less soil 13. Unconfined compression test in cohesive soil		
		TOTAL : 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Categorize the soil and determine the index properties of soil.

CO2: Analyze the stresses in soils and Permeability.

CO3: Classify and determine the settlement in soils.

CO4: Examine the shear strength of soil.

CO5: Identify both finite and infinite slopes.

TEXT BOOKS:

1. Murthy, V.N.S., "Text book of Soil Mechanics and Foundation Engineering", 2nd Edition, CBS Publishers Distribution Ltd., New Delhi. 2018.
2. Arora, K.R., "Soil Mechanics and Foundation Engineering", 7th Edition, Standard Publishers and Distributors, New Delhi, 2019 (Reprint).
3. Gopal Ranjan, A S R Rao, "Basic and Applied Soil Mechanics", 3rd Edition, New Age International Publication, 2016.
4. Punmia, B.C., "Soil Mechanics and Foundations", 16th Edition, Laxmi Publications Pvt. Ltd. New Delhi, 2019.

REFERENCES:

1. McCarthy, D.F., "Essentials of Soil Mechanics and Foundations: Basic Geotechnics", 7th Edition, Prentice-Hall, 2006.
2. Coduto, D.P., "Geotechnical Engineering – Principles and Practices", 2nd Edition, Prentice Hall of India Pvt. Ltd. New Delhi, 2010.
3. Braja M Das, "Principles of Geotechnical Engineering", 9th Edition, Cengage Learning India Private Limited, 2017.
4. Craig.R.F. "Soil Mechanics", 7th Edition, E & FN Spon, London and New York, 2012.
5. Purushothama Raj. P., "Soil Mechanics and Foundations Engineering", 2nd Edition, Pearson Education, 2018.
6. Venkatramaiah.C., "Geotechnical Engineering", 6th Edition, New Age International Pvt. Ltd., New Delhi, 2017.

21CE213	SURVEY CAMP (During III Semester Winter Vacation for 2 weeks)	L	T	P	C
		0	0	2	1

COURSE OBJECTIVE:

- To prepare the students to get practical training in the field work to record all original field observations and calculations.
- To prepare the students to get practical training in the field work to plot and contour the given area.

LIST OF EXPERIMENTS

Two weeks Survey Camp will be conducted during summer vacation in the following activities:

1. Traverse - using Total station
2. Contouring
(i). Radial tachometric contouring - Radial Line at Every 45 Degree and Length not less than 60 Meter on each Radial Line
(ii). Block Level/ by squares of size at least 100 Meter x 100 Meter at least 20 Meter interval
(iii). L.S & C.S - Road and canal alignment for a Length of not less than 1 Kilo Meter at least L.S at Every 30M and C.S at every 90 M
3. Offset of Buildings and Plotting the Location
4. Sun observation to determine azimuth (guidelines to be given to the students)
5. Use of GPS to determine latitude and longitude and locate the survey camp location
6. Traversing using GPS
7. Curve setting by deflection angle
Apart from above students may be given survey exercises in other area also based on site condition to give good exposure on survey.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1: Survey a building or structure using various surveying techniques.
CO2: Connect the angles and elevations of a given location / point.

21CE214	WATER AND WASTEWATER ANALYSIS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To analyse the physical and chemical and biological characteristics of water.
- To inspect the physical and chemical and biological characteristics of wastewater.
- To test for the dosage requirement for coagulation process.
- To examine the growth of micro-organism and its quantification.
- To calculate the sludge in wastewater.

LIST OF EXPERIMENTS:

1. Determination of pH, Turbidity and conductivity
2. Determination of Hardness
3. Determination of Alkalinity and Acidity
4. Determination of Chlorides
5. Determination of Phosphates and Sulphates
6. Determination of iron and fluoride
7. Determination of Optimum Coagulant dosage
8. Determination of residual chlorine and available chlorine in bleaching powder
9. Determination of Oil, and Grease
10. Determination of suspended, settleable, volatile and fixed solids

11. Determination Dissolved Oxygen and BOD for the given sample
12. Determination of COD for given sample
13. Determination of SVI of Biological sludge and microscopic examination
14. Determination of MPN index of given water sample
15. Determination of Ammonia nitrogen in wastewater samples.
16. Determination of Nitrates in water and wastewater

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Examine the physical and chemical and biological characteristics of water.

CO2: Compare the physical and chemical and biological characteristics of wastewater.

CO3: Select the type of treatment required and amount of dosage required for the treatment.

CO4: Survey the conditions for the growth of micro-organisms.

CO5: Calculate the amount of sludge in wastewater.

REFERENCES:

1. Eaton, A.D., Clesceri, L.S., Rice, E.W., Greenberg, A.E., Franson, "Standard methods for the examination of water & wastewater", 21st Edition, American Public Health Association (APHA) M.A.H. APHA, Washington, 2005.
2. IS 3025 : Part 21 : 2009 Methods of sampling and test (Physical and Chemical) for water and wastewater : Hardness
3. IS 3025 : Part 23 : 1986 Methods of sampling and test (Physical and Chemical) for water and wastewater : Alkalinity
4. IS 3025 : Part 32 : 1988 Methods of sampling and test (Physical and Chemical) for water and wastewater : Chloride
5. IS 3025 : Part 34 : 1988 Methods of sampling and test (Physical and Chemical) for water and wastewater : Nitrate
6. IS 3025 : Part 24 : 1986 Methods of sampling and test (Physical and Chemical) for water and wastewater : Sulphate
7. IS 3025 : Part 60 : 2008 Methods of sampling and test (Physical and Chemical) for water and wastewater : Fluoride
8. IS 3025 : Part 10 : 1984 Methods of sampling and test (Physical and Chemical) for water and wastewater : Turbidity
9. IS 3025 : Part 16 : 1984 Methods of sampling and test (Physical and Chemical) for water and wastewater : FILTERABLE RESIDUE (TOTAL DISSOLVED SOLIDS)
10. IS 3025 : Part 11 : 1983 Methods of sampling and test (Physical and Chemical) for water and wastewater : pH VALUE
11. IS 3025 : Part 44 : 1993 Methods of sampling and test (Physical and Chemical) for water and wastewater : BIOCHEMICAL OXYGEN DEMAND (BOD)
12. IS 3025 : Part 39 : 1989 Methods of sampling and test (Physical and Chemical) for water and wastewater : Oil and Grease

13. IS 3025 : Part 58 : 2006 Methods of sampling and test (Physical and Chemical) for water and wastewater : CHEMICAL OXYGEN DEMAND (COD)
14. IS 3025 : Part 31 : 1988 Methods of sampling and test (Physical and Chemical) for water and wastewater : Phosphorous

SEMESTER-V

21CE301	STRUCTURAL ANALYSIS I	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the concept of determinate and indeterminate beam using standard techniques.
- To apply the slope and deflection approach for analysing complex structures.
- To develop the moment distribution analysis method for analysing uncertain structures.
- To make use of the idea of the matrix flexibility approach for rigid frames, continuous beams, and indeterminate pin-jointed frames analysis.
- To utilize the concept of the matrix stiffness method to the analysis of rigid frames, continuous beams, and uncertain pin-jointed frames.

UNIT I	INDETERMINATE BEAMS	9

Introduction - Indeterminate Beams - Propped cantilever and fixed beams - fixed end moments and reactions – sinking and rotation of supports - Theorem of three moments – analysis of continuous beams – shear force and bending moment diagrams.

UNIT II	SLOPE DEFLECTION METHOD	9

Slope deflection equations – Equilibrium conditions - Analysis of continuous beams and rigid frames – Rigid frames with inclined members - Support settlements- symmetric frames with symmetric and skew-symmetric loadings.

UNIT III	MOMENT DISTRIBUTION METHOD	9

Stiffness and carry over factors – Distribution and carryover of moments - Analysis of continuous Beams- Plane rigid frames with and without sway – Support settlement - symmetric frames with symmetric and skew-symmetric loadings.

UNIT IV	FLEXIBLITY MATRIX METHOD	9

Primary structures - Compatibility conditions – Formation flexibility matrices - Analysis of indeterminate pin- jointed plane frames, continuous beams and rigid jointed plane frames by direct flexibility approach.

UNIT V	STIFFNESS MATRIX METHOD	9

Restrained structure –Formation of stiffness matrices - equilibrium condition - Analysis of Continuous Beams, Pin-jointed plane frames and rigid frames by direct stiffness method.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Demonstrate the indeterminate beams by conventional methods.

CO2: Solve the rigid frames and continuous beams using the slope defection technique.

CO3: Utilise moment distribution method to build continuous beams and rigid frames with and without sway.

CO4: Select the Matrix Flexibility Methods of Indeterminate Pin Jointed Plane Frames, Continuous Beams, and Rigid Frames.

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CO5: Choose the Matrix stiffness method analysis of indeterminate pin jointed planar frames, continuous beams, and rigid frames.

TEXT BOOKS:

1. Bhavikatti, S.S, "Structural Analysis", Vol.1 & 2", 5th Edition, Vikas Publishing House Pvt.Ltd., NewDelhi-4, 2021.
2. Bhavikatti, S.S, "Matrix Method of Structural Analysis", 1st Edition. Dreamtech Press, New Delhi-4, 2019.
3. Hibbeler R.C, "Structural Analysis", 9th Edition. Pearson Education, 2017.
4. Vaidyanadhan, R and Perumal, P, "Comprehensive Structural Analysis – Vol. 1 & Vol. 2", 4th Edition, Laxmi Publications Pvt. Ltd, New Delhi, 2019.

REFERENCES:

1. Punmia. B.C, Ashok Kumar Jain & Arun Kumar Jain, "Theory of structures", 13th Edition, Laxmi Publications, New Delhi, 2017.
2. Khurmi R.S, "Theory of structures", 13th Edition, S Chand, New Delhi, 2020.
3. Ramamrutham S, Narayanan R, "Theory of structures", 12th Edition, Dhanpat Rai Publishing Company Ltd., 2020.

21CE302	DESIGN OF REINFORCED CEMENT CONCRETE ELEMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make use of the various design methodologies for the design of RC elements.
- To analyze and design flanged beams by limit state method and design of beams for shear, bond and torsion.
- To develop the various types of slabs and staircase by limit state method.
- To make use of axial, uniaxial and biaxial eccentric loadings for design of columns.
- To prepare design of footing by limit state method.

UNIT I | **INTRODUCTION** | 9

Objective of structural design-Steps in RCC Structural Design Process- Type of Loads on Structures and Load combinations- Code of practices and Specifications - Concept of Working Stress Method, Ultimate Load Design and Limit State Design Methods for RCC –Properties of Concrete and Reinforcing Steel - Analysis and Design of Singly reinforced Rectangular beams by working stress method - Limit State philosophy as detailed in IS code - Advantages of Limit State Method over other methods - Analysis and design of singly and doubly reinforced rectangular beams by Limit State Method.

UNIT II | **DESIGN OF BEAMS** | 9

Analysis and design of Flanged beams for – Use of design aids for Flexure - Behaviour of RC members in Shear, Bond and Anchorage - Design requirements as per current code - Behaviour of rectangular RC beams in shear and torsion - Design of RC members for combined Bending, Shear and Torsion.

UNIT III | **DESIGN OF SLABS AND STAIRCASE** | 9

Analysis and design of cantilever, one way simply supported and continuous slabs and supporting beams-Two way slab- Design of simply supported and continuous slabs using IS code coefficients-Types of Staircases – Design of dog-legged Staircase.

UNIT IV	DESIGN OF COLUMNS	9

Types of columns –Axially Loaded columns – Design of short Rectangular Square and circular columns –Design of Slender columns- Design for Uniaxial and Biaxial bending using Column Curves.

UNIT V	DESIGN OF FOUNDATIONS	9

Concepts of Proportioning footings and foundations based on soil properties-Design of wall footing – Design of axially and eccentrically loaded Square, Rectangular pad and sloped footings – Design of Combined Rectangular footing for two columns only.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the various design approaches used to create RC components.

CO2: Utilize the limit state approach for the analysis and design of flanged beams as well as the sign of the beams for torsion, bonding, and shear.

CO3: Choose the design for various slab types and staircases using the limit state approach.

CO4: Select from the options for axial, uniaxial, and biaxial eccentric loadings for columns.

CO5: Apply the limit state technique to footing design.

TEXT BOOKS:

1. Varghese, P.C., "Limit State Design of Reinforced Concrete", 2nd Edition, P Chaukhamba Auriyantaliya, 2020.
2. Dayaratnam P, "Limit State Design of Reinforced Concrete Structures", 1st Edition, CBS Publishers and Distributors Pvt Ltd, 2018.
3. Krishnaraju.N "Design of Reinforced Concrete Structures", 4th Edition, CBS Publishers & Distributors Pvt. Ltd., 2019.

REFERENCES:

1. Jain, A.K., "Limit State Design of RC Structures", 4th Edition, Nemchand Publications, Roorkee, 2012.
2. Unnikrishna Pillai, S., Devdas Menon, "Reinforced Concrete Design", 4th Edition, McGraw Hill, 2021
3. Punmia. B.C., Ashok Kumar Jain, Arun Kumar Jain, "Limit State Design of Reinforced Concrete",7th Edition, Laxmi Publication Pvt. Ltd., New Delhi, 2016.
4. Rathaliya R.P., "Design of Reinforced Concrete Structures", 1st Edition, Atul Prakashan, 2018.
5. IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi, 2000
6. SP16, IS456:1978 "Design Aids for Reinforced Concrete to Bureau of Indian Standards", New Delhi, 1999

21CE303	FOUNDATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the concept of site investigation and soil exploration methods in field.
- To apply the design procedure for finding bearing capacity for various types of shallow foundations.
- To choose the foundation based on the in-situ requirements.
- To relate the load carrying capacity and settlement behavior for pile group.
- To calculate the earth pressures acting on retaining wall.

UNIT I	SITE INVESTIGATION AND SELECTION OF FOUNDATION	9

Scope and objectives – Methods of exploration – Auguring and boring- Depth and spacing of bore holes- Sampling techniques- Representative and undisturbed sampling- sampling methods- Split spoon sampler, Thin wall sampler, Stationary piston sampler- Geophysical methods – Electrical resistivity Method – Seismic refraction method - Penetration tests (SPT and SCPT)- Bore log report and Selection of foundation.

UNIT II	SHALLOW FOUNDATION	9

Location and depth of foundation – Codal provisions – Bearing capacity of shallow foundation on homogeneous deposits- Terzaghi's formula and BIS formula – factors affecting bearing capacity – problems- Bearing capacity from in-situ tests (plate load test)- Allowable bearing pressure- Determination of Settlement of foundations on granular and clay deposits – Total and differential settlement – Allowable settlements – Codal provision – Methods of minimizing total and differential settlements.

UNIT III	FOOTINGS AND RAFTS	9

Types of footings – Contact pressure distribution: Isolated footing – Combined footings – Types and proportioning- Mat foundation – Types and applications – Proportioning – Floating foundation – Seismic force consideration – Codal Provision.

UNIT IV	PILE FOUNDATION	9

Types of piles and their function – Factors influencing the selection of pile – Carrying capacity of single pile in granular and cohesive soil – static formula – dynamic formulae (Engineering news and Hileys)- Negative skin friction – Uplift capacity-Group capacity by different methods (Feld's rule, Converse – Labarra formula and block failure criterion)- Settlement of pile groups – Interpretation of pile load test (routine test only)- Under reamed piles – Capacity under compression and uplift.

UNIT V	RETAINING WALLS	9

Plastic equilibrium in soils – Active and passive states – Rankine's theory – Cohesion less and cohesive soil – Coulomb's wedge theory- Earth pressure on retaining walls of simple configurations – Culmann's Graphical method- pressure on the wall due to line load – Stability analysis of retaining walls.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Select the concept of site investigation and soil exploration methods in field.
CO2: Apply design procedure for finding bearing capacity for various types of shallow foundations.
CO3: Plan the foundation based on the in-situ requirements.
CO4: Identify the load carrying capacity and settlement behavior for pile group.
CO5: Solve the earth pressures acting on retaining wall.

TEXT BOOKS:

1. Murthy, V.N.S., "Soil Mechanics and Foundation Engineering", 5th Edition, CBS Publishers Distribution Ltd., New Delhi, 2018.
2. Arora, K.R., "Soil Mechanics and Foundation Engineering", 7th Edition, Standard Publishers and Distributors, New Delhi, 2020.
3. Punmia, B.C., "Soil Mechanics and Foundations", Laxmi Publications Pvt. Ltd. New Delhi, 16th Edition, 2017.
4. Modi P.N.," Soil Mechanics and Foundation", 5th Edition, Technology & Engineering, 2019.

REFERENCES:

1. Braja M Das, "Principles of Foundation Engineering" 8th Edition, Cengage India Private Limited, 2017.
2. Venkataramaiah C. "Geotechnical Engineering", 6th Edition, New Age International, New Delhi, 2018.
3. IS Code 6403: 1981 (Reaffirmed 1997) "Bearing capacity of shallow foundation", Bureau of Indian Standards, New Delhi.
4. IS Code 8009 (Part 1):1976 (Reaffirmed 1998) "Shallow foundations subjected to symmetrical static vertical loads", Bureau of Indian Standards, New Delhi.
5. IS Code 8009 (Part 2):1980 (Reaffirmed 1995) "Deep foundations subjected to symmetrical static vertical loading", Bureau of Indian Standards, New Delhi.
6. IS Code 2911 (Part 1): 1979 (Reaffirmed 1997) "Concrete Piles" Bureau of Indian Standards, New Delhi.
7. IS Code 2911 (Part 2): 1979 (Reaffirmed 1997) "Timber Piles", Bureau of Indian Standards, New Delhi.
8. IS Code 2911 (Part 3): 1979 (Reaffirmed 1997) "Under Reamed Piles", Bureau of Indian Standards, New Delhi.
9. IS Code 2911 (Part 4): 1979 (Reaffirmed 1997) "Load Test on Piles", Bureau of Indian Standards, New Delhi.
10. IS Code 1904: 1986 (Reaffirmed 1995) "Design and Construction of Foundations in Soils", Bureau of Indian Standards, New Delhi.
11. IS Code 2131: 1981 (Reaffirmed 1997) "Method for Standard Penetration test for Soils", Bureau of Indian Standards, New Delhi.
12. IS Code 2132: 1986 (Reaffirmed 1997) "Code of Practice for thin – walled tube sampling for soils", Bureau of Indian Standards, New Delhi.
13. IS Code 1892 (1979): Code of Practice for subsurface Investigation for Foundations. Bureau of Indian Standards, New Delhi.

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14. IS Code 14458 (Part 1): 1998 "Retaining Wall for Hill Area – Guidelines, Selection of Type of Wall", Bureau of Indian Standards, New Delhi.
15. IS Code 14458 (Part 2): 1998 "Retaining Wall for Hill Area – Guidelines, Design of Retaining/Breast Walls", Bureau of Indian Standards, New Delhi.
16. IS Code 14458 (Part 3): 1998 "Retaining Wall for Hill Area – Guidelines, Construction of Dry Stone Walls", Bureau of Indian Standards, New Delhi.

21MCC01	CONSTITUTION OF INDIA	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- To explain the basic features and fundamental principles of Constitution of India.
- To explain the salient features and characteristics of the Constitution of India
- To explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers
- To explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India
- To explain the Local Self Government – Constitutional Scheme in India

SYLLABUS

1. Meaning of the constitution law and constitutionalism
2. Historical perspective of the Constitution of India
3. Salient features and characteristics of the Constitution of India
4. Scheme of the fundamental rights
5. The scheme of the Fundamental Duties and its legal status
6. The Directive Principles of State Policy – Its importance and implementation
7. Federal structure and distribution of legislative and financial powers between the Union and the States.
8. Parliamentary Form of Government in India – The constitution powers and status of the President of India.
9. Amendment of the Constitutional Powers and Procedure
10. The historical perspectives of the constitutional amendments in India
11. Emergency Provisions : National Emergency, President Rule, Financial Emergency
12. Local Self Government – Constitutional Scheme in India
13. Scheme of the Fundamental Right to Equality
14. Scheme of the Fundamental Right to certain Freedom under Article 19
15. Scope of the Right to Life and Personal Liberty under Article 21

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the meaning of the constitution law and constitutionalism and Historical perspective

of the Constitution of India.
CO2: Explain the salient features and characteristics of the Constitution of India, scheme of the fundamental rights and the scheme of the Fundamental Duties and its legal status.
CO3: Explain the Directive Principles of State Policy, Federal structure and distribution of legislative and financial powers between the Union and the States, and Parliamentary Form of Government in India.
CO4: Explain the amendment of the Constitutional Powers and Procedure, the historical perspectives of the constitutional amendments in India, and Emergency Provisions.
CO5: Explain the Local Self Government – Constitutional Scheme in India, Scheme of the Fundamental Right to Equality.

TEXT BOOKS:

1. Durga Das Basu,"Introduction to the Constitution of India", LexisNexis Butterworths Wadhwa, 20^{th} edition, Reprint 2011.
2. Web link: https://www.india.gov.in/my-government/ constitution-india.

21CE304	HIGHWAY AND RAILWAY ENGINEERING (Theory with Practical Course)	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To identify the various parts of highway development and design cross section.
- To show an overview of the roadway in terms of planning, design, construction, and maintenance in accordance with IRC standards, specifications, and methodologies.
- To examine the concepts and techniques of roadway material testing.
- To use railway planning ideas for developing the permanent route.
- To illustrate railway maintenance and operation.

UNIT I | HIGHWAY ENGINEERING | 9

Classification of highways – Institutions for Highway planning, design and construction at different levels – factors influencing highway alignment –Typical cross sections of Urban and Rural roads – Engineering surveys for alignment- Conventional and Modern method.

UNIT II | DESIGN OF HIGHWAY ELEMENTS | 9

Cross sectional elements – Horizontal curves, super elevation, transition curves, widening of curves – Sight distances – Vertical curves, gradients– pavement components and their role – Design practice for flexible and rigid pavements (IRC methods only).

UNIT III | EVALUATION AND MAINTENANCE OF PAVEMENTS | 9

Pavement distress in flexible and rigid pavements – Types of maintenance – Pavement Management Systems - Pavement evaluation, roughness, present serviceability index, skid resistance, structural evaluation, evaluation by deflection measurements – Strengthening of pavements –Highway Project formulation.

UNIT IV | RAILWAY PLANNING AND CONSTRUCTION | 9

Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges - Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods-Geometric design of railway, gradient, super elevation, widening of gauge on curves (Problems)-Railway drainage- Level Crossings-Signaling.

UNIT V	**RAILWAY CONSTRUCTION MAINTENANCE AND OPERATION**	**9**

Construction & Maintenance – Conventional, Modern methods and Materials, lay outs of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance - Role of Indian Railways in National Development – Railways for Urban Transportation – LRT & MRTS Feasibility study, Planning and construction.

TOTAL : 45 PERIODS

PRACTICAL COURSE	**30**

List of Experiments

I TEST ON AGGREGATES

a) Specific Gravity
b) Los Angeles Abrasion Test
c) Water Absorption of Aggregates

II TEST ON BITUMEN

a) Specific Gravity of Bitumen
b) Penetration Test
c) Viscosity Test
d) Softening Point Test
e) Ductility Test

TOTAL: 75 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the various highway development and design cross section elements.

CO2: Illustrate the geometric features of road network and design of pavement as per IRC.

CO3: Appraise the concept of pavement management system, evaluation of distress and maintenance of pavements.

CO4: Relate the methods of route alignment and design elements in railway planning and constructions.

CO5: Identify the construction techniques and maintenance of track laying and railway stations.

TEXT BOOKS:

1. Khanna.S. K., Justo.C.E.G and Veeraragavan A., "Highway Engineering", 10th edition, Nemchand Publishers, 2022.

2. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", 3rd edition, Scitech Publications,2018.

3. Kadiyali.L.R. "Principles and Practice of Highway Engineering", 1st edition, Khanna Technical Publications, 6th edition Delhi,2019.

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REFERENCES:

1. Saxena Subhash C, and Satyapal Arora, "A Course in Railway Engineering", Dhanpat Rai and Sons, Delhi, 2020.
2. Rangwala, "Highway Engineering", 12th edition, Charotar Publishing House, 2022.
3. Rangwala, "Railway Engineering", 3rd edition, Charotar Publishing House, 2017.
4. IRC: 37-2012, "The Indian roads Congress, Guidelines for the Design of Flexible Pavements", NewDelhi.
5. IRC: 58-2012, "The Indian roads Congress, Guidelines for the Design of Flexible Pavements", NewDelhi.
6. IRC: 37–2012, "The Indian roads Congress, Guidelines for the Design of Flexible Pavements", NewDelhi.
7. IRC: 58-2012, "The Indian Road Congress, Guidelines for the Design of Rigid Pavements for Highways", NewDelhi.

21EN301	**PROFESSIONAL COMMUNICATION LABORATORY** *(Common to all B.E./B.Tech. Programmes)*	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To demonstrate communication skills that can lead to improved interpersonal relationships.
- To plan to set and achieve goals with focus.
- To organize themselves in work life to face the professional set up with confidence.
- To interpret ideas and participate in group discussion with positive attitude.
- To develop their confidence and help learners to attend interviews successfully.

UNIT I	COMMUNICATION AND PROFESSIONAL ETIQUETTES	6

Importance and Types of Communication Verbal communication -Presentation skills- Non-Verbal communication - Personal Appearance, Posture, Gestures, Facial Expressions, Eye Contact and Space Distancing - Professional Etiquettes.

UNIT II	GOAL SETTING AND MOTIVATION	6

Short term and Long term Goals- Strategies to set and achieve goals- Motivation.

UNIT III	TIME AND STRESS MANAGEMENT	6

Importance of Time - Time Management Skills - Sources of Stress - Managing Stress - Analysis of the Case Studies on time and stress management.

UNIT IV	GROUP DISCUSSIONS AND POSITIVE ATTITUDE	6

Group Discussions - Leadership Qualities - Decision Making - Problem Solving - Negotiation Skills - Positive Attitude.

UNIT V	RESUME MAKING AND INTERVIEW SKILLS	6

Preparing Resume - E-Resume - Covering Letter - Job Application through email - Career Portfolio -Types of Interviews - Mock Interviews.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Demonstrate effective communication skills through presentations.

CO2: Utilize their knowledge of motivation in setting and achieving goals.

CO3: Examine time and stress management.

CO4: Formulate their ideas into an effective communication in formal contexts.

CO5: Develop a well-composed resume and face interviews confidently.

TEXTBOOKS:

1. Dhanavel S P, "English and Soft Skills", 1st Edition , Orient BlackSwan Ltd, Hyderabad : 2012.
2. Dr.Tobin Porterfield & Bob Graham, "The 55 Soft Skills That Guide Employee and Organizational Success," Mason-West Publishing House, 2018.
3. Prashant Sharma, "Soft Skills Personality Development for Life Success," BPB Publications, New Delhi, 2018.

REFERENCES:

1. M. Ashraf Rizvi, "Effective Technical Communication," Tata McGraw Hill Education Pvt. Ltd. New Delhi, 2016.
2. Mohan Krishna & Meera Banerji, "Developing Communication Skills," First Edition, Trinity Press, 2017.
3. N. Krishnaswami& T. Sriraman, "Creative English for Communication,"Third edition, Laxmi Publications Private Limited, 2017.

21CE305	INTERNSHIP+SEMINAR (During IV Semester Summer Vacation for 2 weeks)	L	T	P	C
		0	0	0	1

COURSE OBJECTIVES:

- To appraise the students in field work so as to have a firsthand knowledge of practical problems in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.
- To break down work and its function in the economy.
- To point out interests and abilities in their field of study.
- To relate theory and practice.

STRATEGY:

- The students individually undertake training in Construction Sites on basic material testing & properties and good construction practices in the field for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal faculty members.

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Connect the implementation of textbook knowledge into practice.

CO2: Discover the concepts of developments and implementation of new techniques.

CO3: Develop communication, interpersonal and other critical skills in the job interview process.
CO4: Categorize their interest and create a record of work experience.
CO5: Choose career alternatives prior to graduation.

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SEMESTER VI

21CE306	STRUCTURAL ANALYSIS II	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the concept of strain energy method.
- To use the concept of plastic analysis and analyze beams and rigid frames.
- To identify the analysing method of three hinged, two hinged and fixed arches.
- To construct influence lines for structures and calculate critical stress resultants.
- To solve suspension bridges with stiffening girders and space structures.

UNIT I — STRAIN ENERGY METHOD — 9

Strain energy in tension, compression and shear – resilience, Strain energy due to axial load (gradual, sudden and impact loadings), shear, flexure and torsion, Castigliono's theorems – determinate beams, plane frames and plane trusses, Determination of Static and Kinematic Indeterminacies – Analysis of continuous beams, plane frames and indeterminate plane trusses by strain energy method (up to two degree of redundancy).

UNIT II — PLASTIC ANALYSIS — 9

Plastic theory - Statically indeterminate structures – Plastic moment of resistance – Plastic modulus – Shape factor – Load factor – Plastic hinge and mechanism – collapse load - Static and kinematic methods – Upper and lower bound theorems - Plastic analysis of indeterminate beams and frames.

UNIT III — ARCHES — 9

Arches - Types of arches – Analysis of three hinged, two hinged and fixed arches - Parabolic and circular arches – Settlement and temperature effects.

UNIT IV — INFLUENCE LINES — 9

Influence lines for reactions in statically determinate beams – Influence lines for shear force and bending moment – Calculation of critical stress resultants due to concentrated and distributed moving loads – absolute maximum bending moment - influence lines for member forces in pin jointed plane frames. Muller Breslau's principle– Influence line for Shearing force, Bending Moment and support reaction components of propped cantilever, continuous beams (Redundancy restricted to one), and fixed beams.

UNIT V — SPACE AND CABLE STRUCUTRES — 9

Equilibrium of cable – length of cable - anchorage of suspension cables – stiffening girders - cables with three hinged stiffening girders – Influence lines for three hinged stiffening girders. Analysis of Space trusses using method of tension coefficients – Beams curved in plan.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use strain energy method to analyze continuous beams, pin-jointed indeterminate plane frames and rigid plane frames.

CO2: Select between the concept of plastic analysis and the technique for analysing rigid beams and frames.

CO3: Solve three hinged, two hinged and fixed arches.

CO4: Sketch the influence lines for structures and able to calculate critical stress resultants.

CO5: Interpret and analyze space constructions and suspension bridges with stiffening girders.

TEXT BOOKS:

1. Bhavikatti, S.S, "Structural Analysis, Vol.1, & 2", 5th edition, Vikas Publishing House Pvt.Ltd., NewDelhi-4, 2021.
2. Hibbeler R.C, "Structural Analysis", 9th edition, Pearson Education, 2017.
3. Vaidyanadhan, R and Perumal, P, "Comprehensive Structural Analysis – Vol. 1 & Vol. 2", 4th edition, Laxmi Publications Pvt. Ltd, New Delhi, 2019.

REFERENCES:

1. Punmia. B.C, Ashok Kumar Jain & Arun Kumar Jain, "Theory of structures", 13th edition, Laxmi Publications, New Delhi, 2017.
2. Khurmi R.S, "Theory of structures", 13th edition, S Chand, New Delhi, 2020.
3. Ramamrutham S, Narayanan R, "Theory of structures", 12th edition, Dhanpat Rai Publishing Company Ltd., 2020.

21CE307	DESIGN OF STEEL STRUCTURAL ELEMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the concepts of various design philosophies.
- To identify the various bolted and welded connections for steel structures.
- To calculate the steel tension and compression member design.
- To utilize concept of axially loaded columns and column base connections.
- To make use of the design of various flexural members in steel

UNIT I	INTRODUCTION AND ALLOWABLE STRESS DESIGN	9

Structural steel types – Mechanical Properties of structural steel- Indian structural steel products- Steps involved in the Deign Process -Steel Structural systems and their Elements- -Type of Loads on Structures and Load combinations- Code of practices, Loading standards and Specifications - Concept of Allowable Stress Method, and Limit State Design Methods for Steel structures-Relative advantages and Limitations-Strengths and Serviceability Limit states.

Allowable stresses as per IS 800 section 11 -Concepts of Allowable stress design for bending and Shear –Check for Elastic deflection-Calculation of moment carrying capacity –Design of Laterally supported Solid Hot Rolled section beams-Allowable stress deign of Angle Tension and Compression Members and estimation of axial load carrying capacity.

UNIT II	CONNECTIONS IN STEEL STRUCTURES	9

Type of Fasteners- Bolts Pins and welds- Types of simple bolted and welded connections Relative advantages and Limitations-Modes of failure-the concept of Shear lag-efficiency of joints- Axially loaded bolted connections for Plates and Angle Members using bearing type bolts –Prying forces and Hanger connection– Design of Slip critical connections with High strength Friction Grip bolts.- Design of joints for combined shear and Tension- Eccentrically Loaded Bolted Bracket Connections- Welds-symbols and specifications- Effective area of welds-Fillet and but Welded connections-Axially Loaded connections for Plate and angle truss members and Eccentrically Loaded bracket connections.

UNIT III	TENSION MEMBERS	9

Tension Members - Types of Tension members and sections –Behaviour of Tension Members-modes of failure-Slenderness ratio- Net area – Net effective sections for Plates ,Angles and Tee in tension –Concepts of Shear Lag- Design of plate and angle tension members-design of built up tension Members-Connections in tension members – Use of lug angles – Design of tension splice.

UNIT IV	COMPRESSION MEMBERS	9

Types of compression members and sections–Behaviour and types of failures-Short and slender columns- Current code provisions for compression members- Effective Length, Slenderness ratio – Column formula and column curves- Design of single section and compound Angles-Axially Loaded solid section Columns- Design of Built up Laced and Battened type columns – Design of column bases – Plate and Gusseted bases for Axially loaded colums- Splices for colums.

UNIT V	DESIGN OF FLEXURAL MEMBERS	9

Types of steel Beam sections- Behaviour of Beams in flexure- Codal Provisions – Classification of cross sections- Flexural Strength and Lateral stability of Beams –Shear Strength-Web Buckling, Crippling and defection of Beams- Design of laterally supported Beams- Design of solid rolled section Beams- Design of Plated beams with cover plates - Design Strength of Laterally unsupported Beams – Design of laterally unsupported rolled section Beams- Purlin in Roof Trusses-Design of Channel and I section Purlins. Introduction – Beam column.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret the fundamental knowledge of steel structural design.

CO2: Select the bolted and welded connection design for steel constructions.

CO3: Solve tension members and understand the effect of shear lag.

CO4: Choose the design concept of axially loaded columns and column base connections.

CO5: Model and design various types of flexural members.

TEXT BOOKS:

1. Subramanian.N, "Design of Steel Structures",3rd edition, Oxford University Press, 2018.
2. Gambhir. M.L., " Design of Steel Structures",5th edition, Dreamtech Press, 2019
3. Duggal. S.K, "Limit State Design of Steel Structures",3rd edition, Tata McGraw Hill Publishing Company, 2019

REFERENCES:

1. Kanthimathinathan S. "Limit State Design of Steel Structures: As per IS: 800 / 2007", 1st edition, Dreamtech Press, 2019.
2. Vijaya kumar Halakatti et.al, "Limit State Design of Steel and RCC Structures", 1st edition,

Medtech, 2019.

3. IS800 :2007, General Construction Vijaya kumar Halakatti (Author), Prakash K. E (Author), N. S Kumar (Author), Prahallada M. C (Author)n in Steel - Code of Practice, (Third Revision), Bureau of Indian Standards, New Delhi, 2007
4. SP 6(1) Hand book on structural Steel Sections

21CE308	ESTIMATION, COSTING AND VALUATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make use of the various methods of estimation of buildings.
- To identify the rate analysis for all type of structures and cost estimate.
- To apply the various types of specifications, principles for report preparation, tender notices.
- To build knowledge on types of contracts.
- To develop knowledge on valuation for building and land.

UNIT I **ESTIMATE OF DIFFERENT STRUCTURES** 9

Philosophy – Purpose – Methods of estimation – Types of estimates – Approximate estimates – Detailed estimate – Estimation of quantities for buildings, bituminous and cement concrete roads, septic tank, soak pit, retaining walls – culverts (additional practice in class room using computer softwares).

UNIT II **RATE ANALYSIS AND COSTING** 9

Standard Data – Observed Data – Schedule of rates – Market rates – Standard Data for Man Hours and Machineries for common civil works – Rate Analysis for all Building works, canals, and Roads– Cost Estimates (additional practice in class room using Computer softwares) - (Analysis of rates for the item of work asked, the data regarding labour, rates of material and rates of labour to be given in the Examination Question Paper).

UNIT III **SPECIFICATIONS, REPORTS AND TENDERS** 9

Specifications – sources – Preparation of detailed and general specifications – Principles for report preparation – report on estimate of residential building – Culvert – Roads - Tenders – TTT Act – e-tender – Preparation of Tender Notice and Document.

UNIT IV **CONTRACTS** 9

Contracts – Types of contracts – Drafting of contract documents – Drafting of contract documents based on IBRD / MORTH Standard bidding documents - Arbitration and legal requirements.

UNIT V **VALUATION** 9

Necessity – Basics of value engineering – Capitalised value – Depreciation – Escalation – Value of building – Calculation of Standard rent – Mortgage – Lease.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

J. P. [signature]

CO1: Illustrate the method of Estimation and calculating the quantities for different structures.
CO2: Calculate the rate analysis for all building works, canals, and roads and cost estimate.
CO3: Use the different types of specifications, principles for report preparation, tender notices types.
CO4: Identify and explain the different types of contracts.
CO5: prepare the valuation for various building and land.

TEXT BOOKS:

1. Dutta, B.N., "Estimating and Costing in Civil Engineering", 28th edition, CBS Publishers & Distributors Pvt. Ltd., 2020.
2. Kohli, R.C., "A Text Book of Estimating and Costing (Civil)", 3rd edition, S.Chand & Company Ltd., 2018.
3. Rethaliya R, Rethaliya Mayur R, "Estimating Costing and Valuation", 1st edition, Atul Prakashan, 2018.

REFERENCES:

1. Len Holm, Schaufelberger John E, "Construction Cost Estimating", 1st edition, CBS publishers & distributors pvt. Ltd, 2018.
2. Holm Leonard et.al, "Construction Cost Estimating: Process and Practices", 1st edition, Pearson Education, 2017.
3. Ostwald Phillip F, "Construction Cost Analysis and Estimating", 1st edition, Pearson Education, 2017.

21CE309	IRRIGATION ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make use of the knowledge and skills on crop water requirements.
- To choose the methods and management of irrigation.
- To develop knowledge on types of impounding structures.
- To illustrate the methods of irrigation including canal irrigation.
- To interpret water management on optimization of water use.

UNIT I	CROP WATER REQUIREMENT	9

Need and classification of irrigation- historical development and merits and demerits of irrigation types of crops-crop season-duty, delta and base period- consumptive use of crops- estimation of Evapo-transpiration using experimental and theoretical methods.

UNIT II	IRRIGATION METHODS	9

Tank irrigation – Well irrigation – Irrigation methods: Surface and Sub-Surface and Micro Irrigation – design of drip and sprinkler irrigation – ridge and furrow irrigation-Irrigation scheduling – Water distribution system- Irrigation efficiencies.

UNIT III	DIVERSION AND IMPOUNDING STRUCTURES	9

Types of Impounding structures - Gravity dam – Forces on a dam -Design of Gravity dams; Earth dams, Arch dams- Diversion Head works - Weirs and Barrages.

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UNIT IV	CANAL IRRIGATION	9

Canal regulations – direct sluice - Canal drop – Cross drainage works-Canal outlets – Design of prismatic canal-canal alignments-Canal lining - Kennedy's and Lacey's Regime theory-Design of unlined canal.

UNIT V	WATER MANAGEMENT IN IRRIGATION	9

Modernization techniques- Rehabilitation – Optimization of water use-Minimizing water losses- On form development works-Participatory irrigation management- Water resources associations changing paradigms in water management-Performance evaluation-Economic aspects of irrigation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the knowledge and skills on crop water requirements.

CO2: Select the methods and management of irrigation.

CO3: Relate the knowledge on types of impounding structures.

CO4: Identify the methods of irrigation including canal irrigation.

CO5: Interpret water management on optimization of water use.

TEXT BOOKS:

1. Basak N.N, "Irrigation Engineering", 5th Edition, McGraw Hill Education, 2017.
2. Punmia B.C., et. al; "Irrigation and water power Engineering", Laxmi Publications, 17th Edition, New Delhi, 2021.
3. Garg S. K., "Irrigation Engineering and Hydraulic structures", Khanna Publishers, 35th Revised Edition, New Delhi, 2019.

REFERENCES:

1. Sharma S.K., "Irrigation Engineering and Hydraulic Structures", 1st edition, S Chand Publishing.
2. Linsley R.K. and Franzini J.B, "Irrigation Engineering", 2nd edition, Standard Book House Since 1960, 2018.
3. Modi P.N., "Irrigation Water Resources and Water Power Engineering", 1st edition, Standard Book House Since 1960, 2020.

21MCC02	ESSENCE OF INDIAN TRADITIONAL KNOWLEDGE	L	T	P	C
		1	0	0	0

COURSE OBJECTIVES:

- To explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge.
- To explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.
- To explain about the use of Traditional Knowledge to meet the basic needs of human being.
- To explain the rich biodiversity materials and knowledge preserved for practicing traditional

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lifestyle.

- To explain the use of Traditional Knowledge in Manufacturing and Industry.

UNIT-I	TRADITIONAL AND MODERN KNOWLEDGE	3

Two Worlds of Knowledge - Phase of Explorers, Sir Arthur Cotton and Irrigation, Smallpox Vaccination, Late Nineteenth Century, Voelcker, Howard and Agriculture, Havell and Indian Art; Indians at the Encounter - Gaekwad of Baroda and Technical Education, Science Education and Modern Industries, Hakim Ajmal Khan and Ayurveda, R. N. Chopra and Indigenous Drugs, Gauhar Jaan and Indian Classical Music; Linking Science and the Rural - Tagore's Sriniketan Experiment, Marthandam, the YMCA Model, Gandhi's Thoughts on Development, Nehru's View of Growth; Post- Independence Era - Modernization and Traditional Knowledge, Social Roots of Traditional Knowledge Activism, Global Recognition for Traditional Knowledge.

UNIT-II	PROTECTION AND SHARING	3

For Recognition and Protection - United Nations Educational, Scientific and Cultural Organization (UNESCO), World Health Organization (WHO), International Labour Organization (ILO), UN Working Group on Indigenous Populations, Evolution of Other Organizations; Norms of Sharing - United Nations Environment Programme (UNEP), World Intellectual Property Organization (WIPO), World Trade Organization (WTO); IPR and Traditional Knowledge - Theoretical Background, Positive Protections of TK, Defensive Strategies, IPR Facilitation for TK.

UNIT-III	TRADITIONAL KNOWLEDGE FOR BASIC NEEDS	3

Indian Midwifery Tradition—The Dai System, Surface Flow Irrigation Tanks, Housing - A Human Right, Changing Priorities—Niyamgiri.

Biodiversity and Genetic Resources: Jeevani - The Wonder Herb of Kanis, A Holistic Approach - FRLHT, Basmati - In the New Millennium, AYUSH-Based Cosmetics.

UNIT-IV	TRADITIONAL KNOWLEDGE IN MANUFACTURING	3

Drug Discovery, A Sweetener of Bengal, The Sacred Ring of Payyanur, Channapatna Toys.

UNIT-V	TRADITIONAL CULTURAL EXPRESSIONS	3

Banarasi Saree, Music, Built and Tangible Heritage, Modern Yoga, Sanskrit and Artificial Intelligence, Climate Change and Traditional Knowledge.

TOTAL :15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to:

CO1: Explain the concept of Indian Traditional Knowledge along with Indian Modern Knowledge.

CO2: Explain the need and importance of protecting Traditional Knowledge, Knowledge sharing, and Intellectual property rights over Traditional Knowledge.

CO3: Explain about the use of Traditional Knowledge to meet the basic needs of human being.

CO4: Explain the rich biodiversity materials and knowledge preserved for practicing traditional lifestyle.

CO5: Explain the use of Traditional Knowledge in Manufacturing and Industry.

TEXT BOOKS:

1. Nirmal Sengupta "Traditional Knowledge in Modern India Preservation, Promotion, Ethical

Access and Benefit Sharing Mechanisms" Springer, 2019.
2. Amit Jha,"Traditional Knowledge System in India", Atlantic Publishers and Distributors Pvt Ltd, 2009.
3. Basanta Kumar Mohanta, Vipin Kumar Singh "Traditional Knowledge System and Technology in India", Pratibha Prakashan, 2012.
4. Kapil Kapoor, Michel Danino "Knowledge Traditions and Practices of India", Central Board of Secondary Education, 2012.

WEB REFERENCES :

1. NPTEL video lecture on "Ayurvedic Inheritance of India", Video link: https://nptel.ac.in/courses/121/106/121106003/#.
2. Youtube video on "Introduction to Indian Knowledge Systems", Video link: https://www.youtube.com/watch?v=LZP1StpYEPM.
3. Youtube video on "12 Great achievements of Indian Civilization", Video link: https://www.youtube.com/watch?v=xmogKGCmclE.

21CE310	COMPUTER AIDED STRUCTURAL DESIGN AND DRAWING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To classify detailing practices and its software applications.
- To analyse the structural elements with different load combinations.
- To categorize the elements as per the functional requirements provided in the IS Code provisions.
- To infer design developed for elements and develop them into drawings.
- To explain and design environmental and irrigation structures.

LIST OF EXPERIMENTS:

Analyse, design and produce detailed drawing as per relevant codes using Excel and drafting software for

Part A - RCC Structures

1. Analysis and design of residential building.
2. Design and drawing of RCC cantilever type retaining walls with reinforcement details.
3. Design and drawing of RCC rectangular and circular water tank.

Part B- Steel Structures

1. Analysis, design and detailing of steel roof truss
2. Analysis and design of Framed Connections and Detailing
3. Analysis and design of Steel water Tank

Part C – Environmental

1. Analysis and Design Septic tank
2. Design of Rapid sand filter

Part D – Irrigation

1. Design of tank sluice with tower head
2. Design of tank surplus weir

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Analyze, design and prepare detailing drawing for residential building.

CO2: Plan and draw reinforced concrete Cantilever Retaining Walls

CO3: Analyze, design and prepare detailing drawing for steel roof truss and steel water tank.

CO4: Sketch the Septic tank and Rapid sand filter

CO5: Prepare the design of tank sluice with tower head and tank surplus weir

TEXT BOOKS:

1. Sarma T S, "Design of R C C Buildings using Staad Pro V8i with Indian Examples English", 2nd edition, Educreation Publishing, 2017.
2. Aghunandan M H, "Analysis of Structural Elements by STAAD Pro for beginners [with RCC design]", 2nd edition, Kindle Edition, 2020.
3. Sarma T S, "Design of Industrial Steel Buildings Using Staad Pro: With Indian Examples", 1st edition, Notion Press; 2020.

REFERENCES:

1. Krishnamurthy, D., "Structural Design & Drawing – Vol. II and III", 2nd edition, CBS Publishers, 2018.
2. IS 456:2000 "Code of Practice for Plain and Reinforced Concrete".
3. IS 875(1-5):1987 "Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures".
4. SP (16): 1980 "Design Aids for Reinforced Concrete to IS: 456-1978".
5. IS 800:2007 "Code of Practice for General Construction in steel".
6. SP6: Part 1:1964 "Handbook for Structural Engineers".

SEMESTER VII

21CE401	PROJECT WORK - I	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To analyze a specific problem for the current need of the society.
- To infer information related to the problem through detailed review of literature.
- To survey the methodology to solve the identified problem.
- To test and analyze the identified problem.
- To prepare project reports and to face reviews and viva-voce examination.

STRATEGY:

- The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Survey any challenging practical problems in Civil Engineering.

CO2: Simplify the problem from its identification and through literature reviews.

CO3: Discover appropriate techniques, modern Engineering tools to solve the problems.

CO4: Analyse the problem in context with societal and environmental need.

CO5: Develop project reports, presentations and to face interviews.

21CE402	COMPREHENSION	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To apply the concept of mathematics, science and engineering fundamentals and an engineering specialization to solve complex engineering problems.
- To prepare the students for higher studies and competitive examinations.

ENGINEERING GROUP I

Strength of Materials: Basics of statics - Simple Stresses and Strains - Principal stresses and strains - Shear Force and Bending Moment - Geometric properties of sections - Bending and shear stresses.

Surveying: Chain surveying- Compass surveying- Plane table surveying – Levelling - Areas and volumes - Theodolite survey – Curves - Modern methods of surveying.

Geology: General geology - Seismology-Minerals and rocks - Structural geology - Engineering Geology.

ENGINEERING GROUP II

J.P. Anil

Building Materials and Technology: Orientation in buildings - Materials for construction - Technologies for construction - Construction tools and Machinery.

Mechanics of Solids: Axial and bending stresses - Torsion of circular shafts - Slope and deflection of beams - Analysis of Trusses - Moving Loads and Influence Line - Cables, stiffening girders and arches.

Fluid Mechanics: Fluid statics - Pressure measurements - Fluid kinematics - Fluid dynamics - Flow measurements in pipes - Boundary layer theory - Flow through pipes.

Engineering Group 3

Water Supply Engineering: Demand estimation - Identification of sources, intakes and transport of water - Quality assessment - Treatment of water - Water distribution.

Concrete Technology: Concrete making Materials – Cement - Fine aggregate - Coarse aggregate - Water-Admixtures - Concrete Production & Fresh concrete - Concrete mix design - Engineering properties of concrete - Dimensional stability and Durability of concrete - Special concretes.

Engineering Group 4

Structural Analysis: ILD for indeterminate beams- Strain Energy Method- Theorem of Three Moments- Slope Deflection Method- Moment Distribution Method- Matrix Stiffness Method

Hydraulics and Hydraulic Machinery: Open channel flow- Dimensional Analysis- Impact of jets- Water turbines and Pumps

Wastewater Engineering: Characterization of sewage- Collection of sewage- Transportation of wastewater- Treatment of wastewater- Disposal of sewage.

Engineering Hydrology: Hydrologic processes- Surface runoff- Floods- Groundwater

Soil Mechanics: Physical Properties of soils- Consistency limits- Soil Classification- Permeability- Geostatic Stress- Stress due to applied loads- Shear Strength- Compressibility- Soil Compaction- Stability of Slopes

Highways and Pavement Engineering: Highway planning and Alignment- Geometric Elements- Traffic Engineering- Highway materials- Design of pavements- Highway Construction practice- Highway Maintenance

Engineering Group 5

Design of Masonry, Timber and Steel Elements: Brick masonry- Design of Timber Structures- Bolted connection in steel Structures- Welded connection in steel structures- Steel tension members- Steel compression members- Steel flexure members- Column base

Irrigation and Water Resources Engineering: Water Resources Planning- Irrigation- Dams- Diversion Head works- Cross Drainage works

Design of RC Elements: concept of working stress method, Limit state philosophy as detailed in IS code, Limit state of collapse in flexure, Limit state of collapse in shear and torsion, Limit state of collapse in compression, Limit state of serviceability, Design of footing.

Airports, Railways, Docks and Harbour: Permanent Way - its Components and their Functions, Geometric Design of Railway Tracks, Points and Crossings - Design of Turnouts, Working Principle - Signalling, Interlocking and Track Circuiting, Components of Airports, Runway Design - Orientation, Cross wind Component, Wind rose Diagram(Problems), Geometric Design, Requirements of Harbour components.

Foundation Engineering: Methods of Site Investigation - Depth of subsurface exploration and Spacing of bore holes - Geophysical methods, Methods of obtaining undisturbed samples, - Bearing Capacities of soils, Types of settlement, functions and types of pile foundation – Bearing capacity failure in piles - Estimating load carrying capacity of piles by Static approach, Efficiency of Pile Group, Drainage and dewatering techniques, Lateral earth Pressure and Retaining Walls.

Design of Steel Structures: Design of welded plate girder, Gantry girder- Determination of maximum bending moment and shear force due vertical component of crane wheel load, Design of gantry girder, Beam – Column -behaviour of beam-column - second order moment in beam-column, Design of Truss using Rolled steel sections – Purlins – truss members – Supports. Design of Truss using tubular sections, web angle connection – Beam to Beam Connection - clip and seat Connection – Concept of semi rigid Connection.

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Ouline the basic concepts of core engineering courses in the programme.

CO2: Summarize the importance of mathematics and science in the programme and its correlation in core engineering courses of the programme.

CO3: Solve basic problems in core engineering of the programme.

CO4: Apply the concepts of core engineering, mathematics and science course to solve complex problems.

21CE403	INTERNSHIP+SEMINAR (During VI Semester Summer Vacation for 4 weeks)	L	T	P	C
		0	0	0	2

COURSE OBJECTIVES:

- To appraise the students in field work so as to have a firsthand knowledge of practical problems in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.
- To break down work and its function in the economy.
- To point out interests and abilities in their field of study.
- To relate theory and practice.

STRATEGY:

- The students individually undertake training in Construction Sites on basic material testing & properties and good construction practices in the field for the specified duration. At the end of the training, a report on the work done will be prepared and presented. The students will be evaluated through a viva-voce examination by a team of internal staff.

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Connect the implementation of textbook knowledge into practice.

CO2: Discover the concepts of developments and implementation of new techniques.

CO3: Develop communication, interpersonal and other critical skills in the job interview process.
CO4: Categorize their interest and create a record of work experience.
CO5: Choose career alternatives prior to graduation.

SEMESTER VIII

21CE404	PROJECT WORK - II	L	T	P	C
		0	0	20	10

COURSE OBJECTIVES:

- To analyze a specific problem for the current need of the society.
- To infer information related to the problem through detailed review of literature.
- To survey the methodology to solve the identified problem.
- To test and analyze the identified problem.
- To prepare project reports and to face reviews and viva-voce examination.

STRATEGY:

- The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Survey any challenging practical problems in Civil Engineering.

CO2: Simplify the problem from its identification and through literature reviews.

CO3: Discover appropriate techniques, modern Engineering tools to solve the problems.

CO4: Analyse the problem in context with societal and environmental need.

CO5: Develop project reports, presentations and to face interviews.

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PROFESSIONAL ELECTIVE COURSES: VERTICALS

VERTICAL-I: CONSTRUCTION MANAGEMENT AND GEO INFORMATICS

21PCE01	ENGINEERING MATERIALS FOR SUSTAINABILITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the concepts of sustainability in construction.
- To show the importance of Green Building Technologies.
- To identify the essential qualities of Resources and its utilisation.
- To illustrate the importance of Sustainability practices
- To construct the relationship between the Sustainability Issues with Construction Industry

UNIT I	SUSTAINABILITY	9

Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

UNIT II	GREEN BUILDING TECHNOLOGIES	9

Introduction- Necessity - Concept of Green building. Principles of green building – Selection of site and Orientation of the building – usage of low energy materials – effective cooling and heating systems – effective electrical systems – effective water conservation systems - Certification systems- Green Rating for Integrated Habitat Assessment (GRIHA) and Leadership in Energy and Environmental Design (LEED), case studies.

UNIT III	RESOURCES AND ITS UTILISATION	9

Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans and Geothermal energy.

UNIT IV	SUSTAINABILITY PRACTICES	9

Basic concept of sustainable habitat, Methods for increasing energy efficiency in buildings, Green Engineering, Sustainable Urbanisation, Sustainable cities, Sustainable transport.

UNIT V	SUSTAINABILITY ISSUES WITH CONSTRUCTION INDUSTRY	9

Global warming due to Construction, Loss of Biodiversity and Natural Habitats, Acidification due to Construction, Air Pollution due to Construction, Toxicity due to Construction, Water Resource Pollution due to Construction, Deforestation due to Construction.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Identify the relevance and the concept of sustainability

CO2: Make use of services integrating concepts of green buildings.

CO3: Solve the concepts related to conventional and non-conventional energy.

CO4: Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge

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and principles.

CO5: Apply the fundamentals of sustainability issues with construction industry.

TEXT BOOKS:

1. Bhavik R, "Sustainable Engineering: Principles and Practice", 1st Edition, Cambridge University Press, 2019.
2. Mike Montoya, "Green Building Fundamentals", 2nd Edition, Pearson, 2010.
3. Charles J. Kibert "Sustainable Construction - Green Building Design", 5th Edition, John Wiley & Sons, Prentice Hall, 2022.

REFERENCES:

1. Michael Ashby, "Materials and the Environment: Eco-Informed Material Choice" 1st Edition, Butterworth-Heinemann, Elsevier, Inc. Burlington, MA. ISBN: 978-1-85617-608-8, 2009.
2. Hoboken NJ and Meg Calkins, "Materials for Sustainable Sites: A Complete Guide to the Evaluation, Selection and Use of Sustainable Construction Materials", 1st Edition, John Wiley & Sons, 2009.
3. Ravindra K. Dhir OBE et al., "Sustainable Construction Materials: Recycled Aggregates", 1st Edition, Woodhead Publishing, 2019.

21PCE02	ADVANCED SURVEYING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate astronomical bodies and field astronomy.
- To relate the method and applications of collective imagery using photogrammetry.
- To discover the working and applications of total station.
- To demonstrate the concept of satellite navigation system and the field work procedure of GPS in data collection.
- To identify surveys subjected to curves, water bodies and tunnel alignments.

UNIT I	ASTRONOMICAL SURVEYING	9

Astronomical terms and definition – Motion of sun and stars – Celestial co-ordinate System - Time system - Nautical Alamance – Apparent attitude and corrections – Field observations and determinations of time, longitude, latitude and azimuth by attitude and Hour angle method.

UNIT II	AERIAL SURVEYING	9

Terrestrial Photogrammetry – Terrestrial stereo photogrammetry – Aerial photogrammetry – overlaps – scale of photographs – Vertical and titled photographs distortion in aerial photographs – Stereostopic vision - photo interpretation – Applications

UNIT III	TOTAL STATION SURVEYING	9

Classification – basic measuring and working principles of an Electro – optical and Microwave total station- sources of errors in Electro – optical and Microwave total station – Care and Maintenance of total station – trilateration – Applications

UNIT IV	GPS SURVEYING	9

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Basic concepts – Space, Control and User segments – Satellite configuration – Signal structure – Orbit determination and representation – Antispoofing and selective availability – hand held and geodetic receivers – Field work procedure – Data processing Applications		
UNIT V	**MISCELLANEOUS**	**9**
Reconnaissance – Route surveys for highways, railways and waterways – simple, compound, reverse , transition and vertical curve – setting out methods - hydrographic surveying – tides – MSL – Sounding methods – measurement of current and discharge – Tunnel alignment and setting out – Settlement and Deformation studies		
	TOTAL : 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the concepts of astronomical observations in surveying.

CO2: Utilize the photographs from aerial surveying.

CO3: Solve the field problems using Total station.

CO4: Experiment the concepts of GPS surveying and data processing.

CO5: Interpret data on route, hydrographic surveys and tunnel alignments.

TEXT BOOKS:

1. Punmia BC, "Surveying", 17th Edition, Laxmi Publications, 2016.
2. James M.Anderson and Edward M.Mikhail, "Surveying, Theory and Practice", 7th Edition, McGraw Hill, 2001.
3. Bannister and S.Raymond, "Surveying", 7th Edition, Longman 2004.
4. Alfred Leick, "GPS satellite surveying", 4th Edition, John Wiley & Sons Inc., 2015.

REFERENCES:

1. Arora K.R. "Surveying Vol I & II", 15th Edition, Standard Book House, 2018.
2. GuochengXu, "GPS - Theory, Algorithms and Applications", 2nd Edition, Springer – Verlag, Berlin, 2007
3. Roy S.K., "Fundamentals of Surveying", 2nd Edition, Prentice Hall of India, 2004.

21PCE03	REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To build understanding on the basic concepts of remote sensing.
- To utilize information on various platforms and sensors.
- To interpret and process images.
- To make use of the concept about Geographic Information System.
- To apply the concept of GIS in civil engineering projects.

UNIT I	**EMR AND ITS INTERACTION WITH ATMOSPHERE & EARTH MATERIAL**	**9**
Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions		

important to remote sensing – Wave theory, Particle theory, Stefan-Boltzman and Wein's Displacement Law – Atmospheric scattering, absorption – Atmospheric windows – spectral signature concepts – typical spectral reflective characteristics of water, vegetation and soil.

UNIT II	PLATFORMS AND SENSORS	9

Types of platforms – orbit types, Sun-synchronous and Geosynchronous – Passive and Active sensors – resolution concept – Payload description of important Earth Resources and Meteorological satellites – Airborne and spaceborne TIR and microwave sensors

UNIT III	IMAGE INTERPRETATION AND ANALYSIS	9

Types of Data Products – types of image interpretation – basic elements of image interpretation - visual interpretation keys – Digital Image Processing – Pre-processing – image enhancement techniques – multispectral image classification – Supervised and unsupervised

UNIT IV	GEOGRAPHIC INFORMATION SYSTEM	9

Introduction – Maps – Definitions – Map projections – types of map projections – map analysis – GIS definition – basic components of GIS – standard GIS softwares – Data type – Spatial and non-spatial (attribute) data – measurement scales – Database Management Systems (DBMS).

UNIT V	DATA ENTRY, STORAGE AND ANALYSIS	9

Data models – vector and raster data – data compression – data input by digitization and scanning – attribute data analysis – integrated data analysis – Modeling in GIS Highway alignment studies – Land Information System.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the basic concepts of Geographic information system.

CO2: Make use of various platforms and sensors used in GIS.

CO3: Develop images through processing.

CO4: Experiment with the concepts behind GIS.

CO5: Utilize GIS data for Civil engineering applications.

TEXT BOOKS:

1. Lillesand,T.M., Kiefer, R.W. and J.W.Chipman., "Remote Sensing and Image Interpretation", 7th Edition, John Willey and Sons Asia Pvt. Ltd., New Delhi, 2015.
2. Basudeb Bhatta, "Remote Sensing and GIS 3E", 3rd Edition, OUP India, 2021.
3. Anji Reddy, M. "Textbook of Remote Sensing and Geographical Information System" 2nd Edition, BS Publications, Hyderabad, 2001.

REFERENCES:

1. Lo.C.P.and A.K.W.Yeung, "Concepts and Techniques of Geographic Information Systems", 2nd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2006.
2. Peter A.Burrough, Rachael A. McDonnell, "Principles of Geographical Information Systems", 3rd Edition, Oxford University Press, 2015.
3. Ian Heywood, Sarah Cornelivs and Steve Carver, "An Introduction to Geographical Information System", 4th Edition, Pearson Education Pvt Ltd., New Delhi, 2011.

21PCE04	CONSTRUCTION PLANNING AND SCHEDULING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify the basic concepts of construction planning.
- To plan the construction activities.
- To develop the cost control in construction.
- To make use of concepts in quality control and safety during construction.
- To organize information in Centralized database Management systems.

UNIT I	CONSTRUCTION PLANNING	9

Basic concepts in the development of construction plans-Choice of Technology and Construction method-Defining Work Tasks- Work breakdown structure- Definition- Precedence relationships among activities-Estimating Activity Durations-Estimating Resource Requirements for work activities-coding systems.

UNIT II	SCHEDULING PROCEDURES AND TECHNIQUES	9

Relevance of construction schedules-Bar charts – The critical path method-Calculations for critical path scheduling-Activity float and schedules-Presenting project schedules-Critical path scheduling for Activity-on-node and with leads, Lags and Windows-Calculations for scheduling with leads,lags and windows-Resource oriented scheduling-Scheduling with resource constraints and precedences - Use of Advanced Scheduling Techniques-Scheduling with uncertain durations-Crashing and time/cost tradeoffs -Improving the Scheduling process – Introduction to application software.

UNIT III	COST CONTROL MONITORING AND ACCOUNTING	9

The cost control problem-The project budget-Forecasting for Activity cost control – financial accounting systems and cost accounts-Control of project cash flows-Schedule control-Schedule and Budget updates-Relating cost and schedule information.

UNIT IV	QUALITY CONTROL AND SAFETY DURING CONSTRUCTION	9

Quality and safety Concerns in Construction-Organizing for Quality and Safety-Work and Material Specifications-Total Quality control-Quality control by statistical methods -Statistical Quality control with Sampling by Attributes-Statistical Quality control by Sampling and Variables-Safety.

UNIT V	ORGANIZATION AND USE OF PROJECT INFORMATION	9

Types of project information-Accuracy and Use of Information-Computerized organization and use of Information – Organizing information in databases-relational model of Data bases-Other conceptual Models of Databases-Centralized database Management systems-Databases and application programs-Information transfer and Flow.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the basic concepts of construction planning.

CO2: Make use in construction activities.

CO3: Utilize to control the cost in a construction.

CO4: Plan for quality control and safety during construction.

CO5: Construct centralized database Management systems.

TEXT BOOKS:

1. Hinze, "Construction Planning and Scheduling", 4th Edition, Pearson Education India, 2013.
2. Chitkara, K.K. "Construction Project Management Planning, Scheduling and Control", 3rd Edition, Tata McGraw Hill Publishing Co., New Delhi, 2014.
3. Srinath,L.S., "Pert and CPM Principles and Applications", 3rd Edition, Affiliated East West Press, 2001.

REFERENCES:

1. Chris Hendrickson and Tung Au, "Project Management for Construction – Fundamentals Concepts for Owners, Engineers, Architects and Builders", Prentice Hall, Pitsburgh, 2000.
2. Moder.J., Phillips. C. and Davis E, "Project Management with CPM, PERT and Precedence Diagramming", Van Nostrand Reinhold Co., 3rd Edition, 1985.
3. Willis. E.M., "Scheduling Construction projects", John Wiley and Sons, 1986.

21PCE05	HOUSING PLANNING AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To utilize the basic infrastructure consideration and the integrated approach on the National Housing policies.
- To interpret the basic housing programmes including the slum redevelopment and relocation using GIS and MIS.
- To illustrate on the planning, design, evaluation and construction of housing projects.
- To relate the Construction techniques and methods of Green building concept.
- To prepare the Housing finance, cost recovery and pricing of housing units.

UNIT I	INTRODUCTION TO HOUSING	9

Definition of Basic Terms – House, Home, Household, Apartments, Multi storied Buildings, Special Buildings, Objectives and Strategies of National Housing Policies including Slum Housing Policy, Principle of Sustainable Housing – Integrated approach on arriving holding capacity and density norms - All basic infrastructure consideration - Institutions for Housing at National, State and Local levels.

UNIT II	HOUSING PROGRAMMES	9

Basic Concepts, Contents and Standards for Housing Programmes - Sites and Services, Neighbourhoods- Plotted land development programs, Open Development Plots, Apartments, Gated communities, Townships, Rental Housing, Co-operative Housing, Slum Housing Programmes – Slum improvement – Slum redevelopment and Relocation – Use of GIS and MIS in Slum Housing Projects, Role of Public housing agencies, and Private sector in supply , quality, infrastructure and pricing – Role of Non-Government Organizations in slum housing.

UNIT III	PLANNING AND DESIGN OF HOUSING PROJECTS	9

Formulation of Housing Projects – Land Use and Soil suitability analysis -Building Byelaws and Rules and Development Control Regulations - Site Analysis, Layout Design, Design of Housing

Units (Design Problems) – Housing Project Formulation

UNIT IV	CONSTRUCTION TECHNIQUES AND COST-EFFECTIVE MATERIALS	9

New Constructions Techniques – Cost Effective Modern Materials and methods of Construction- Green building concept- Building Centres – Concept, Functions and Performance Evaluation.

UNIT V	HOUSING FINANCE AND PROJECT APPRAISAL	9

Evaluation of Housing Projects for sustainable principles – Housing Finance, Cost Recovery – Cash Flow Analysis, Subsidy and Cross Subsidy- Public Private Partnership Projects – Viability Gap Funding - Pricing of Housing Units (Problems).

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build the basic infrastructure consideration and the integrated approach on the National Housing policies.

CO2: Make use of the basic housing programmes including the slum redevelopment and relocation using GIS and MIS.

CO3: Utilize the planning, design, evaluation and construction of housing projects.

CO4: Model the Construction techniques and methods of Green building concept.

CO5: Plan the Housing finance, cost recovery and pricing of housing units.

TEXT BOOKS:

1. Donald Watson and Michael J.Crosbie, "Time Saver Standards for Architectural Design", 8th Edition, Tata McGraw Hill Edition, 2011.
2. Meera Mehta and Dinesh Mehta, "Metropolitan Housing Markets", Sage Publications Pvt. Ltd., New Delhi, 1999.
3. Francis Cherunilam and Odeyar D Heggade, "Housing in India", Himalaya Publishing House, Bombay, 1997.

REFERENCES:

1. Wiley- Blackwell, "Neufert Architects Data", 4th Edition, Blackwell Publishing Ltd, 2012.
2. Walter Martin Hosack, "Land Development Calculations", 2nd Edition, McGraw Hill USA 2010.
3. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2004.

21PCE06	INFRASTRUCTURE PLANNING AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To relate the various stages of infrastructure projects lifecycle and its finance.
- To explain the infrastructure privatization with case studies.
- To apply the successful infrastructure planning and the challenges in construction and maintenance of Infrastructure.
- To show the strategies in shaping and planning for successful infrastructure projects.

- To make use of the sustainable development of the Infrastructure Management Systems and Future Directions.

UNIT I	AN OVERVIEW OF BASIC CONCEPTS RELATED TO INFRASTRUCTURE	9

Introduction to Infrastructure-an overview of the Power Sector in India-an Overview of the Water Supply and Sanitation Sector in India- an overview of the Road, Rail-Air and Port Transportation Sectors in India- an overview of the Telecommunications Sector in India-an overview of the Urban Infrastructure in India-an overview of the Rural Infrastructure in India-an Introduction to Special Economic Zones-Organizations and layers in the field of Infrastructure-The Stages of an Infrastructure Project Lifecycle- an overview of Infrastructure Project Finance.

UNIT II	PRIVATE INVOLVEMENT IN INFRASTRUCTURE:	9

A Historical Overview of Infrastructure Privatization-The Benefits of Infrastructure Privatization-Problems with Infrastructure Privatization-Challenges in Privatization of Water Supply: A Case Study-Challenges in Privatization of Power: Case Study- Privatization of Infrastructure in India: Case Study-Privatization of Road Transportation Infrastructure in India.

UNIT III	CHALLENGES TO SUCCESSFUL INFRASTRUCTURE PLANNING AND IMPLEMENTATION	9

Mapping and Facing the Landscape of Risks in Infrastructure Projects- Economic and Demand Risks: The Case study for Political Risks- Socio-Environmental Risks- Cultural Risks in International Infrastructure Projects- Legal and Contractual Issues in Infrastructure- Challenges in Construction and Maintenance of Infrastructure.

UNIT IV	STRATEGIES FOR SUCCESSFUL INFRASTRUCTURE PROJECT IMPLEMENTATION	9

Risk Management Framework for Infrastructure Projects- Shaping the Planning Phase of Infrastructure Projects to mitigate risks- Designing Sustainable Contracts- Introduction to Fair Process and Negotiation- Negotiating with multiple Stakeholders on Infrastructure Projects

UNIT V	SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE	9

Information Technology and Systems for Successful Infrastructure Management- - Innovative Design and Maintenance of Infrastructure Facilities- Infrastructure Modeling and Life Cycle Analysis Techniques- Capacity Building and Improving the Governments Role in Infrastructure Implementation- An Integrated Framework for Successful Infrastructure Planning and Management - Infrastructure Management Systems and Future Directions.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret the basic concepts related to Infrastructure Projects.

CO2: Show the role of private sector in infrastructure growth.

CO3: Construct the strategies for successful Infrastructure Project implementation.

CO4: Develop Infrastructure modelling and Life Cycle Analysis Techniques.

CO5: Illustrate Sustainable development of Infrastructure.

TEXT BOOKS:

1. Grigg, Neil, "Infrastructure engineering and management", John Wiley & Sons, Newyork, 1996.
2. Haas, Hudson, Zaniewski, "Modern Pavement Management", Krieger Publishing Company, Malabar, 1994.
3. Hudson, Haas, Uddin, "Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation", McGraw Hill, 1997.

REFERENCES:

1. World Development Report 1994: "Infrastructure for Development".
2. Zimmerman, K. and F. Botelho, "Pavement Management Trends in the United States," 1st European Pavement Management Systems Conference, Budapest, September, 2000.
3. Munnell, Alicia, "Is There a Shortfall in Public Capital Investment?" Proceedings of a Conference Held in June, 1990.

21PCE07	GREEN BUILDING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop knowledge on environmental implications of buildings.
- To apply the implications of building technologies in embodied energy of buildings.
- To make use of knowledge on comforts in building.
- To discover utility of solar energy in buildings.
- To interpret the concept of green composites for buildings.

UNIT I	**ENVIRONMENTAL IMPLICATIONS OF BUILDINGS**	9

Energy use, carbon emissions, water use, waste disposal; Building materials: sources, methods of production and environmental Implications. Embodied Energy in Building Materials: Transportation Energy for Building Materials; Maintenance Energy for Buildings.

UNIT II	**IMPLICATIONS OF BUILDING TECHNOLOGIES EMBODIED ENERGY OF BUILDINGS**	9

Framed Construction, Masonry Construction. Resources for Building Materials, Alternative concepts. Recycling of Industrial and Buildings Wastes. Biomass Resources for buildings.

UNIT III	**COMFORTS IN BUILDING**	9

Thermal Comfort in Buildings- Issues; Heat Transfer Characteristic of Building Materials and Building Techniques. Incidence of Solar Heat on Buildings-Implications of Geographical Locations.

UNIT IV	**UTILITY OF SOLAR ENERGY IN BUILDINGS**	9

Utility of Solar energy in buildings concepts of Solar Passive Cooling and Heating of Buildings. Low Energy Cooling. Case studies of Solar Passive Cooled and Heated Buildings.

UNIT V	**GREEN COMPOSITES FOR BUILDINGS**	9

Concepts of Green Composites. Water Utilisation in Buildings, Low Energy Approaches to Water Management. Management of Solid Wastes. Management of Sullage Water and Sewage. Urban Environment and Green Buildings. Green Cover and Built Environment.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1 : Interpret knowledge on environmental implications of buildings.

CO2: Relate the implications of building technologies in embodied energy of buildings.

CO3: Develop knowledge on comforts in buildings.

CO4: Identify utility of solar energy in buildings.

CO5: Illustrate the green composites for buildings.

TEXT BOOKS:

1. K.S.Jagadish, B. U. Venkataramareddy and K. S. Nanjundarao, "Alternative Building Materials and Technologies", 2nd Edition, New Age International Private Limited, 2017.
2. Ursula Eicker, "Low Energy Cooling For Sustainable Buildings", John Wiley and Sons Ltd, 2009.
3. "Sustainable Building Design Manual-Vol 1 and 2", TERI, New Delhi, 2004.

REFERENCES:

1. Osman Attmann, "Green Architecture Advanced Technologies and Materials", 1st Edition, McGraw Hill, 2010.
2. Jerry Yudelson, "Green building Through Integrated Design", 1st Edition, McGraw Hill, 2008.
3. Marian Keeler and Bill Burke, "Fundamentals of Integrated Design for Sustainable Building", John Wiley & sons, 2009.

VERTICAL-II: GEOTECHNICAL

21PCE08	GEO SYNTHETICS IN CIVIL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To choose the evolution of new construction materials in geotechnical engineering and to initiate geosynthetic materials.
- To identify the properties and the testing methods of different types of materials of geosynthetics.
- To classify manufacturing methods, uses and applications of geotextiles, geogrids, geomembranes and geocomposites.
- To show the functions of separation, reinforcement, stabilization, filtration, drainage and moisture barriers and other applications of geosynthetics
- To illustrate design criteria of reinforced earth retaining walls, gabions, pond liners, covers for reservoirs, canal liners, landfill liners, caps and closures, dams and embankments.

UNIT I	GEOSYNTHETICS	9

Basic description – Polymeric materials– Uses and Applications. Properties of Geotextiles – Geogrids – Geomembranes – Geocomposites.

UNIT II	GEOTEXTILES	9

Design criteria for Separation – Reinforcement – Stabilization – Filtration – Drainage and Moisture barriers. Geogrids: Designing for Reinforcement – Stabilization – Designing Gabions – Construction methods.

UNIT III	USE OF GEOSYNTHETICS IN ROADS	9

Geosynthetics in road ways- applications role of subgrade conditions-design criteria-survivability-application in paved roads.

UNIT IV	REINFORCED EARTH RETAINING WALLS	9

Components - External stability – Internal stability-Design of reinforced earth walls with strip, sheet and grid reinforcement

UNIT V	GEOMEMBRANES AND NATURAL GEOTEXTILES	9

Pond Liners – Covers for Reservoirs – Canal Liners – Landfill Liners– Caps and closures, moisture barriers. Geocomposites: An added advantage – Geocomposites in Separation – Reinforcement – Filtration – Geocomposites as Geowebs and Geocells - Natural fibres as geotextiles- factors governing the use of fibres-coir geotextiles-bamboo/timber-combination of geotextiles.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Utilize the need and demand for the use of geosynthetic materials in the field of geotechnical construction works.

CO2: Select the Experiments on laboratory and field tests to obtain the properties of different materials of geosynthetics.

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CO3: Relate various manufacturing methods of geotextiles, geogrids, geomembranes, natural geotextiles and geocomposites.

CO4: Make use of the concepts and design the geosynthtics for the functions of separation, reinforcement, stabilization, filtration, drainage and moisture barriers.

CO5: Develop designs for reinforced earth retaining walls, gabions, pond liners, covers for reservoirs, canal liners, landfill liners, caps and closures.

TEXT BOOKS:

1. Robert M. Koerner, "Designing with Geosynthetics", 6th Edition, Pearson Prentice Hall, 2012.
2. SivakumarBabu.G.L, "An Introduction to Soil Reinforcement and Geosynthetics", 1st Edition Universities Press (India) Pvt. Ltd., 2009.
3. Venkatappa Rao.G and Suryanarayana Raju GVS, "Engineering with Geosynthetics", Tata McGraw Hill Publishing Company Limited – New Delhi, 1990.

REFERENCES:

1. Robert M. Koerner and Josoph P. Welsh, "Construction and Geotechnical Engineering using Synthetic Fabrics", 1st Edition, John Willey and Sons, New York, 1980.
2. Bowles.J.E, "Foundation Analysis and Design", 5th Edition, McGraw Hill Publications, 2001.
3. Swami Saran, "Analysis and Design of Substructures: Limit State Design", 2nd Edition, Oxford & IBH Publishing Co Pvt.Ltd, 2018.

21PCE09	GROUND IMPROVEMENT TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify the various methods and selection of ground improvement techniques.
- To interpret different dewatering techniques and design for simple cases.
- To select in situ treatment of cohesion less and cohesive soils.
- To apply the concept of earth reinforcement and design of reinforced earth.
- To classify types of grouts and grouting techniques.

UNIT I	PROBLEMATIC SOIL AND IMPROVEMENT TECHNIQUES	8

Role of ground improvement in foundation engineering – Methods of ground improvement – Geotechnical problems in alluvial, lateritic and black cotton soils – Selection of suitable ground improvement techniques based on soil conditions.

UNIT II	DEWATERING	10

Dewatering Techniques - Well points – Vacuum and electro osmotic methods – Seepage analysis for two dimensional flows for fully and partially penetrated slots in homogeneous deposits – Design for simple cases.

UNIT III	INSITU TREATMENT OF COHESIONLESS AND COHESIVE SOILS	10

Insitu densification of cohesionless soils – Shallow as deep compaction – Dynamic compaction -

Vibroflotation, Sand compaction piles and deep compaction. Consolidation of cohesionless soils - Preloading with sand drains, and fabric drains, Stabilization of soft clay ground using stone columns and Lime piles-Installation techniques – Simple design - Relative merits of above methods and their limitations.

UNIT IV	EARTH REINFORCEMENT	9

Concept of reinforcement – Types of reinforcement material – Reinforced earth wall – Mechanism – Simple design - Applications of reinforced earth; Functions of Geotextiles in filtration, drainage, separation, road works and containment applications.

UNIT V	GROUTING TECHNIQUES	8

Types of grouts – Grouting equipments and machinery – Injection methods – Grout monitoring – Stabilization with cement, lime and chemicals – Stabilization of expansive soil.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Utilize various methods and selection of ground improvement techniques.

CO2: Make use of dewatering techniques and design for simple cases.

CO3: Apply in situ treatment of cohesion less and cohesive soils.

CO4: Interpret the concept of earth reinforcement and design of reinforced earth.

CO5: Compare various types of grouts and grouting techniques.

TEXT BOOKS:

1. Purushothama Raj. P, "Ground Improvement Techniques", 2nd Edition, Lakshmi Publications, 2016.
2. NiharRanjanPatra, "Ground Improvement Techniques", 1st Edition, Vikas Publishing House, 2012.
3. Mittal.S, "An Introduction to Ground Improvement Engineering", 1st Edition, Medtech Publisher, 2013.

REFERENCES:

1. Das, B.M., "Principles of Foundation Engineering", 7th Edition, Cengage learning, 2010.
2. Coduto, D.P., "Geotechnical Engineering – Principles and Practices", 1st Edition, Prentice Hall of India Pvt.Ltd. New Delhi, 2011.
3. Koerner, R.M., "Designing with Geosynthetics" 6th Edition, Xlibris Corporation, U.S.A, 2012.
4. IS Code 9759: 1981 (Reaffirmed 1998) "Guidelines for Dewatering During Construction", Bureau of Indian Standards, New Delhi.
5. IS Code 15284 (Part 1): 2003 "Design and Construction for Ground Improvement – Guidelines" (Stone Column), Bureau of Indian Standards, New Delhi.

21PCE10	SOIL DYNAMICS AND MACHINE FOUNDATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the theory and measurement of vibration.
- To make use of the concept of wave propagation in infinite medium in the design of machine foundation.
- To identify dynamic properties of soils and laboratory and field testing.
- To interpret the design of foundation for different types of machines.
- To illustrate about the liquefaction, motion isolation and vibration control.

UNIT I	THEORY OF VIBRATION	9

Introduction – Nature dynamic loads – Vibrations of single degree freedom system – Free vibrations of spring – mass systems – Forced vibrations – Viscous damping - Transmissibility – Principles of vibration measuring instruments – Effect of Transient and Pulsating loads.

UNIT II	WAVE PROPAGATION	9

Elastic waves in rods of infinite length – Longitudinal and Torsional – Effect of end conditions – Longitudinal and torsional vibrations of rods of finite length – Wave Propagation in infinite, homogeneous isotropic and elastic medium - Wave propagation in elastic half space – Typical values of compress wave and shear wave velocity – Wave propagation due to Machine foundation – Surface wave – Typical values – Particle movements and velocity.

UNIT III	DYNAMIC PROPERTIES OF SOILS	9

Dynamic stress – Strain characteristics – Principles of measuring dynamic properties – Laboratory Techniques – Field tests – Factors affecting dynamic properties – Typical values – Dynamic bearing capacity – Dynamic earth pressure.

UNIT IV	FOUNDATION FOR DIFFERENT TYPES OF MACHINES	9

Types of machines and foundation – General requirements – Modes of vibration of a rigid foundation – Method of analysis – Linear elastic weightless spring method – Elastic half space method – Analog Method – Design of block foundation – Special consideration for rotary, Impact type of machines – Codal Provisions.

UNIT V	INFLUENCE OF VIBRATION AND REMEDIATION	9

Mechanism of Liquefaction – Influencing factors – Evaluation of Liquefaction potential based on SPT-Force Isolation – Motion Isolation – Use of spring and damping materials – Vibration control of existing machine foundation – Screening of vibration – Open trenches – Pile Barriers – Salient construction aspects of machine Foundations.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the theory and measurement of vibration.

CO2: Utilize the concept of wave propagation in infinite medium and design machine foundation.

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CO3: Identify dynamic properties of soils by laboratory techniques and field testing.

CO4: Develop the types of foundation for different machines.

CO5: Identify the influence of vibrations and remediation.

TEXT BOOKS:

1. Swamisaran, "Soil Dynamics and Machine Foundations", 3rd Edition, Galgotia Publications Pvt.Ltd. New Delhi-110002, 2016.
2. Srinivasulu.P, and Vaidyanathan.C.V , "Handbook of Machine Foundations", Tata McGraw-Hill, 2007.
3. Braja M. Das, G.V. Ramana "Principles of soil dynamics", 2nd Edition, Cengage Learning, 2010.

REFERENCES:

1. IS Code 5249: 1992 (Reaffirmed 2006) "Determination of Dynamic Properties of Soil – Method of Test" Bureau of Indian Standards, New Delhi.
2. IS Code 2974: (Part 1) 1982 (Reaffirmed 2008) "Code of Practice for Design and Construction of Machine Foundations - Foundation for Reciprocating Type Machines" Bureau of Indian Standards, New Delhi.
3. IS Code 2974: (Part 2) 1980 (Reaffirmed 2008) "Code of Practice for Design and Construction of Machine Foundations - Foundations for Impact Type Machines (Hammer Foundations)" Bureau of Indian Standards, New Delhi.

21PCE11	REINFORCED EARTH STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify and formulate reinforced earth techniques that is suitable for different soils and different structures.
- To model reinforced earth retaining walls and understand soil nailing concepts.
- To interpret the load carrying capacity of foundations resting on reinforced earth soil bed.
- To apply geosynthetics in stabilization of roads and slopes.
- To use geosynthetics in drainage and landfill designs.

UNIT I	BASICS OF REINFORCED EARTH CONSTRUCTION	9

Definition, Historical Background, Components, Mechanism and Concept, Advantages and Disadvantage of reinforced earth Construction, Sandwich technique for clayey soil.- Historical developments, Recent developments, manufacturing process woven & non-woven, Raw materials – Classification based on materials type – Metallic and Non-metallic, Natural and Man-made, Geosynthetics- Physical, Chemical, Mechanical, Hydraulic, Endurance and Degradation requirements, Testing & Evaluation of properties

UNIT II	DESIGN OF REINFORCED EARTH RETAINING WALLS	9

Concept of Reinforced earth retaining wall, Internal and external stability, Selection of materials, Typical design problems- Concept, Advantages & limitations of soil nailing techniques, comparison

of soil nailing with reinforced soil, methods of soil nailing, Construction sequence, Components of system, Design aspects and precautions to be taken.		
UNIT III	**DESIGN OF REINFORCED EARTH FOUNDATIONS**	**9**
Modes of failure of foundation, Determination of force induced in reinforcement ties – Location of failure surface, tension failure and pull out resistance, length of tie and its curtailment, Bearing capacity improvement in soft soils, General guidelines		
UNIT IV	**GEOSYNTHETICS FOR ROADS AND SLOPES**	**9**
Roads - Applications to Temporary and Permanent roads, Role of Geosynthetic in enhancing properties of road, control of mud pumping, Enhancing properties of subgrade, Design requirements Slopes – Causes for slope failure, Improvement of slope stability with Geosynthetic, Drainage requirements, Construction technique. Simple Numerical Stability Checking Problems on Reinforced Slopes		
UNIT V	**GEOSYNTHETICS - FILTER, DRAIN AND LANDFILLS**	**9**
Filter & Drain – Conventional granular filter design criteria, Geosynthetic filter design requirements, Drain and filter properties, Design criteria – soilretention, Geosynthetic permeability, anti-clogging, survivability and durability (No Numerical Problems) Landfills – Typical design of Landfills – Landfill liner & cover, EPA Guidelines, Barrier walls for existing landfills and abandoned dumps		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of reinforced earth techniques that are suitable for different soils and different structures

CO2: Construct reinforced earth retaining structures and utilize soil nailing concepts

CO3: Apply the load carrying capacity of foundations resting on reinforced earth soil bed.

CO4: Choose geosynthetics for stabilization of roads and slopes.

CO5: Utilize geosynthetics in drainage and landfill designs.

TEXT BOOKS:

1. Swami Saran, "Reinforced Soil and its Engineering Applications", 3rd Edition, I. K. International Pvt. Ltd, New Delhi, 2017.
2. SivakumarBabu G. L., "An introduction to Soil Reinforcement and Geosynthetics", 1st Edition, Universities Press, Hyderabad, 2006.
3. Venkattappa Rao, G., & Suryanarayana Raju., G.V.S, "Engineering with Geosynthetics", Tata McGraw Hill publishing Company Limited., New Delhi, 2018.

REFERENCES:

1. Jones, "Earth reinforcement and Soil structure", Subsequent Edition, CJEP Butterworths, London, 2013.
2. Ingold, T.S, "Reinforced Earth", Thomas, Telford, London, 1982.
3. Sarsby R W- Editor, "Geosynthetics in Civil Engineering", 1st Edition, Woodhead Publishing Ltd & CRC Press, 2007

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21PCE12	ROCK ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the fundamentals of rock mechanics and its classifications for the Engineering purposes.
- To interpret the knowledge on the Rock strength and its mechanical properties.
- To identify the initial stresses and distribution of rocks using different methods.
- To select the application of rock mechanics in the Engineering applications.
- To choose the principles and support reactions on rock stabilizations.

UNIT I	CLASSIFICATION AND INDEX PROPERTIES OF ROCKS	9

Geological classification – Index properties of rock systems – Classification of rock masses for engineering purpose – Rock Mass Rating and Q System.

UNIT II	ROCK STRENGTH AND FAILURE CRITERIA	9

Modes of rock failure – Strength of rock – Laboratory measurement of shear, tensile and compressive strength. Stress - strain behaviour of rock under Hydrostatic compression and deviatoric loading – Mohr –Coulomb failure criteria and Hoek and Brown empirical criteria.

UNIT III	INITIAL STRESSES AND THEIR MEASUREMENTS	9

Estimation of initial stresses in rocks – influence of joints and their orientation in distribution of stresses – measurements of in-situ stresses – Hydraulic fracturing – Flat jack method – Over coring method.

UNIT IV	APPLICATION OF ROCK MECHANICS IN ENGINEERING	9

Simple engineering application – Underground openings – Rock slopes – Foundations and mining subsidence.

UNIT V	ROCK STABILISATION	9

Introduction – Rock support and Rock reinforcement – Principles – Support reaction curves – Shotcreting.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Relate the index properties of rock systems.

CO2: Show the modes of failure, stress-strain characteristics, and failure criteria of rocks.

CO3: Calculate the stresses in rocks.

CO4: Utilize rock mechanics in engineering.

CO5: Identify the principles and support reactions on rock stabilizations.

TEXT BOOKS:

1. Ramamurthy T., "Engineering in Rocks for Slopes Foundations and Tunnels", 3rd Edition,PHI Learning Pvt. Ltd.,2014.
2. Goodman, P.E. "Introduction to Rock Mechanics", 2nd Edition, John Wiley and Sons, 1999.
3. Stillborg B., "Professional User Handbook for rock Bolting", Tran Tech Publications, 1996.

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REFERENCES:
1. Brady, B.H.G. and Brown, E.T., "Rock mechanics for underground mining", 3rd Edition Kluwer Academic Publishers, Dordrecht, 2006.
2. Brown, E.T. "Rock Characterisation Testing and Monitoring". Pergaman Press 1991.
3. Arogyaswamy, R.N.P., "Geotechnical Application in Civil Engineering", 1st Edition, Oxford and IBH, 1991.

21PCE13	TUNNELING ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:
- To apply the scope and background of tunnel engineering to underground excavations.
- To interpret knowledge on types of tunnels and tunneling methods.
- To identify drilling and blasting tunneling method.
- To choose methods of tunneling
- To illustrate the supports in tunneling procedures with ground treatment, tunneling services and its hazards

UNIT I	INTRODUCTION	9

Scope and application, historical developments, art of tunneling, tunnel engineering, future tunneling considerations. Types of Underground Excavations - Tunnel, adit, decline, shaft; parameters influencing location, shape and size; geological aspects; planning and site investigations.

UNIT II	TUNNELING METHODS	9

Types and purpose of tunnels - factors affecting choice of excavation technique; Methods – soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered in tunneling and remedial measures.

UNIT III	TUNNELING BY DRILLING AND BLASTING	9

Unit operations in conventional tunneling; Drilling – drilling principles, drilling equipment, drilling tools, drill selection, rock drillability factors; Blasting – explosives, initiators, blasting mechanics, blast hole nomenclature; types of cuts- fan, wedge and others; blast design, tunnel blast performance – powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.

UNIT IV	TUNNELING BY ROADHEADERS AND IMPACT HAMMERS	9

Cutting principles, method of excavation, selection, performance, limitations and problems. Tunneling by Tunnel Boring Machines - Boring principles, method of excavation, selection, performance, limitations and problems; TBM applications.

UNIT V	SUPPORTS IN TUNNELS	9

Different types of supports in tunneling and their applicability, NATM. Ground Treatment inTunneling: Adverse ground conditions and its effect on tunneling; introduction to groundcontrol.

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Tunnel Services - Ventilation, drainage and pumping. Tunneling Hazards - Explosion,flooding, chimney formation, squeezing ground

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify tunneling and the types of underground excavations

CO2: Utilize the methods of tunneling with respect to the types of tunnels

CO3: Apply the conventional tunneling method - Drilling and blasting

CO4: Select the cutting principles and machines used for borings.

CO5: Make use of the types of supports in tunneling and ground treatment

TEXT BOOKS:

1. Srinivasan R, "Harbour, Dock and Tunneling Engineering", 30th edition, R. C. Pattii, Chal'otar Book Stall, Station Road TulsiSada, Arland (W. Rly), India, 2022.
2. Pokorovski, "Driving Horizontal Workings and Tunnel", Mir Publishers, 1980.
3. Hoek, E. and Brady, J. D. "Rock Slope Engineering", 4th Edition, Taylor and Francis, 2005.

REFERENCES:

1. Hoek, E., Brown, E, "Underground excavations in Rock", 1st Edition, CRC Press, 1980. (ebook - 2014).
2. Carlos L Jimeno, "Drilling and Blasting of Rocks", 1st Edition, A.A. Balkema/Rotterdam/Brookfield 1995.
3. Nick Barton, "Tunnel Boring Machines", 1st edition, 2000.

21PCE14	PILE FOUNDATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To classify the concepts of pile foundation.
- To illustrate the response of axial load capacity and settlement of piles and pile groups.
- To identify the importance of lateral and uplift load capacity of piles.
- To interpret and solve design techniques for deep foundations
- To develop knowledge on caissons.

UNIT I	PILE CLASSIFICATIONS AND LOAD TRANSFER PRINCIPLE	9

Necessity of pile foundation – classification of piles – Factors governing choice of type of pile – Load transfer mechanism – piling equipment and methods – effect of pile installation on soil condition – pile raft system – basic interactive analysis - criteria for pile socketing - responsibility of engineer and contractor

UNIT II	AXIAL LOAD CAPACITY OF PILES AND PILE GROUPS	9

Allowable load of piles and pile groups – Static and dynamic methods – for cohesive and cohesionless soil – negative skin friction – group efficiency – pile driving formulae - limitation –

Wave equation application – evaluation of axial load capacity from field test results – pile integrity test - Settlement of piles and pile group - codal provisions and IRC guide lines.		
UNIT III	**LATERAL AND UPLIFT LOAD CAPACITY OF PILES**	**9**
Piles under Lateral loads – Broms method, elastic, p-y curve analyses – Batter piles – response to moment – piles under uplift loads – under reamed piles – Drilled shaft – Lateral and pull out load tests – codal provision – IRC guide lines – case studies.		
UNIT IV	**STRUCTURAL DESIGN OF PILE AND PILE GROUPS**	**9**
Structural design of pile – structural capacity – pile and pile cap connection – pile cap design – shape, depth, assessment and amount of steel – truss and bending theory- Reinforcement details of pile and pile caps — pile subjected to vibration – codal provision – IRC guide line.		
UNIT V	**CAISSONS**	**9**
Necessity of caisson – type and shape - Stability of caissons – principles of analysis and design – tilting of caisson – construction - seismic influences - codal provision.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1: Identify the concepts of pile foundation and its classifications.

CO2: Make use of the response of axial load capacity and settlement of piles and pile groups.

CO3: Calculate lateral and uplift load capacity of piles.

CO4: Apply the design techniques for deep foundations

CO5: Utilize knowledge on caissons.

TEXT BOOKS:

1. Reese, L. C. and Van Impe, W. F., "Single Piles and Pile Groups under Lateral Loading", 2nd Edition, Taylor and Francis, London, 2011.
2. Reese,L.C., Isenhower,W.M. and Wang,S.T. "Analysis and Design of Shallow and Deep Foundations", 1st Edition, John Wiley and Sons, New York, 2005.
3. Tomlinson, M.J. "Foundation engineering", 1st Edition, ELBS, Longman Group, U.K. Ltd., England 1995.

REFERENCES:

1. Michael Tomlinson and John Woodward, "Pile design and construction practice", 5th Edition, Taylor & Francis Group, London & New York, 2008.
2. Varghese P.C., "Design of Reinforced Concrete Foundations", 1st Edition, PHI Learning Private Limited, New Delhi, 2009.
3. Varghese P.C., "Foundation Engineering", Kindle Edition, PHI Learning Private Limited, New Delhi, 2005.

T. P. Anil

VERTICAL-III: ENVIRONMENT

21PCE15	INDUSTRIAL WASTEWATER MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate the concept of industries in the Indian scenario.
- To apply knowledge in Pollution Prevention and Pollution Control.
- To identify physical, chemical, and biological phenomena for successful industrial wastewater treatment.
- To utilize the dynamic processes and understand the concept of wastewater reuse and residual management.
- To interpret the importance of the environment by assessing and envisioning its impact on the human world.

UNIT I | INTRODUCTION TO INDUSTRIAL WASTEWATER | 9

Industrial scenario in India – industrial activity and environment, uses of water by industry, sources and types of industrial wastewater. Regulatory requirements for treatment of industrial waste water, industrial waste survey, industrial waste water generation rates, characterization and variables, population equivalent.

UNIT II | INDUSTRIAL POLLUTION PREVENTION | 9

Prevention Vs Control of industrial pollution – benefits and barriers. Source reduction techniques – waste audit, evaluation of pollution prevention options, environmental statement as a tool for pollution prevention, waste minimization circles.

UNIT III | INDUSTRIAL WASTEWATER TREATMENT | 9

Equalization – neutralization, oil separation, flotation, precipitation, Aerobic and anaerobic biological treatment – sequencing batch reactors, high-rate reactors (Recall) Advanced Chemical oxidation – Electro chemical oxidation, wet air oxidation, ozonation, photocatalysis, Other Treatment Processes Heavy metal removal, Refractory organics separation by adsorption. ion exchange, membrane technologies, nutrient removal.

UNIT IV | WASTEWATER REUSE AND RESIDUAL MANAGEMENT | 9

Evaporation- Evaporators types and classification. Zero effluent discharge systems - Quality requirements for wastewater reuse, industrial reuse, disposal on water and land. Residuals from industrial wastewater treatment units - quantification and characteristics of sludge – thickening, digestion, conditioning, dewatering and disposal of sludge. Management of RO rejects. Individual and common effluent treatment plants – combined treatment of industrial waste water and domestic/municipal wastewater.

UNIT V | CASE STUDIES | 9

Industrial manufacturing process description, waste water characteristics, source reduction options and waste treatment flow sheet for textiles, tanneries, pulp and paper, metal finishing, sugar and distilleries.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

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BoS Chairman

At the end of the course, learners will be able to

CO1: Identify the of industrial wastewater and regulatory requirements for treatment.

CO2: Select a proper tool for industrial pollution prevention.

CO3: Develop appropriate treatment systems for the pollution generated from the industries.

CO4: Make use of the possible methods to reuse wastewater and manage the obtained residues.

CO5: Apply the knowledge obtained from various industries to face real time problems.

TEXT BOOKS:

1. Thirugnanasambandham and Karchiyappan, "Industrial Wastewater Treatment", Kindle Edition, Springer Nature, Switzerland AG, 2022.
2. Eckenfelder, W.W., "Industrial Water Pollution Control", 3rd Edition, McGraw – Hill, 2000.
3. Paul L. and Bishop "Pollution Prevention: - Fundamentals and Practice", 2nd Edition, McGraw – Hill International, 2004.

REFERENCES:

1. Frank Woodard, "Industrial Waste Treatment Handbook", Kindle Edition, Butterworth Heinemann, New Delhi, 2001.
2. World Bank Group, "Pollution Prevention and Abatement Handbook, Towards Cleaner Production", World Bank and UNEP, Washington.D.C, 1998.
3. Nemerrow N. L "Theories and practices of Industrial Waste Engineering", 1st Edition, PE Cunniff, McGraw Hill, New York, 2010.

21PCE16	AIR AND NOISE POLLUTION CONTROL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the basic principles on various aspects of atmospheric chemistry.
- To make use of key transformations and meteorological influence on air.
- To plan and control the air pollution with regulation on its scientific basis.
- To select the major sources and effects of Noise pollution.
- To identify and control the noise pollution with regulation on its scientific basis.

UNIT I	INTRODUCTION	9

Structure and composition of Atmosphere – Definition, Scope and Scales of Air Pollution – Sources and classification of air pollutants and their effect on human health, vegetation, animals, property, aesthetic value and visibility- Ambient Air Quality and Emission standards. Sources, types and control of indoor air pollutants.

UNIT II	METEOROLOGY	9

Effects of meteorology on Air Pollution – Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Atmospheric Diffusion Theories – Dispersion models, Plume rise.

UNIT III	CONTROL OF PARTICULATE AND GASEOUS CONTAMIN	9

Factors affecting Selection of Particulate Control Equipment – Gas Particle Interaction – Working principle – Gravity Separators, Centrifugal separators Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Factors affecting Selection of Gaseous contamination Control Equipment – Working principle – absorption, Adsorption, condensation, Incineration, Bio filters – Process control and Monitoring.

UNIT IV	FUNDAMENTALS OF NOISE POLLUTION	9

Sound power, Sound intensity and Sound pressure levels – Sources and Effects of Noise Pollution – Characterization of Noise from Construction, Mining, Transportation and Industrial Activities – Permissible noise levels in different zones – Noise standards and indices.

UNIT V	NOISE MONITORING AND CONTROL	9

Ambient and road traffic noise monitoring – Noise Control measures – Design of Sound Absorption, Acoustic Barrier, Vibration Isolation, Vibration Damping, Muffling, Personal Protector and Green Belt for noise attenuation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Plan a better environment by knowing the effects of Air Pollution.

CO2: Identify the effect of meteorology on air pollution.

CO3: Select the suitable methodology to control particulate and gaseous contaminants.

CO4: Build proper indoor environment by knowing the fundamentals of Noise Pollution.

CO5: Make use of knowledge about noise pollution to control them.

TEXT BOOKS:

1. Lawrence K. Wang, Norman C. Pareira, Yung Tse Hung, "Air Pollution Control Engineering", Tokyo, 2004.
2. Rao M N and Rao H V N "Air Pollution", 1st Edition, Tata McGraw-Hill, New Delhi, 2007.
3. "Environmental Noise Pollution" – PE Cunniff, 1st Edition , McGraw Hill, New York, 2021.

REFERENCES:

1. Noel de Nevers, "Air Pollution Control Engineering", 2nd Edition, McGraw Hill, New York, 1995.
2. Anjaneyulu. Y, "Air Pollution and Control Technologies", 2nd Edition, Allied Publishers (P) Ltd., India 2002.
3. Bruel & Kjaer, "Noise Control: Principles and Practices", 2nd Edition, B & K Pub., Denmark, 1982.

21PCE17	SOLID AND HAZARDOUS WASTE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify sources, classification and regulatory framework for solid and hazardous waste.
- To interpret the characteristics of different types of solid and hazardous wastes.
- To choose the methods of collection, storage and transport for solid wastes

- To select the suitable waste processing technologies
- To plan suitable technical solutions for disposal of municipal and industrial waste

UNIT I	SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK	9

Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management –Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management.

UNIT II	WASTE CHARACTERIZATION AND SOURCE REDUCTION	9

Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse.

UNIT III	STORAGE, COLLECTION AND TRANSPORT OF WASTES	9

Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport.

UNIT IV	WASTE PROCESSING TECHNOLOGIES	9

Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes- treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment.

UNIT V	WASTE DISPOSAL	9

Waste disposal options – Disposal in landfills - Landfill Classification, types and methods – site selection - design and operation of sanitary landfills, secure landfills and landfill bioreactors – leachate and landfill gas management – landfill closure and environmental monitoring – Rehabilitation of open dumps – landfill remediation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of the role legislation and policy drivers play in stakeholders' response to the waste.

CO2: Organize the composition of solid waste generated from the community.

CO3: Utilize the collection methods and transport modes of generated solid waste.

CO4: Relate the various processing technologies for solid waste management.

CO5: Select appropriate disposal methods for environmental safety.

TEXT BOOKS:

1. George Tchobanoglous et al., "Integrated Solid Waste Management: Engineering Principles and

Management Issues", International Edition, McGraw Hill Publishers, New York, 1993.

2. Michael D. et al., "Environmental Resources Management", Kindle Edition, Hazardous waste Management, Mc-Graw Hill International Edition, New York, 2001.
3. Vesilind P.A, et al., "Solid waste Engineering", 1st Edition, Thomson Learning Inc., Singapore, 2002.

REFERENCES:

1. "Manual on Municipal Solid Waste Management", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000.
2. Bhide, A. D. and Sundaresan, B. B. "Solid Waste Management Collection, Processing and Disposal", NEERI, Nagpur, 2001.
3. Paul T Williams, "Waste Treatment and Disposal", 2nd Edition, John Wiley and Sons, England, 2005.

21PCE18	ENVIRONMENTAL IMPACT ASSESSMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop knowledge on Environmental regulation and legislations.
- To identify and predict environmental impacts.
- To relate social and economic impact.
- To prepare environmental management and monitoring plan.
- To apply knowledge to assess impacts of similar projects based on case studies.

UNIT I	INTRODUCTION	9

Historical development of Environmental Impact Assessment (EIA). Environmental Clearance- EIA in project cycle. Legal and regulatory aspects in India – types and limitations of EIA –EIA process- screening – scoping - terms of reference in EIA- setting – analysis – mitigation. Cross sectoral issues –public hearing in EIA- EIA consultant accreditation.

UNIT II	IMPACT INDENTIFICATION AND PREDICTION	9

Matrices – networks – checklists – cost benefit analysis – analysis of alternatives – expert systems in EIA. prediction tools for EIA – mathematical modeling for impact prediction – assessment of impacts – air – water – soil – noise – biological — cumulative impact assessment.

UNIT III	SOCIO-ECONOMIC IMPACT ASSESSMENT	9

Socio-economic impact assessment - relationship between social impacts and change in community and institutional arrangements. Factors and methodologies- individual and family level impacts. communities in transition-rehabilitation.

UNIT IV	EIA DOCUMENTATION AND ENVIRONMENTAL MANAGEMENT PLAN	9

Environmental management plan - preparation, implementation and review – mitigation and rehabilitation plans – policy and guidelines for planning and monitoring programmes – post project audit – documentation of EIA findings – ethical and quality aspects of environmental impact

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assessment.

UNIT V	CASE STUDIES	9

Mining, power plants, cement plants, highways, petroleum refining industry, storage & handling of hazardous chemicals, common hazardous waste facilities, CETPs, CMSWMF, building and construction projects.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Utilize the environmental clearance, its legal procedure, need of EIA, its types, stakeholders and their roles.

CO2: Make use of various impact identification methodologies, prediction techniques and model of impacts on various environments.

CO3: Build relationship between social impacts and change in community due to development activities and rehabilitation methods.

CO4: Organize the EIA findings and prepare environmental management and monitoring plan.

CO5: Identify, predict and assess impacts of similar projects based on case studies.

TEXT BOOKS:

1. EIA Notification including recent amendments, by Ministry of Environment, Forest and Climate Change, Government of India, 2006.
2. Sectoral Guidelines under EIA Notification by Ministry of Environment, Forest and Climate Change, Government of India, 2020.
3. Lawrence, D.P., "Environmental Impact Assessment – Practical solutions to recurrent problems", Wiley–Blackwell, 2005.

REFERENCES:

1. Sam Mannan, Lees' Loss Prevention in the Process Industries, Hazard Identification Assessment and Control, 4th Edition, Butterworth Heineman, 2012.
2. Lee N. and George C." Environmental Assessment in Developing and Transitional Countries", 1st Edition, Wiley, 2000.
3. World Bank –Source book on EIA, 1999.

21PCE19	ENVIRONMENT, HEALTH AND SAFETY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify environmental hazards in communities and occupational health and hygiene in work place.
- To develop safety practices and environmental issues in construction.
- To identify potential hazards and prepare a risk assessment report for highly polluting industries.
- To apply work place safety acts and rules and establishes safety systems for any industry.

- To utilize complete knowledge about Health and safety.

UNIT I	INTRODUCTION TO OCCUPATIONAL HEALTH AND HYGIENE	9
Need for developing Environment, Health and Safety systems in work places-Status and relationship of Acts, Regulations and Codes of Practice-Role of trade union safety representatives and international initiatives-Ergonomics and work place. Occupational health and hygiene: Definition of the term occupational health and hygiene-Categories of health hazards-Exposure pathways and human responses to hazardous and toxic substances-Advantages and limitations of environmental monitoring and occupational exposure limits-Hierarchy of control measures for occupational health risks-Role of personal protective equipment and the selection criteria-Effects on humans, control methods and reduction strategies for noise, radiation and excessive stress, OHSAS ISO 18001 certification.		
UNIT II	**WORKPLACE SAFETY AND SAFETY SYSTEMS**	**9**
Features of the satisfactory design of work premises HVAC, ventilation-Safe installation and use of electrical supplies-Fire safety and first aid provision – construction safety management – environmental issues in management- construction safety provision at site – significance of human factors in the establishment and effectiveness of safe systems-Safe systems of work for manual handling operations.		
UNIT III	**TECHNIQUES OF ENVIRONMENTAL SAFETY**	**9**
Elements of a health and safety policy and methods of its effective implementation and review-Functions and techniques of risk assessment, inspections and audits-Investigation of accidents-Principles of quality management systems in health and safety management-Relationship between quality manuals, safety policies and written risk assessments-Records and other documentation required by an organization for health and safety-Industry specific EHS issues.		
UNIT IV	**SAFETY PRACTICES IN CONSTRUCTION**	**9**
Construction accidents, Construction safety management, Environmental issues in construction, Occupational and safety hazard assessment, Job site assessment, Safety in hand tools, Construction safety provision at site, operations of machineries, Hoisting apparatus and conveyors, Safety in the use of mobile cranes, Safety in demolition work, Fire hazards and preventing methods.		
UNIT V	**EDUCATION AND TRAINING**	**9**
Requirements for and benefits of the provision of information, instruction, training and supervision-Factors to be considered in the development of effective training programmes-Principles and methods of effective training-Feedback and evaluation mechanism.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Develop solution which will address the environmental hazards in communities and occupational health and hygiene in work place.

CO2: Choose proper safety practices to handle environmental issues in industries.

CO3: Identify potential hazards and prepare a risk assessment report for highly polluting industries.

CO4: Make use of work place safety acts and rules to establish safety systems for any industry.

CO5: Plan a training program which addresses the health and safety in Industrial environment.

TEXT BOOKS:

1. Bill Taylor, "Effective Environmental, Health, and Safety Management Using the Team Approach", 1st Edition, Culinary and Hospitality Industry Publications Services, 2005.
2. Nicholas P. Cheremisinoff and Madelyn L. Graffia, "Environmental and Health and Safety Management", William Andrew Inc. NY, 2013.
3. Gupta Anil K, Sreeja S. Nair, "Environmental Knowledge for Disaster Risk Management", 1st Edition, NIDM, New Delhi, 2011.

REFERENCES:

1. Brian Gallant, "The Facility Manager's Guide to Environmental Health and Safety", 1st Edition, Government Inst Publ., 2007.
2. Dan Hopwood and Steve Thompson, "Workplace Safety: A Guide for Small and Midsized Companies", 1st Edition", 2006.
3. Mansdorf S Z., "Handbook of Occupational Safety and Health", 3rd Edition, Wiley, 2019.

21PCE20	DISASTER MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret exposure to disasters, their significance and types.
- To identify and understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
- To build a preliminary understanding of approaches to Disaster Risk Reduction (DRR).
- To make use of institutional processes in the country.
- To choose rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity.

UNIT I	INTRODUCTION TO DISASTERS	9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global trends in disasters: urban disasters, pandemics, complex emergencies, Climate change- Do's and Don'ts during various types of Disasters.

UNIT II	APPROACHES TO DISASTER RISK REDUCTION (DRR)	9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority (SDMA) -- Early Warning System – Advisories from Appropriate Agencies.

UNIT III	INTER RELATIONSHIP BETWEEN DISASTER AND	9

	DEVELOPMENT	
Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.		
UNIT IV	DISASTER RISK MANAGEMENT IN INDIA	9
CHazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.		
UNIT V	DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS	9
Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the types of disasters, causes and their impact on the environment and society.

CO2: Select vulnerability and various methods of risk reduction measures as well as mitigation.

CO3: Solve the impact of developmental projects and the scenarios with respect to Indian context.

CO4: Develop hazard and vulnerability profile of India and the role of GIS and IT in the context of damage assessment.

CO5: Apply the disaster management strategies to their surroundings with potential disaster response.

TEXT BOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2019.
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012.
3. Gupta Anil K and Sreeja S. Nair, "Environmental Knowledge for Disaster Risk Management", 1st Edition, NIDM, New Delhi, 2011.

REFERENCES:

1. Govt. of India: Disaster Management Act, Government of India, New Delhi, 2005.
2. Government of India, National Disaster Management Policy, 2009
3. Kapur Anu, "Vulnerable India: A Geographical Study of Disasters", 1st Edition, IIAS and Sage Publishers, 2018.

21OCH01	CLIMATE CHANGE AND ITS IMPACTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To describe the impacts of greenhouse gases.
- To identify the effects of greenhouse effect and global warming.
- To predict the consequences of climate change.
- To apply the mitigation measures of climate change.
- To summarize the policies at international level.

UNIT I	**INTRODUCTION TO CLIMATE CHANGE**	9

Introduction – General issues of climate change – weather, climate and greenhouse gases – climate system –climate change scenario – factors determining Earth's temperature – human contribution.

UNIT II	**GLOBAL WARMING AND ITS IMPACTS**	9

Introduction – green house effect – global warming – sea level changes – ocean acidity – ocean temperatures – wild fire – Artic sea ice content – heat related mortality – Indian scenario – carbon credit – carbon footprint – total carbon emission trading-case studies.

UNIT III	**IMPACTS OF CLIMATE CHANGE**	9

Introduction –perception on climate change and its impacts – IPCC's perceptions–Wikipedia perceptions – Hypothetical perceptions– Impacts on nature – weather system – water resources–ecosystems – unusual events –agriculture-case studies.

UNIT IV	**CLIMATE CHANGE - MITIGATION AND ADAPTATION**	9

Introduction to climate change mitigation – early warning system - low carbon development – agriculture – forestry – Barriers to mitigation – Introduction to climate change adaptations – Adaptation strategies in agriculture – forestry – coastal region – waste water management – Synergies in adaptation and mitigation – linking adaptation and mitigation within climate policy mechanisms – climate risk management-case studies.

UNIT V	**INTERNATIONAL LEGAL AND POLICY FRAMEWORK FOR CLIMATE CHANGE- PROTOCOLS**	9

International Policy – Intergovernmental Panel On Climate Change (IPCC) – UN Framework Convention On Climate Change (UNFCCC) – United Nations Framework Convention on Climate Change – Kyoto Protocol – Paris Agreement – 2019 Climate Action Summit – Nobel Peace Prize – India: National Action Plan On Climate Change (NAPCC).

TOTAL: 45 PERIODS

COURSE OUTCOMES :

At the end of the course, learners will be able to

CO1: Discuss the issues of climate change.

CO2: Demonstrate the impact of global warming.

CO3: Summarize the perceptions of climate change.

CO4: Identify the methods of mitigating the climate change.

CO5: Illustrate the protocols of climate change.

TEXT BOOKS:

1. Colleen Murphy, Gordon Paolo, Robert McKim, "Climate Change and its Impacts-Risks and Inequalities", Springer Publications, 2018.
2. S. Jeevananda Reddy, "Climate Change and its Impacts: Ground Realities", BS Publications / BSP Books, Hyderabad, 2018.
3. Wei-Yin Chen, Maximilian Lackner and Toshio Suzuki, "Handbook of Climate Change Mitigation and Adaptation", 2nd Edition, Springer Publications, 2017.

REFERENCES:

1. N. NakiCeizovi, W.D. Arordhnus, R. Richels, F.L.Toth, "Integrative Assessment of Mitigation, Impacts, and Adaptation to Climate Change", IIASA Publications, Austria, 1994.
2. Seinfeld J.H. and Pandis S.N, "Atmospheric Chemistry and Physics-from Air Pollution to Climate Change", 3rd Edition, Wiley Publications, US, 2016.
3. Andreas Schmittner, "Introduction to Climate Science", Regan State University Press, 2018.

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VERTICAL-IV: STRUCTURES

21PCE21	PRESTRESSED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the concept and behavior of prestressing in a structure.
- To demonstrate the method of designing prestressed concrete beams for flexure and shear based on Indian standards.
- To build understanding of concept on deflection and the design concept of anchorage zone on prestressed concrete beams.
- To analyze and design composite and continuous beams.
- To identify the behavior of prestressed members subjected to tensile and compressive forces.

UNIT I	INTRODUCTION – THEORY AND BEHAVIOUR	9

Basic concepts – Advantages and disadvantages – Materials required – Systems and methods of prestressing – Analysis of sections – Stress concept – Strength concept – Load balancing concept – Effect of loading on the tensile stresses in tendons – Effect of tendon profile on deflections – Factors influencing deflections – Calculation of deflections – Short term and long term deflections - Losses of prestress – Estimation of crack width..

UNIT II	DESIGN FOR FLEXURE AND SHEAR	9

Basic assumptions of flexural design – Permissible stresses in steel and concrete as per I.S.1343 Code – Different Types of sections - Design of sections of Type I and Type II post-tensioned and pre tensioned beams – Check for flexural capacity based on I.S. 1343 Code – Influence of Layout of cables in post-tensioned beams – Location of wires in pre-tensioned beams – Design for shear based on I.S. 1343 Code

UNIT III	DEFLECTION AND DESIGN OF ANCHORAGE ZONE	9

Factors influencing deflections – Short term deflections of uncracked members – Prediction of long term deflections due to creep and shrinkage – Check for serviceability limit states. Determination of anchorage zone stresses in post-tensioned beams – design of anchorage zone reinforcement – Check for transfer bond length in pre-tensioned beams.

UNIT IV	COMPOSITE BEAMS AND CONTINUOUS BEAMS	9

Analysis and design of composite beams – Methods of achieving continuity in continuous beams – Analysis for secondary moments – Concordant cable and linear transformation – Calculation of stresses – Principles of design.

UNIT V	TENSION AND COMPRESSION MEMBERS	9

Role of prestressing in members subjected to Tensile forces and compressive forces - Design of tension and compression members – Tanks, pipes and poles – Partial prestressing – Definition, methods of achieving partial prestressing, merits and demerits of partial prestressing.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the behaviour of prestressed concrete members.

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CO2: Solve the prestressed concrete members for flexure and shear as per the relevant design code (IS 1343).

CO3: Calculate for the deflection of prestressed concrete members and design the anchorage zone.

CO4: Compare the concept of analyzes and design of composite beams and continuous beams.

CO5: Relate the behavior of prestressed members subjected to tensile and compressive forces.

TEXT BOOKS:

1. Krishna Raju N., "Prestressed concrete", 6th Edition, Tata McGraw Hill Company, New Delhi, 2018.
2. Pandit.G.S. and Gupta.S.P, "Prestressed Concrete", Kindle Edition, CBS Publishers and Distributers Pvt. Ltd, 2019.
3. Hurst.M.K., "Prestressed Concrete Design", 2nd Edition, CRC Press, 2017.

REFERENCES:

1. Rajagopalan.N, "Prestressed Concrete", 2nd Edition, Narosa Publishing House, 2017.
2. Dayaratnam.P., "Prestressed Concrete Structures", 5th Edition, Oxford and IBH, 2013.
3. Lin T.Y. and Ned.H.Burns, "Design of prestressed Concrete Structures", 3rd Edition, Wiley India Pvt. Ltd., New Delhi, 2013.
4. IS 1343:1980 (Reaffirmed 1999), Code of Practice for Prestressed Concrete, Bureau of Indian Standards, New Delhi, 2012.

21PCE22	REPAIR AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the approaches for maintenance and repair.
- To demonstrate the various patterns of fractures and moisture flow both within and outside.
- To relate the characteristics of special concrete.
- To discover appropriate ways for removing distressing from concrete and steel buildings.
- To choose appropriate repair options for various degradation.

UNIT I	MAINTENANCE AND REPAIR STRATEGIES	9

Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating damaged structure, causes of deterioration.

UNIT II	STRENGTH AND DURABILITY OF CONCRETE	9

Quality assurance for concrete–Strength, Durability- Cracks, different types, causes–Effects due to climate, temperature, Sustained elevated temperature, Corrosion.

UNIT III	SPECIAL CONCRETES	9

Polymer concrete, Sulphur infiltrated concrete, Fibre reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes.

UNIT IV	TECHNIQUES FOR REPAIR AND PROTECTION METHODS	9

Non-destructive Testing Techniques, Load Test for Stability-Epoxy injection, Shoring, Underpinning, Corrosion protection techniques–Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.

UNIT V	REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES	9

Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, leakage, earthquake-Transportation of Structures from one place to other –Structural Health Monitoring-demolition techniques-Engineered demolition methods-Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Use the importance of maintenance and assessment method of distressed structures.

CO2: Apply the concept to identify the strength and durability properties, their effects due to climate and temperature.

CO3: Interpret the properties and applications of special concretes.

CO4: Choose appropriate techniques for repair and protection methods.

CO5: Select the repair, rehabilitation and retrofitting of structures and demolition methods.

TEXT BOOKS:

1. Nandini Devi G, "Maintenance, Repair, Rehabilitation, and Retrofitting of Structures", Wiley India Pvt Ltd, 2021.
2. Vidivelli B, "Rehabilitation of Concrete Structures", 1st Edition, Standard Publishers Distributors, New Delhi, 2015.
3. Varghese.P.C, "Maintenance Repair and Rehabilitation & Minor works of building", Prentice Hall India Pvt Ltd, 2014.
4. Dr.Sumitra K, "Repair and Rehabilitation of structures", Kindle Edition, Sree kamalamani publications, 2018.

REFERENCES:

1. Guha P.K, "Maintenance and Repairs of Buildings", 2nd Revised Edition, New Central Book Agency Pvt. Ltd, Calcutta, 2011.
2. Dr.Rethaliya R P, "Repairs and Rehabilitation of Concrete Structures", 1st Edition, Atul Prakashan, 2019.
3. Bhattacharjee J, "Concrete Structures Repair Rehabilitation and Retrofitting", 1st Edition, CBS Publishers & Distributors Pvt. Ltd, 2019.

21PCE23	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate the importance of Prefabrication.
- To illustrate the process of prefabrication of various structural elements.
- To interpret the assembling and dismantling of prefabricated components.
- To relate the design considerations in the process of prefabrication.
- To choose the techniques in prefabrication to avoid collapse.

UNIT I	**INTRODUCTION**	**9**
Need for prefabrication – Principles of prefabrication – Modular coordination – Standarization – Materials – Systems – Production – Transportation – Erection.		
UNIT II	**PREFABRICATED COMPONENTS**	**9**
Behaviour and types of structural components – Large panel systems – roof and floor slabs – Walls panels - Beams - Columns - Shear walls.		
UNIT III	**DESIGN PRINCIPLES**	**9**
Design philosophy- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation - Demountable precast concrete systems.		
UNIT IV	**JOINTS AND CONNECTIONS IN STRUCTURAL MEMBERS**	**9**
Types of Joints – based on action of forces - compression joints - shear joints - tension joints - based on function - construction, contraction, expansion. Design of expansion joints - Dimensions and detailing - Types of sealants - Types of structural connections - Beam to Column - Column to Column - Beam to Beam - Column to foundation.		
UNIT V	**DESIGN FOR ABNORMAL LOADS**	**9**
Progressive collapse – Codal provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Relate modular construction and industrialised construction.

CO2: Apply principles and design philosophy of prefabricated elements.

CO3: Make use of the design considerations in the process of prefabrication.

CO4: Select the types of joints and connections of structural members.

CO5: Plan the appropriate techniques in prefabrication to avoid collapse.

TEXT BOOKS:

1. Alfred Steinle et.al., "Precast Concrete Structures", 2nd Edition, Wiley - Ernst & Sohn, Berlin, 2019.
2. Bruggeling A.S. G and Huyghe G.F, "Prefabrication with Concrete", 1st Edition, CRC Press, 1991
3. Lewitt. M, "Precast Concrete- Materials, Manufacture, Properties and Usage", Applied Science Publishers, London and New Jersey, 1982.

REFERENCES:

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1. Koncz T., "Manual of precast concrete construction", Vol. I, II and III, Bauverlag, GMBH, 1976.
2. "Handbook on Precast Concrete Buildings", Indian Concrete Institute, 2016.
3. "Structural design manual", Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 2009.

21PCE24	INTRODUCTION TO FINITE ELEMENT METHOD	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify the application and characteristics of Finite Element Method.
- To construct element characteristic equation and generation of global equation.
- To interpret numerical problems on beams and shafts.
- To demonstrate heat transfer problems.
- To apply suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axisymmetric problems.

UNIT I	INTRODUCTION TO FINITE ELEMENT METHOD	9

General steps of the finite element method. Engineering applications of finite element method. Advantages of the Finite Element Method. Boundary conditions: Homogeneous and non-homogeneous for structural, heat transfer and fluid flow problems. Potential energy method, Rayleigh Ritz method, Galerkin's method, Displacement method of finite element formulation. Convergence criteria, Discretisation process. Types of elements: 1D, 2D and 3D, Node numbering, Location of nodes. Interpolation models: Simplex, complex and multiplex elements, linear interpolation polynomials in terms of global coordinates 1D, 2D, 3D Simplex Elements.

UNIT II	INTRODUCTION TO THE STIFFNESS (DISPLACEMENT) METHOD	9

Introduction, Derivation of stiffness matrix, Derivation of stiffness matrix for a spring element, Assembly the total stiffness matrix by superposition. One-Dimensional Elements-Analysis of Bars and Trusses, Linear interpolation polynomials in terms of local coordinate's for1D, 2Delements.

UNIT III	BEAMS AND SHAFTS	9

Boundary conditions, Load vector, Hermite shape functions, Beam stiffness matrix based on Euler-Bernoulli beam theory, Examples on cantilever beams, propped cantilever beams, Numerical problems on simply supported, fixed straight and stepped beams using direct stiffness method with concentrated and uniformly distributed load. Torsion of Shafts: Finite element formulation of shafts, determination of stress and twists in circular shafts.

UNIT IV	HEAT TRANSFER	9

Basic equations of heat transfer: Energy balance equation, Rate equation: conduction, convection, radiation, 1D finite element formulation using vibration method, Problems with temperature gradient and heat fluxes, heat transfer in composite sections, straight fins.

UNIT V	AXISYMMETRIC SOLID ELEMENTS	9

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Derivation of stiffness matrix of axisymmetric bodies with triangular elements, Numerical solution of axisymmetric triangular element(s) subjected to surface forces, point loads, angular velocity, pressure vessels.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to

CO1: Make use of application and characteristics of Finite Element Method.

CO2: Experiment element characteristic equation and generation of global equation.

CO3: Solve numerical problems on beams and shafts.

CO4: Calculate heat transfer in composite sections.

CO5: Relate suitable boundary conditions to a global equation for bars, trusses, beams, circular shafts, heat transfer, fluid flow, axisymmetric problems.

TEXT BOOKS:

1. Daryl L. Logan, "A first course in the Finite Element Method", 6th Edition, Cengage Learning, 2016.
2. Sinigiresu S. Rao, "Finite Element Method in Engineering", 5th Edition, Pergaman Int. Library of Science, 2010.
3. Tirupathi R. Chandrupatla and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering", 4th Edition, Pearson Publisher, 2011.

REFERENCES:

1. C.S.Krishnamoorty, "Finite Element Analysis – Theory and Programming", 2nd Edition, Tata McGraw-Hill Education (India) Pvt, Limited, 2001.
2. David V. Hutton, "Fundamentals of Finite Element Analysis", 1st Edition, Tata McGraw-Hill Education (India) Pvt, Limited, 2017.
3. D. Maity, "Computer Analysis of Framed Structures", I.K. International Pvt. Ltd. New Delhi, 2013.

		L	T	P	C
21PCE25	**STEEL CONCRETE COMPOSITE STRUCTURES**	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- To develop knowledge on composite construction and composite behaviour of steel concrete composite structures.
- To prepare the design of composite beams, columns, floors, slabs and concrete filled steel tubes.
- To demonstrate the connection design of composite structures.
- To illustrate the behaviour of composite box girder bridges.
- To interpret composite construction and seismic behaviour of composite structures through case studies.

UNIT I	**THEORY OF COMPOSITES**	9

Introduction to steel - Concrete composite construction - Behaviour of composite structures - Composite construction - Design of composite beams.		
UNIT II	**DESIGN OF COMPOSITE MEMBERS**	**9**
Design of composite slabs, composite columns and composite trusses.		
UNIT III	**DESIGN OF CONNECTIONS**	**9**
Types of connections - Design of connections in the composite structures - Shear connections - Degree of shear connection - Partial shear interaction.		
UNIT IV	**COMPOSITE BOX GIRDER BRIDGES**	**9**
Introduction - Behaviour of box girder bridges - Design concepts.		
UNIT V	**SEISMIC BEHAVIOUR**	**9**
Case Studies on Steel-Concrete composite construction in buildings - Seismic behaviour of composite structures – sandwich structure – Behaviour and applications.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the behaviour of composite structures.

CO2: Calculate various composite structural elements such as beams, columns, floors, slabs and concrete filled steel tubes.

CO3: Interpret the connection behaviour and design.

CO4: Apply the behaviour of box girder bridges and design concepts of the same.

CO5: Relate the concepts of various structural elements and design concepts through case studies.

TEXT BOOKS:

1. Johnson R.P., "Composite Structures of Steel and Concrete", 4th Edition, Wiley - Blackwell Scientific Publications, 2018.
2. Oehers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental Behaviour", 1st Edition, Permagon Press, Oxford, 2013.
3. Narayanan. R, "Steel-Concrete Composite Structures Stability and Strength", 1st Edition, CRC Press, 2019.

REFERENCES:

1. Richard Liew J.Y, "Design of Steel-Concrete Composite Structures Using High-Strength Materials", 1st Edition, Woodhead Publishing, 2021.
2. INSDAG Materials, Volume I and II. 2000.
3. Course material of workshop on "Steel Concrete Composite structures" conducted by Anna University, 2007.

21PCE26	BRIDGE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret loads on bridges and selection of type of bridge for the site condition.

- To illustrate the super structure by various methods.
- To make use of the design of trussed bridge and plate girder bridges.
- To prepare the design of reinforced concrete slab and T beam bridges and prestressed concrete bridges.
- To use the appropriate sub structural systems, bearings and expansion joints for the bridges.

UNIT I	**INTRODUCTION**	9

History of bridges - Components of a bridge - Classification of road bridges - Selection of site and initial decision process - Survey and alignment; Geotechnical investigations and interpretations. River Bridge: Selection of Bridge site and planning - Collection of bridge design data - Hydrological calculation Road Bridges - IRC codes - Standard Loading for Bridge Design - Influence lines for statically determinate and indeterminate structures - Transverse distribution of Live loads among deck longitudinal - Load combinations for different working state and limit state designs Railway Bridges: Loadings for Railway Bridges; Railroad data. Pre-design considerations - Railroad vs. Highway bridges.

UNIT II	**SUPERSTRUCTURES**	9

Bridge decks – Structural forms and behaviour – Choices of superstructure types – Behaviour and modeling of bridge decks – Simple beam model – Plate model – Grillage method – Finite Element method - Different types of superstructure (RCC and PSC); Longitudinal Analysis of Bridge.- Transverse Analysis of Bridge - Temperature Analysis - Distortional Analysis - Effects of Differential settlement of supports - Reinforced earth structures.

UNIT III	**DESIGN OF STEEL BRIDGES**	9

Design of Truss Bridges – Design of Plate girder bridges.

UNIT IV	**DESIGN OF RC AND PRESTRESSED CONCRETE BRIDGES**	9

Design of slab bridges – T beam bridges – Prestressed Concrete bridges.

UNIT V	**SUBSTRUCTURE, BEARINGS AND EXPANSION JOINTS, PARAPETS AND RAILINGS**	9

Substructure - Pier; Abutment - Wing walls- Importance of Soil-Structure Interaction - Types of foundations - Open foundation- Pile foundation- Well foundation- Simply supported bridge- Continuous Bridge - Bearings and Expansion Joints - Different types of bridge bearings and expansion joints - Parapets and Railings for Highway Bridges.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify loads on bridges and selection of type of bridge for the site condition.

CO2: Relate the super structure by various methods.

CO3: Interpret the trussed bridge and plate girder bridges.

CO4: Illustrate reinforced concrete slab and T beam bridges and prestressed concrete bridges.

CO5: Prepare the appropriate sub structural systems, bearings and expansion joints for the bridges.

TEXT BOOKS:

1. Praveen Nagarajan, "Design of Concrete Bridges: As per latest IRC Codes", Wiley, 2020.

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2. Jagadeesh. T.R. and Jayaram. M.A., "Design of Bridge Structures", 2nd Edition, Prentice Hall of India Pvt. Ltd, Learning Pvt. Ltd., 2009.
3. Johnson Victor D., "Essentials of Bridge Engineering", 6th Edition, Oxford and IBH Publishing Co., New Delhi, 2019.
4. Krishna Raju. N, "Design of Bridges" 5th Edition, Oxford and IBH Publishing Co., New Delhi, 2019.

REFERENCES:

1. Rajagopalan. N. "Bridge Superstructure", Alpha Science International, 2006
2. Phatak D.R., "Bridge Engineering", SatyaPrakashan, New Delhi, 1990.
3. Ponnuswamy S., "Bridge Engineering", 3rd Edition, Tata McGraw-Hill, New Delhi, 1996.

21PCE27	STRUCTURAL DYNAMICS AND ASEISMIC DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To demonstrate the concept in the theory of vibrations.
- To solve multiple degree of freedom system.
- To identify the importance of elements of seismology.
- To illustrate the response of structure to earthquake.
- To apply suitable codes for design methodology.

UNIT I	THEORY OF VIBRATIONS	9

Concept of inertia and damping – Types of Damping – Difference between static forces and dynamic excitation – Degrees of freedom – SDOF idealisation – Equations of motion of SDOF system for mass as well as base excitation – Free vibration of SDOF system – Response to harmonic excitation – Impulse and response to unit impulse – Duhamel integral.

UNIT II	MULTIPLE DEGREE OF FREEDOM SYSTEM	9

Two degree of freedom system – Normal modes of vibration – Natural frequencies - Mode shapes - Introduction to MDOF systems – Decoupling of equations of motion – Concept of mode superposition.

UNIT III	ELEMENTS OF SEISMOLOGY	9

Causes of Earthquake – Geological faults – Tectonic plate theory – Elastic rebound – Epicentre – Hypocentre – Primary, shear and Raleigh waves – Seismogram – Magnitude and intensity of earthquakes – Magnitude and Intensity scales – Spectral Acceleration - Information on some disastrous earthquakes

UNIT IV	RESPONSE OF STRUCTURES TO EARTHQUAKE	9

Response and design spectra – Design earthquake – concept of peak acceleration – Site specific response spectrum – Effect of soil properties and damping – Liquefaction of soils – Importance of ductility – Methods of introducing ductility into RC structures.

UNIT V	DESIGN METHODOLOGY	9

IS 1893, IS 13920 and IS 4326 – Codal provisions – Design as per the codes – Base isolation techniques – Vibration control measures – Important points in mitigating effects of earthquake on structures.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the student will be able to:

CO1: Apply the concept of inertia in the theory of vibrations.

CO2: Interpret and solve multiple degree of freedom system.

CO3: Identify the methods of measuring seismic activity.

CO4: Relate the response of structures and effects of earthquake.

CO5: Utilize the codal provisions for aseismic design.

TEXT BOOKS:

1. Agarwal. P and Shrikhande. M, "Earthquake Resistant Design of Structure", 3rd Edition, Prentice Hall of India Pvt.Ltd., 2011.
2. Mario Paz and William Leigh, "Structural Dynamics Theory and Computation", 5th Edition, Kluwer Academic Publishers, 2006.
3. Chopra, A.K., "Dynamics of Structures – Theory and Applications to Earthquake Engineering", 2nd Edition, Pearson Education, 2003.

REFERENCES:

1. Biggs, J.M., "Introduction to Structural Dynamics", 1st Edition, McGraw–Hill Book Co., N.Y., 1964.
2. Dowrick, D.J., "Earthquake Resistant Design", 2nd Edition, John Wiley & Sons, London, 2009.
3. Clough R.W and Penzien. J, "Dynamics of Structures", 2nd Edition, McGraw Hill International Edition, 1995.

VERTICAL-V: WATER RESOURCES

21PCE28	GROUNDWATER ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To relate aquifer properties and its dynamics.
- To illustrate the exposure towards well design and practical problems of groundwater aquifers.
- To interpret the basics of ground water modelling.
- To develop the knowledge on groundwater quality concepts.
- To utilize the knowledge on groundwater conservation.

UNIT I HYDROGEOLOGICAL PARAMETERS 9

Introduction – Water bearing Properties of Rock – Type of aquifers - Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation– Ground water table fluctuation and its interpretations – Groundwater development and Potential in India – GEC norms.

UNIT II WELL HYDRAULICS 9

Objectives of Groundwater hydraulics – Darcy's Law - Groundwater equation – steady state flow – Dupuit Forchheimer assumption - Unsteady state flow - Theis method - Jacob method -Slug tests - Image well theory – Partial penetrations of wells.

UNIT III GROUNDWATER MANAGEMENT 9

Need for Management Model – Database for groundwater management –groundwater balance study – Introduction to Mathematical model – Conjunctive use – Collector well and Infiltration gallery.

UNIT IV GROUNDWATER QUALITY 9

Ground water chemistry - Origin, movement and quality - Water quality standards – Health and aesthetic aspects of water quality - Saline intrusion – Environmental concern and Regulatory requirements.

UNIT V GROUNDWATER CONSERVATION 9

Artificial recharge techniques – Remediation of Saline intrusion– Ground water management studies – Protection zone delineation, Contamination source inventory, remediation schemes - Ground water Pollution and legislation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply aquifer properties and its dynamics.

CO2: Solve exposure towards well design and practical problems of groundwater aquifers.

CO3: Develop the basics of ground water modelling.

CO4: Build the knowledge on groundwater quality concepts.

CO5: Utilize the importance of artificial recharge.

TEXT BOOKS:

1. Raghunath H.M., "Ground Water Hydrology", 4th Edition, New Age International (P) Limited,

New Delhi, 2021.
2. Todd D.K., "Ground Water Hydrology", 3rd Revised Edition, John Wiley and Sons, New York, 2011.
3. Saxena R.N and Gupta D.C, "Elements of Hydrology and Groundwater", PHI Learning, India, 2017.

REFERENCES:

1. Fitts R Charles, "Groundwater Science", 2nd Revised Edition, Elsevier, Academic Press, 2012.
2. Ramakrishnan, S, "Ground Water", 1st Edition, K.J. Graph arts, Chennai, 1998.
3. Vijay Pal Meena, "Ground Water Hydrology", 1st Edition, Oxford Book Company, India, 2022.

21PCE29	HYDROLOGY AND WATER RESOURCES ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify the key drivers on water resources, hydrological processes.
- To utilize the knowledge on integrated behaviour in catchments.
- To build and apply a range of hydrological models to surface water and groundwater problems.
- To prepare spatial analysis of rainfall data and design water storage reservoirs.
- To make use of the concept and methods of ground water management.

UNIT I	PRECIPITATION AND ABSTRACTIONS	9

Hydrological cycle- Meteorological measurements – Requirements, types and forms of precipitation - Rain gauges-Spatial analysis of rainfall data using Thiessen and Isohyetal methods-Interception - Evaporation. Horton"s equation, pan evaporation measurements and evaporation suppression - Infiltration-Horton"s equation - double ring infiltrometer, infiltration indices.

UNIT II	RUNOFF	9

Watershed, catchment and basin - Catchment characteristics - factors affecting runoff - Run off estimation using empirical – Strange's table and SCS methods – Stage discharge relationships- flow measurements- Hydrograph – Unit Hydrograph – IUH.

UNIT III	FLOOD AND DROUGHT	9

Natural Disasters-Flood Estimation- Frequency analysis- Flood control- Definitions of droughts- Meteorological, hydrological and agricultural droughts- IMD method-NDVI analysis- Drought Prone Area Programme (DPAP).

UNIT IV	RESERVOIRS	9

Classification of reservoirs, General principles of design, site selection, spillways, elevation – area - capacity - storage estimation, sedimentation - life of reservoirs – rule curve.

UNIT V	GROUNDWATER AND MANAGEMENT	9

Origin- Classification and types - properties of aquifers- governing equations – steady and unsteady flow - artificial recharge - RWH in rural and urban areas.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Relate the key drivers on water resources and hydrological processes.

CO2: Calculate runoff and discharge using empirical formula.

CO3: Estimate flood and analyze drought.

CO4: Plan and design water storage reservoirs.

CO5: Classify aquifers and know about artificial recharge of water bodies.

TEXT BOOKS:

1. Subramanya .K. "Engineering Hydrology", 5th Edition, Tata McGraw Hill, 2020.
2. Jayarami Reddy .P. "Hydrology", 1st Edition, Tata McGraw Hill, 2016.
3. Linsley, R.K. and Franzini, J.B. "Water Resources Engineering", 1st Edition, McGraw Hill International Book Company, 1995.

REFERENCES:

1. David Keith Todd. "Groundwater Hydrology", 1st Edition , John Wiley & Sons, Inc. 2007
2. VenTe Chow, Maidment, D.R. and Mays, L.W. "Applied Hydrology", 1st Edition, McGraw Hill International Book Company, 1998.
3. Raghunath .H.M., "Hydrology", 1st Edition, Wiley Eastern Ltd., 1998.

21PCE30	PARTICIPATORY WATER RESOURECS MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To relate the basic concepts of participatory water resource management.
- To organise farmers participation in water resources management.
- To show the issues related to water conservation and watershed Development.
- To demonstrate global challenges in participatory water conservation.
- To identify the concept, principle, approach of watershed management.

UNIT I	FUNDAMENTALS: SOCIOLOGY AND PARTICIPATORY APPROACH	9

Sociology – Basic concepts – Perspectives- Social Stratification – Irrigation as a Socio technical Process - Participatory concepts– Objectives of participatory approach.

UNIT II	UNDERSTANDING FARMERS PARTICIPATION	9

Farmers participation –need and benefits – Comparisons of cost and benefit -Sustained system performance - Kinds of participation – Context of participation, factors in the environment – WUA - Constraints in organizing FA – Role of Community Organiser – Case Studies.

UNIT III	ISSUES IN WATER MANAGEMENT	9

Multiple use of water – Issues in Inter -sectoral Water Allocation - domestic, irrigation, industrial sectors - modernization techniques – Rehabilitation – Command Area Development - Water delivery systems.

UNIT IV	PARTICIPATORY WATER CONSERVATION	9

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Global Challenges -Social – Economic – Environmental - Solutions –Political - Water Marketing – Water Rights -Consumer education – Success Stories Case Studies.		
UNIT V	**PARTICIPATORY WATERSHED DEVELOPMENT**	**9**
Concept and significance of watershed - Basic factors influencing watershed development – Principles of watershed management - Definition of watershed management – Identification of problems - Watershed approach in Government programmes – People participation – Entry point activities - Evaluation of watershed management measures.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build the knowledge on various processes involved in participatory water resource management.

CO2: Make use of farmer's participation in water resources management.

CO3: Solve the issues related to water conservation and watershed Development.

CO4: Utilize the knowledge in participatory water conservation.

CO5: Develop the concept, principle, approach of watershed management.

TEXT BOOKS:

1. Siva subramaniyan K. "Water Management", SIMRES Publication, Chennai, 2011.
2. Uphoff N., "Improving International Irrigation management", 1st Revised Edition, 2011.
3. Tideman E.M., "Watershed Management", Omega Scientific Publishers, New Delhi, 1996.

REFERENCES:

1. Rodolfo S S, "Integrated and Participatory water resources management", 1st Edition, Elsevier Science, 2007.
2. Dian Tristi Agustini, "Overview of participatory water management", 4th International Conference on Sustainability Science, 2021.
3. Chambers Robert, "Managing canal irrigation", 1st Edition, Cambridge University Press, 1989

21PCE31	INTEGRATED WATER RESOURCES MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To prepare objectives, principles and evolution of integrated water resources management.
- To sketch an idea of contextualizing Integrated Water Resources Management.
- To interpret the knowledge in emerging issues in water management, flood, drought, pollution and poverty.
- To identify the water resources development in India and wastewater reuse.
- To apply the knowledge on integrated development of water management.

UNIT I	**IWRM FRAMEWORK**	**9**
Definition – Objectives – Principles - Evolution of IWRM - IWRM relevance in water resources management – Paradigm shift: Processes and prospective outcomes.		

UNIT II	CONTEXTUALIZING IWRM	9
UN formulations – Sustainable Development Goals (SDG) - IWRM in Global, Regional and Local water partnership – Institutional transformation - Bureaucratic reforms - Inclusive development.		
UNIT III	**EMERGING ISSUES IN WATER MANAGEMENT**	**9**
Emerging Issues – Drinking water management in the context of climate change - IWRM and irrigation - Flood – Drought – Pollution – Linkages between water, health and poverty.		
UNIT IV	**IWRM AND WATER RESOURCES DEVELOPMENT IN INDIA**	**9**
Rural Development - Ecological sustainability- -Watershed development and conservation - Ecosystem regeneration – Wastewater reuse - Sustainable livelihood - Food security.		
UNIT V	**ASPECTS OF INTEGRATED DEVELOPMENT**	**9**
Capacity building - Conceptual framework of IWRM – Problems and policy issues - Solutions for effective integrated water management - Case studies.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Utilize the knowledge of integrated water resources management in process outcomes.

CO2: Develop reforms to attain Sustainable Development Goals (SDG).

CO3: Develop the knowledge in emerging issues in water management, flood, drought, pollution and poverty.

CO4: Plan the water resources development in India and wastewater reuse.

CO5: Build the knowledge on integrated development of water management.

TEXT BOOKS:

1. Sarbhukan M.M, "Integrated water resources management", 1st Edition, CBS Publishers and Distributors Pvt limted, 2013.
2. Sithamparanathan, Rangasamy, A., and Arunachalam, N., "Ecosystem Principles and Sustainable Agriculture", 1st Edition, Scitech Publications (India) Pvt.Ltd, 1999.
3. Mollinga P. et al. "Integrated Water Resources Management", Water in South Asia Volume I, Sage Publications, 2006.

REFERENCES:

1. Murthy, J.V.S., "Watershed Management in India", 1st Edition, New Age International Publishers, 2017.
2. Cech Thomas V., "Principles of Water Resources: History, Development, Management and Policy", 3rd Revised Edition, John Wiley and Sons Inc., New York, 2009.
3. Dalte, S.J.C., "Soil Conservation and Land Management", 1st Edition, International Book Distribution, India, 1986.

21PCE32	RIVER ENGINEERING	L	T	P	C

		3	0	0	3

COURSE OBJECTIVES:

- To classify river morphology.
- To illustrate hydraulic geometry and behavior of river.
- To relate socio-cultural influences and ethics of stream restorations.
- To show the flow and sediment transport in rivers and channels.
- To plan and design guide band, embankments and flood protection systems.

UNIT I	INTRODUCTION	9

Introduction, classification of Rivers, Mechanics of alluvial rivers including channel and flood plain features, Sediment transport and budgets, River morphology and various classification schemes.

UNIT II	BEHAVIOR OF RIVERS	9

Introduction, River Channel patterns, Straight river channels, causes, characteristics and shapes of meanders and control, cut off, Braided Rivers, Bed forms, Instability of rivers, Hydraulic geometry, Delta formation and control.

UNIT III	STREAM RESTORATION	9

Mechanics of Alluvial Rivers, Rivers and restoration structures, Socio-cultural influences and ethics of stream restoration.

UNIT IV	NATURAL CHANNEL DESIGN	9

Bio-engineering Techniques, Classification review, Natural Channel Design Analysis, Time Series, analysis of flow, Sediment and channel geometry data.

UNIT V	RIVER TRAINING AND PROTECTION WORKS	9

Introduction, Classification of River Training, Types of training works, Protection for Bridges with reduced waterway, Design of Guide Band, embankment and spurs/dampners and other river/ flood protection works.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the river morphology and its classification.

CO2: Utilize the hydraulic geometry and predict behavior of river.

CO3: Apply the socio-cultural influences to ethics of stream restorations.

CO4: Solve problems on flow and sediment transport in rivers and channels.

CO5: Prepare design of guide band, embankments and flood protection systems.

TEXT BOOKS:

1. Santosh Kumar, "River Engineering", Khanna Publishing House, 2021.
2. Margaret S. Petersen, "River Engineering", 1st Edition, Prentice-Hall, 1986
3. "River Behavior Management and Training (Vol. I & II)", Central board of Irrigation and Power, New Delhi.1994.

REFERENCES:

1. Pierre Y Julien, "River Engineering", 2nd edition, Cambridge University Press, 2018.

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2. Punmia B C and Pande B. B. Lal. "Irrigation & Water Power Engineering", 1st Edition, Laxmi Publications Pvt Limited, 2009.
3. Jansen. P. Ph, "Principles of River Engineering: The non tidel alluvial river", VSSD, 1994.

21PCE33	COASTAL ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To show various coastal topography.
- To construct an overview of the analysis and design procedures used in the field of coastal engineering.
- To identify the characteristics of waves.
- To illustrate coastal structures and shore protection.
- To develop modelling in coastal engineering.

UNIT I	COASTAL ZONE	9

Definition and sub division – Factors influencing coastal topography - Waves: Definitions - Classification – Liner wave theory – Assumptions and derivations of relationships – Pressure within progressive wave – Wave energy – Problems.

UNIT II	WAVE PROPERTIES AND ANALYSIS	9

Introduction to non-linear waves and their properties – Waves in shallow waters – Wave Refraction, Diffraction and Shoaling – Hindcasting of waves - Short term wave analysis – wave spectra and its utilities - Long term wave analysis- Statistical analysis of grouped wave data.

UNIT III	TYPES AND WAVE TRANSFORMATION	9

Tide analysis and prediction, storm surge, seiches and seasonal fluctuations - Long term water level fluctuations – Wave shoaling; wave refraction; wave breaking; wave diffraction.

UNIT IV	COASTAL STRUCTURES AND SHORE PROTECTION	9

Risk analysis – design wave – Break waters – Shore protection – groins, seal walls, offshore breakwaters and artificial nourishment.

UNIT V	MODELING IN COASTAL ENGINEERING	9

Physical modelling in Coastal Engineering – Limitations and advantages – Role of physical modeling in coastal engineering – Numerical modeling – Modeling aspects – limitations.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the problems associated with Indian coast and apply Linear wave theory and use wave tables for solving the dispersion equation.

CO2: Solve linear and non-linear wave theories.

CO3: Classify the Types of waves, wave shoaling, diffraction, refraction.

CO4: Construct and design shore defence structures and describe the problems from reliability and risk perspective.

CO5: Select physical and mathematical coastal models and critique the advantages and disadvantages between them.

TEXT BOOKS:

1. Mani, J. S. Coastal Hydrodynamics, 2nd Edition, PHI Learning Pvt. Ltd., 2012.
2. Kamphuis, J.W., Introduction to Coastal engineering and management, 2nd Edition, World scientific, 2000.
3. Dean, R.G. and Dalrymple, R.A., Water wave mechanics for Engineers and Scientists, 1st edition Clarendon Press, 1995.

REFERENCES:

1. Washington DC, Coastal Engineering Manual, Vol. I-VI, Coastal Engineering Research Centre, Dept. of the Army, US Army Corps of Engineers, 2006.
2. Ippen, A.T., Estuarine and coastline Hydrodynamics, 1st Edition, American Society of Civil Engineers, 2002.
3. Sorenson, R.M., Basic Coastal Engineering, A Wiley-Interscience Publication, NewYork, 1978.

21PCE34	WATERSHED CONSERVATION AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply the concept and terminology of watersheds.
- To identify the planning principles and complete evaluation systems.
- To interpret the knowledge on the participatory watershed management.
- To utilize the concept in watershed conservation practices.
- To make use of information about the watershed development programme.

UNIT I	INTRODUCTION	9
Watershed – Definition - concept - Objectives – Land capability classification - priority watersheds - land resource regions in India		
UNIT II	**WATERSHED PLANNING**	**9**
Planning principles – collection of data – present land use - Preparation of watershed development plan - Estimation of costs and benefits - Financial plan – selection of implementation agency - Monitoring and evaluation system		
UNIT III	**WATERSHED MANAGEMENT**	**9**
Participatory watershed Management - run off management - Factors affecting runoff - Temporary & Permanent gully control measures - Water conservation practices in irrigated lands - Soil and moisture conservation practices in dry lands.		
UNIT IV	**WATER CONSERVATION PRACTICES**	**9**
In-situ & Ex-situ moisture conservation principle and practices - Afforestation principle - Micro catchment water harvesting - Ground water recharge – percolation ponds -Water harvesting - Farm pond - Supplemental irrigation - Evaporation suppression - Seepage reduction.		

UNIT V	WATERSHED DEVELOPMENT PROGRAMME	9
River Valley Project (RVP) - Hill Area Development Programme (HADP) - National Watershed Development Programme for Rain fed Agriculture (NWDPRA) - Other similar projects operated in India – Govt. of India guidelines on watershed development programme - Watershed based rural development – infrastructure development - Use of Aerial photography and Remote sensing in watershed management - Role of NGOs in watershed development.		
	TOTAL : 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the concept and terminology of watersheds.

CO2: Organize the planning principles and complete evaluation systems.

CO3: Utilize knowledge on the participatory watershed management.

CO4: Interpret watershed conservation practices.

CO5: Build the watershed development programme.

TEXT BOOKS:

1. Suresh, R., "Soil and Water Conservation Engineering", Standard Publishers & Distributors. 2020.
2. Murty, V.V.N. "Land and water management", 6th Edition, Kalyani publishers, 2013.
3. Ghanashyam Das, "Hydrology and Soil Conservation Engineering", 2nd Edition, Prentice Hall of India Private Limited, 2009.

REFERENCES:

1. Gurmel Singh et al, "Manual of soil and water conservation practices", Oxford & IBH publishing, 2019.
2. Suresh, R, "Land and water management principles", 1st Edition, Standard Publishers & Distributors, 2008.
3. Tripathi R.P. and H.P.Singh, "Soil erosion and conservation", 1st Edition, Willey Eastern Ltd, 1993.

VERTICAL-VI: TRANSPORTATION

21PCE35	AIRPORTS, DOCKS AND HARBOR ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To plan the location of the airport and its components.
- To develop and design airport components.
- To relate the design and construction of docks, harbours and ports as a whole.
- To identify the needs of a Harbour plan in terms of international standards.
- To classify the coastal protection structures.

UNIT I	AIRPORT PLANNING	9

Air transport characteristics - airport classification – ICAO - airport planning: Site selection typical Airport Layouts, Case Studies, parking and Circulation Area.

UNIT II	AIRPORT DESIGN	9

Runway Design: Orientation, Wind Rose Diagram, Problems on basic and Actual Length, Geometric Design – Elements of Taxiway Design – Airport Zones – Passenger Facilities and Services – Runway and Taxiway Markings.

UNIT III	HARBOUR ENGINEERING	9

Modern trends in water transportation - Elements of water transportation - Advantages and disadvantages of water transportation - Definition of Basic Terms: Harbour, Port, Satellite Port, Docks, Waves and Tides – Requirements and Classification of Harbours - Site Selection & Selection Investigation. Classification of dredging works, Types of dredgers, Uses of dredged material, Execution of dredging work.

UNIT IV	HARBOUR LAYOUT AND TYPES	9

Harbour layout and terminal facilities - piers, break waters, wharves, jetties, quays; Spring fenders, dolphins and floating landing stage - Mooring Accessories - Necessity, Types of navigation aids, Requirement of signals, Fixed and floating navigation aid - Harbour docks, Wet docks, Repair docks, Lift docks, Floating docks, Slipways - Types of ports and harbours - Port building facilities, Transit sheds, Warehouses, Cargo handling facility, Services for shipping terminals, Inland port facilities planning.

UNIT V	COASTAL STRUCTURES	9

Coastal protection structures – natural and artificial – design of shore protection structures, seawalls, groins, breakwaters; Types - Sea wall, Revetment, Bulkhead, Cathodic Protection and factors determining selection and stability of breakwaters - latest technologies in shore protection techniques; Environmental impacts of coastal developments.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Select the site and plan the airport.

CO2: Prepare the design of airport elements.

CO3: Develop knowledge on the various features in Harbours and Ports, their construction.

CO4: Apply knowledge on planning of components of docks and harbours to suggest an appropriate layout.

CO5: Choose the types of coastal protection works and coastal regulations to be adopted.

TEXT BOOKS:

1. Srinivasan R, "Harbour, Dock and Tunnel Engineering", Charotar Publishing House Pvt. Ltd.; 30th Edition, 2022.
2. Saxena Subhash C, "Airport Engineering Planning and Design", CBS Publishers & Distributors Pvt. Ltd, 2020.
3. Dr. Rethaliya R P, "Harbour Airport Engineering", 2nd Edition, Atul Prakashan, 2014.
4. Gupta B L, "Roads, Railways, Bridges, Tunnels & Harbour Dock", Standard Publishers Distributors, 2018.

REFERENCES:

1. C.Venkatramaiah., "Transportation Engineering-Vol.2 Railways, Airports, Docks and Harbours, Bridges and Tunnels", 1st Edition, The Orient Blackswan, 2016.
2. Rangwala, "Airport Engineering", Charotar Publishing House, 2017.
3. Subramian K.P., "Highway, Railway, Airport and Harbour Engineering", 1st Edition, Scitech Publications Private Limited, 2013.

21PCE36	PAVEMENT ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To classify the types pavement and its stress distribution.
- To identify various IRC guidelines for designing rigid pavements.
- To develop information on various IRC guidelines for designing flexible pavements.
- To select the maintenance measures based on performance evaluation.
- To choose the method of stabilization of pavements.

UNIT I	TYPE OF PAVEMENT AND STRESS DISTRIBUTION ON LAYERED SYSTEM	9

Introduction – Pavement as layered structure – Pavement types rigid and flexible. Resilient modulus - Stress and deflections in pavements under repeated loading.

UNIT II	DESIGN OF FLEXIBLE PAVEMENTS	9

Flexible pavement design Factors influencing design of flexible pavement, Empirical – Mechanistic empirical and theoretical methods – Design procedure as per IRC guidelines – Design and specification of rural roads.

UNIT III	DESIGN OF RIGID PAVEMENTS	9

Cement concrete pavements Factors influencing CC pavements – Modified Westergaard approach – Design procedure as per IRC guidelines – Concrete roads and their scope in India.

UNIT IV	PERFORMANCE EVALUATION AND MAINTENANCE	9

Pavement Evaluation - Causes of distress in rigid and flexible pavements – Evaluation based on

Surface Appearance, Cracks, Patches and Pot Holes, Undulations, Raveling, Roughness, Skid Resistance. Structural Evaluation by Deflection Measurements - Pavement Serviceability index, - Pavement maintenance (IRC Recommendations only).

UNIT V	STABILIZATION OF PAVEMENTS	9

Stabilisation with special reference to highway pavements – Choice of stabilizers – Testing and field control - Stabilisation for rural roads in India – Use of Geosynthetics in roads.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify types of rigid and flexible pavements.

CO2: Prepare the design of flexible pavements.

CO3: Develop design of rigid pavements.

CO4: Identify the causes of distress in rigid and flexible pavements.

CO5: Select method of stabilization of pavements based on testing and field control.

TEXT BOOKS:

1. Khanna, S.K. and Justo C.E.G.and Veeraragavan, A, "Highway Engineering", Revised 10th Edition, New Chand and Brothers, 2014.
2. Rajib B. Mallick and Tahar El-Korchi, "Pavement Engineering: Principles and Practice", 3rd Edition, CRC Press; 2017.
3. Kadiyali, L.R., "Principles and Practice of Highway Engineering", 1st Edition, Khanna tech. Publications, New Delhi, 2005.

REFERENCES:

1. Yoder, E.J. and Witchak M.W. "Principles of Pavement Design", 2nd Edition, John Wiley 2011.
2. Guidelines for the Design of Flexible Pavements, The Indian roads Congress, New Delhi IRC-37–2001.
3. Guideline for the Design of Rigid Pavements for Highways, The Indian Road Congress, New Delhi IRC 58-1998.

21PCE37	TRANSPORTATION PLANNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To relate the urban travel characteristics and transportation planning.
- To develop the land use and urban design.
- To make use of environmental considerations with mitigation strategies in the system planning process.
- To prepare the road and highway planning with the performance monitoring.
- To illustrate the transportation system management, linking planning and operations.

UNIT I	INTRODUCTION TO TRANSPORTATION PLANNING	9

Introduction-The Transportation Planning Process-Changing Context for Transportation Planning-

Transportation System Characteristics - Urban Travel Characteristics- Estimating Travel Characteristics and Volumes.

UNIT II	LAND USE AND URBAN DESIGN	9
Introduction-What Drives Development and Resulting Urban Form-Urban Form-Urban Design-Land-Use Forecasting and Transportation Planning-Scenario Analysis for Urban Form- Highway Facility-Related Strategies.		
UNIT III	**ENVIRONMENTAL CONSIDERATIONS**	**9**
Environmental Considerations in Transportation Planning and Decision Making - General Principles Regarding Environmental Content and Level of Detail - Land Use and Economic Development Impacts-Social and Community Impacts-Natural Resource Impacts-Construction Impacts - Considering Mitigation Strategies during the Systems Planning Process.		
UNIT IV	**ROAD AND HIGHWAY PLANNING**	**9**
Modeling Travel Demand - Demand Models and Tools- Best Practice for Urban Roadway Systems-Context-Sensitive Solutions (CSS-Traffic Calming- Table of Contents-Green Roads- Complete Streets -System Performance and Capacity Measures- Condition Measures and Management Systems- State Highway Plans and City Thoroughfare Plans- Road Investment Programs and Performance Monitoring.		
UNIT V	**TRANSPORTATION SYSTEM MANAGEMENT AND OPERATIONS.**	**9**
Understanding Network and Facility Performance-Planning and Organizing for TSM&O- Active Transportation and Demand Management-Examples of Management and Operations (M&O) Strategies- Linking Transportation Planning and Planning for Operations- Dissemination of Operations Data- The Connected Transportation System.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Show the relation between the transportation planning process and its characteristics.

CO2: Make use of land use forecasting for urban transportation design.

CO3: Develop system planning process considering environmental impacts.

CO4: Model the roads and highways based on system performance.

CO5: Select the transportation system management, linking planning and operations.

TEXT BOOKS:

1. Michael D. Meyer, "Transportation Planning", 4th Edition, Institute of Transportation Engineers, by John Wiley & Sons, Inc. 2016.
2. Sarkar Prabir Kumar, Maitri Vinay, "Transportation Planning: Principles, Practices and Policies", 1st Edition, Prentice Hall India Learning Private Limited, 2014.
3. Englewood Clifts, "Transportation Planning", Handbook, the Institute of Transportation Engineers, Prentice Hall, 1992.

REFERENCES:

1. Kadiyali L.R, "Traffic Engineering and Transportation Planning" Khanna Publishers, Delhi,

1999.
2. Papacostas "Transportation Engineering and Planning, Pearson Education India", 3rd Edition, 2015.
3. Flaherty, "Transportation Planning and Traffic Engineering", 1st Edition, Elesevier India Pvt Ltd., 2018.

21PCE38	URBAN PLANNING AND DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To classify areas of human settlement.
- To identify and prepare different level of plans.
- To prepare development plans.
- To develop urban layout design for projects.
- To relate legislation and urban development.

UNIT I	**TYPES OF HUMAN SETTLEMENT**	9
Definition of Human settlement, Urban area, Town, City, Urbanisation, Suburbanisation, Urban sprawl, Peri-urban areas, Central Business District (CBD), Classification of urban areas – Trend of Urbanisation at International, National, Regional and State level.		
UNIT II	**PLANNING PROCESS**	9
Principles of Planning – Types and Level of Plan, Stages in Planning Process – Goals, Objectives, Delineation of Planning Areas, Surveys and Questionnaire Design.		
UNIT III	**DEVELOPMENT PLANS, PLAN FORMULATION AND EVALUATION**	9
Scope and Content of Regional Plan, Master Plan, Detailed Development Plan, Development Control Rules, Transfer of Development Rights, Special Economic Zones- Development of small town and smart cities-case studies.		
UNIT IV	**PLANNING AND DESIGN OF URBAN DEVELOPMENT PROJECTS**	9
Site Analysis, Layout Design, Planning Standards, Project Formulation – Evaluation, Plan Implementation, Constraints and Implementation, Financing of Urban Development Projects.		
UNIT V	**LEGISLATION, DEVELOPMENTAND MANAGEMENT OF URBAN SYSTEM**	9
Town and Country Planning Act, Land Acquisition and Resettlement Act etc., Urban Planning Standards and Regulations, Involvement of Public, Private, NGO, CBO and Beneficiaries.		
	TOTAL : 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify basic issues of Urbanisation and Suburbanisation.

CO2: Select various planning process.

CO3: Develop plans, plan formulation and evaluation.
CO4: Plan and implement urban development projects.
CO5: Utilize legislation for urban development.

TEXT BOOKS:

1. Goel, S.L "Urban Development and Management", 1st Edition, Deep and Deep publications, New Delhi, 2002.
2. Singh V.B, "Revitalised Urban Administration in India", 1st Edition, Kalpaz publication, Delhi, 2001.
3. Edwin S. Mills and Charles M. Becker, "Studies in Urban development", A World Bank publication, 1986.

REFERENCES:

1. Tamil Nadu Town and Country Planning Act 1971, Government of Tamil Nadu, Chennai.
2. Goel S.L., Urban Development and Management, Deep and Deep Publications, New Delhi, 2002.
3. Thooyavan, K.R., Human Settlements – A Planning Guide to Beginners, M.A Publications, Chennai, 2005.
4. CMDA, Second Master Plan for Chennai, Chennai 2008.

21PCE39	INTELLIGENT TRANSPORTATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To plan and collect data for Intelligent Transportation System.
- To identify advanced traveller information systems.
- To relate Intelligent Transportation System and public transportation.
- To model safety of Intelligent Transportation System.
- To apply knowledge of Intelligent Transportation System in transportation management.

UNIT I	BASIC ELEMENTS OF INTELLIGENT TRANSPORTATION SYSTEMS	9

Basic elements of intelligent transportation systems (ITS), focusing on technological, systems and institutional aspects. Benefits of ITS -ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.

UNIT II	ADVANCED TRAVELER INFORMATION SYSTEMS	9

Advanced traveler information systems-transportation network operations-commercial vehicle operations and intermodal freight.

UNIT III	PUBLIC TRANSPORTATION APPLICATIONS	9

Public transportation applications- ITS and regional strategic transportation planning, including regional architectures.

UNIT IV	ITS AND CHANGING TRANSPORTATION INSTITUTIONS	9
ITS and changing transportation institutions-ITS and safety-ITS and security-ITS as a technology deployment program-research-development and business models-ITS and sustainable mobility.		
UNIT V	TRAVEL DEMAND MANAGEMENT	9
Electronic toll collection, and ITS and road-pricing-Automated Highway Systems- Vehicles in Platoons –ITS in World – Overview of ITS Implementations in developed countries-ITS in developing countries.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Organize data for Intelligent Transportation System.

CO2: To interpret advanced traveller information systems.

CO3: Apply the concept of information technology for planning public transportation.

CO4: Use advance information to the travellers and improve safety.

CO5: Make use of Intelligent Transportation System in transportation management.

TEXT BOOKS:

1. Pradip Kumar Sarkar, Amit Kumar Jain, "Intelligent Transport Systems", PHI Learning Publishers, 2018.
2. Choudury M A and Sadek A, "Fundamentals of Intelligent Transportation Systems Planning", 1st Edition, Artech House, 2003.
3. Sussman, J. M., "Perspective on ITS", Artech House Publishers, 2005.

REFERENCES:

1. Kan Paul Chen, "ITS Hand Book 2000: Recommendations for World Road Association (PIARC)", John Miles, 2000.
2. US Department of Transportation, "National ITS Architecture Documentation", (CDROM), 2007.
3. Turban. E and Aronson. J. E, "Decision Support Systems and Intelligent Systems", 6th Edition, Prentice Hall, 2004.

21PCE40	PLANNING OF SMART CITIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To relate the smart city and the various types of infrastructure systems.
- To choose the planning and development of smart city infrastructure.
- To make use of the intelligent transport system in smart city.
- To plan water and wastewater management.
- To apply legislations and policies for smart cities.

UNIT I	FUNDAMENTAL OF SMART CITY & INFRASTRUCTURE	9
Introduction of Smart City, Concept of smart city, Objective for smart cities, History of Smart city		

world and India. Need to develop smart city, Challenges of managing infrastructure in India and world, various types of Infrastructure systems, Infrastructures need assessment.		
UNIT II	**PLANNING AND DEVELOPMENT OF SMART CITY INFRASTRUCTURE**	**9**
Energy and ecology, solar energy for smart city, Housing, sustainable green building, safety, security, disaster management, economy, cyber security, Project management.		
UNIT III	**INTELLIGENT TRANSPORT SYSTEMS**	**9**
Smart vehicles and fuels, GIS, GPS, Navigation system, traffic safety management, mobility services, E-ticketing.		
UNIT IV	**MANAGEMENT OF WATER RESOURCES AND RELATED INFRASTRUCTURE**	**9**
Storage and conveyance system of water, sustainable water and sanitation, sewerage system, flood management, conservation system.		
UNIT V	**INFRASTRUCTURE MANAGEMENT SYSTEM & POLICY FOR SMART CITY**	**9**
Integrated infrastructure management systems for smart city, Infrastructure management system applications for existing smart city. Worldwide policies for smart city Government of India - policy for smart city, Mission statement & guidelines, Smart cities in India, Case studies of smart city.		
		TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the various types of infrastructure systems for smart city.

CO2: Identify the aspects of smart city infrastructure.

CO3: Use Intelligent Transport System for smart city development.

CO4: Select the management of water resources related to the infrastructure development.

CO5: Utilize the infrastructure management system and the policies for smart cities.

TEXT BOOKS:

1. Xianyi Li, "Smart City on Future Life - Scientific Planning and Construction", 1st Edition, 2012.
2. Nicos Komninos, "The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities)", 1st Edition, Routledge, 2018.
3. Anthony Townsend, "Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia", Reprint Edition, W.W.Nortan & Company, 2014.

REFERENCES:

1. Grig N.S., "Infrastructure Engineering and Management", 1st Edition, Wiley-Interseience, 1988
2. Hudson W.R., Haas R., Uddin W., Infrastructure Management, McGraw-Hill, 1997.
3. Carol L. Stimmel, "Building Smart Cities", 1st Edition, Auerbach Publications, 2022.

21PCE41	TRAFFIC ENGINEERING AND MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To identify the traffic components and assess the traffic characteristics and related problems.
- To relate the concepts of traffic surveys and its level of service.
- To build traffic control devices and its techniques in transportation interaction.
- To relate road accidents, traffic and environment hazards in transportation interaction.
- To classify traffic management systems.

UNIT I	TRAFFIC PLANNING AND CHARACTERISTICS	9

Road Characteristics – Road user characteristics – PIEV theory – Vehicle – Performance characteristics – Fundamentals of Traffic Flow – Urban Traffic problems in India – Integrated planning of town, country, regional and all urban infrastructure – Towards Sustainable approach - land use & transport and modal integration.

UNIT II	TRAFFIC SURVEYS	9

Traffic Surveys – Speed, journey time and delay surveys – Vehicles Volume Survey including non-motorized transports – Methods and interpretation – Origin Destination Survey – Methods and presentation – Parking Survey – Accident analyses -Methods, interpretation and presentation – Statistical applications in traffic studies and traffic forecasting – Level of service – Concept, applications and significance.

UNIT III	TRAFFIC DESIGN AND VISUAL AIDS	9

Intersection Design - channelization, Rotary intersection design – Signal design – Coordination of signals — Grade separation - Traffic signs including VMS and road markings – Significant roles of traffic control personnel - Networking pedestrian facilities & cycle tracks.

UNIT IV	TRAFFIC SAFETY AND ENVIRONMENT	9

Road accidents – Causes, effect, prevention, and cost – Street lighting – Traffic and environment hazards – Air and Noise Pollution, causes, abatement measures – Promotion and integration of public transportation – Promotion of non-motorized transport.

UNIT V	TRAFFIC MANAGEMENT	9

Area Traffic Management System - Traffic System Management (TSM) with IRC standards — Traffic Regulatory Measures-Travel Demand Management (TDM) – Direct and indirect methods – Congestion and parking pricing – All segregation methods- Coordination among different agencies – Intelligent Transport System for traffic management, enforcement and education.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Choose the fundamental traffic flow theories and identify basic traffic variables.

CO2: Identify the Traffic survey & different types of traffic control device.

CO3: Develop signalized intersections including isolated, signals and parking arrangements.

CO4: Interpret the traffic impacts on environment and safety.

CO5: Plan, evaluate and justify methods of traffic management system.

TEXT BOOKS:

1. Kadiyali.L.R. "Traffic Engineering and Transport Planning", 1st Edition, Khanna Publishers,

Delhi, 2013.

2. Dr.Rethaliya R P, "Traffic Engineering and Management", 1st Edition, Atul Prakashan, 2021.
3. Hobbs.F.D. "Traffic Planning and Engineering", 2nd Edition, University of Brimingham, Peragamon Press Ltd, 1979.
4. Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning and Management, 2018.

REFERENCES:

1. Fred L. Mannering, Scott S. Washburn and Walter P.Kilareski, "Principles of Highway Engineering and Traffic Analysis", 3rd Edition, Wiley India Pvt. Ltd., New Delhi, 2007.
2. Garber and Hoel, "Principles of Traffic and Highway Engineering", 5th Edition, Cengage Learning, New Delhi, 2019.
3. SP: 43-1994, IRC Specification, "Guidelines on Low-cost Traffic Management Techniques", Urban Areas, 1994.

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ONE CREDIT COURSES

21OCCE01	STAAD PRO	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To develop 2D/3D drawings or shapes of frames, beam elements, truss elements or any rotations using rectangular or polar coordinate systems.
- To analyze and design the elements as per the functional requirements provided in the IS Code provisions.

LIST OF EXPERIMENTS

1. Design of simply supported RCC beam.
2. Design of cantilever RCC beam.
3. Design of continuous RCC beam.
4. Design of simply supported Steel beam.
5. Design of continuous Steel beam.
6. Design of RCC columns with different end conditions.
7. Design of Steel columns with different end conditions.
8. Design of steel trusses.
9. Design of RCC portal frames.
10. Design of steel portal frames.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Prepare polar or rectangular coordinate systems-based 2D or 3D drawings or models of frames, beam elements, truss elements, or any rotations.

CO2: Plan, design and analyze the concrete beams, columns, and slabs in accordance with the principal international norms.

TEXT BOOKS:

1. Sarma T S, "Design of R C C Buildings using Staad Pro V8i with Indian Examples English", Educreation Publishing, 2017.
2. Aghunandan M H, "Analysis of Structural Elements by STAAD Pro for beginners [with RCC design], Second Edition, Kindle Edition, 2020.
3. Sarma T S, "Design of Industrial Steel Buildings Using Staad Pro: With Indian Examples", 1st Edition, Notion Press, 2020.

REFERENCES:

1. Krishnamurthy, D., "Structural Design & Drawing – Vol. II and III, CBS Publishers, 2018.
2. Shah V L and Veena Gore, "Limit State Design of Steel Structures IS800-2007", 3rd Edition, Structures Publications, Pune, 2013.
3. IS 456:2000 Code of Practice for Plain and Reinforced Concrete.
4. IS 875(1-5):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures.

5. SP (16): 1980 "Design Aids for Reinforced Concrete to IS: 456-1978".
6. IS 800:2007 "Code of Practice for General Construction in Steel".
7. SP6: Part 1:1964 "Handbook for Structural Engineers".

21OCCE02	REVIT ARCHITECTURE	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To develop higher-quality and more accurate architectural designs; make use of tools specifically built to support Building Information Modelling workflows.
- To plan a 3D building model with walls, curtain walls, windows, and doors.

LIST OF EXPERIMENTS

1. Single storey residential building (load bearing wall structure and framed structure) – Plan and Elevation.
2. Single storey residential building (load bearing wall structure and framed structure) – Interior design and Exterior Design.
3. Multi-storey residential building (load bearing wall structure and framed structure) – Plan and Elevation.
4. Multi storey residential building (load bearing wall structure and framed structure) – Interior design and Exterior Design
5. 3D view of a residential building.
6. Fully panelled door / partly glazed and wooden panelled door
7. Fully panelled window / fully glazed window
8. Draw the Dog legged staircase
9. Estimation of single storey residential building (load bearing wall structure and framed structure).
10. Estimation of multi-storey residential building (load bearing wall structure and framed structure).

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Sketch the detailed building plan and elevation of residential buildings.

CO2: Plan and design different components like Column, Beam, Floor, Wall, Door, Window, Stair, Ramp of residential building.

TEXT BOOKS:

1. Sham Tickoo, "Exploring Autodesk Revit 2021 for Structural Engineers", 11th Edition, BPB Publications, 2021.
2. Harshul Savla et.al, "Building Information Modeling: Global & Indian Perspective, 1st Edition, Notion Press; 2021.

REFERENCES:

1. Bhat N. D. and Panchal V. M., "Engineering Drawing Plane and Solid Geometry", 53rd edition, Charotar Publishing House, 2019.
2. Ashit Bajaj and Mamta Kataria., "Building Drawing (Civil Engineering Drawing-I)", 1st edition, North Publication, 2020.

21OCCE03	PRIMAVERA	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To model and manage project enterprise structure within Primavera P6 database.
- To develop resource loaded or simple project schedule and manage the project time frame related constraints

LIST OF EXPERIMENTS

1. Estimation of single storey residential building (load bearing wall structure and framed structure).
2. Estimation of multi-storey residential building (load bearing wall structure and framed structure).
3. Planning and scheduling of single storey residential building (load bearing wall structure and framed structure).
4. Planning and scheduling of multi-storey residential building (load bearing wall structure and framed structure).
5. Planning, scheduling and Estimation of Retaining wall structure.
6. Planning, scheduling and Estimation of Septic tank.
7. Planning, scheduling and Estimation of Underground water tank.
8. Planning, scheduling and Estimation of Industrial building.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Calculate the required man-hours for various activities up to total project by resource assignment.

CO2: Identify critical tasks and developing various structured reports.

TEXT BOOKS:

1. Vimala A and Vinayagam P, "Planning and Managing Projects with PRIMAVERA (P6) Project Planner", Dreamtech Press, 2020.
2. Jayakumar V, "Process Planning and Cost Estimation", Lakshmi Publications, 2013.

REFERENCES:

1. Rangwala. "Civil Engineering Drawing", 3rd Edition, Charotar Publishing House Pvt. Ltd., 2019.
2. Panneerselvam R. and Sivasankaran P., "Process Planning and Cost Estimation", PHI Learning Pvt Ltd, 2015.

21OCCE04	GPS SURVEYING	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To plan land surveying using Global Positioning System (GPS).
- To identify the different aspects of GPS systems.

COURSE LAYOUT

Lecture 1: Introduction, GPS System.

Lecture 2: GPS Positioning, GPS Observables.

Lecture 3: GPS Data Processing.

Lecture 4: GPS Field Surveying, GPS Field Data Processing.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of GPS data and compare the results of GPS derived positions with classical survey methods over small areas.

CO2: Identify the pros and cons of surveying with GPS vs. other (traditional surveying) methods.

TEXT BOOKS:

1. Gopi Satheesh et.al, "Advanced Surveying: Total Station, GPS, GIS & Remote Sensing", 2nd Edition, Pearson Education, 2017.
2. Agor R, "Advanced Surveying", 5th Edition, Khanna Publishers, 2016.

REFERENCES:

1. Khasiya R B, "Advanced Surveying", 6th Edition, Mahajan Publishing House, 2017.
2. Swapnil S and Sawant, "Advanced Surveying", 1st Edition, Gigatech Publishing House, 2018.

21OCCE05	VISUAL COMMUNICATION DESIGN FOR DIGITAL MEDIA	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To develop knowledge on the different aspects of visual communication design, emphasizing on virtual media platform.
- To identify the aesthetic content of artistic works within a cultural context.

COURSE LAYOUT

Lecture 1: Introduction to Visual Design Introduction to Virtual Media Technology.

Lecture 2: Applications of Visual Design in Virtual Media Paradigm Design Thinking and Visual Cognition.

Lecture 3: Contemporary Trends in Virtual-Media Visual Design Methodology.

Lecture 4: Visual Design Methodology Case Studies of Visual Design in Virtual Media Technology.

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the nature, process, types, models and theories of communication over small areas.
CO2: Identify the meaning and functions of visual communication with its relationships.

TEXT BOOKS:

1. Paul Martin, "Visual Communication", 2nd Edition, Global vision, 2016.
2. Bhatia Arun, "Visual Communication", Rajat Publications, 2016.

REFERENCES:

1. Giorgia Aiello, "Visual Communication: Understanding Images in Media Culture", 1st Edition, SAGE Publications Ltd, 2019.
2. Mathur Pratish K, "Visual Communication", Authors Press, 2016.

21OCCE06	DESIGN THINKING - A PRIMER	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To interpret the importance of design thinking for designing social innovation projects specifically targeting the needs of marginalised social groups
- To develop the design thinking as a method to come up with ideas and implement them.

COURSE LAYOUT

Lecture 1: Introduction to Design Thinking
Lecture 2: Empathize Phase: Customer Journey Mapping
Lecture 3: Analyze Phase: 5-Whys and How might we...
Lecture 4: Solve Phase: Ideation: Free Brainstorming & Make/Test Phase: Prototype

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1: Develop and expand complementary content such as images, video or simulator construction instructions
CO2: Apply design thinking to a systematic method of solving problems.

TEXT BOOKS:

1. Ravindran et.al, "Introduction to Design Thinking", Notion Press, 2017.
2. Pavan Soni, "Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving", Penguin Random House India Private Limited, 2020.

REFERENCES:

1. Kilian Langenfeld, "Design Thinking for Beginners: Innovation as a factor for entrepreneurial success", Personal Growth Hacker, 2019.
2. Don Norman, "The Design of Everyday Things", Basic Books, 2014.

J. P. Aani

21OCCE07	INNOVATION BY DESIGN	L	T	P	C
		1	0	0	1

COURSE OBJECTIVES:

- To utilize the experiences of customers in design thinking to reshape the experiences of the innovators themselves.
- To develop many creative ideas through structured brainstorming sessions.

COURSE LAYOUT

Lecture 1 :
Module 1 – Introduction,
Module 2 - First C: The Cause
Lecture 2 :
Module 3 - Second C: The Context,
Module 4 - Third C: The Comprehension
Lecture 3 :
Module 5 - Fourth C: The Check,
Module 6 - Fifth C: The Conception
Lecture 4 :
Module 7 - Sixth C: The Crafting,
Module 8 - Seventh C: The Connection

TOTAL : 15 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1: Develop rapid prototypes to bring their ideas into reality and obtain feedback.
CO2: Select broad group of stakeholders and understand their needs through the ethnographic method.

TEXT BOOKS:

1. Tom Kelly, "The Art of Innovation", Profile, 2016.
2. Patitapaban Das, "Design and Innovation in Moral Teaching", 1st edition, Notion Press, 2022.

REFERENCES:

1. Thomas Lockwood and Edgar Papke, "Innovation by Design: How Any Organization Can Leverage Design Thinking to Produce", Career Press, 2017.
2. Ashwini Kumar Singh, "Creativity & Innovation", Notion Press, 2021.

21OCCE08	TEKLA STRUCTURES	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To develop the design elements for design options, review mode, design member of concrete & Steel, Lateral loading wind loadings and finally outputting reports and generating drawings.

- To analyze an information-rich 3D model that contains all the structural data needed for building and maintaining the structure.

LIST OF EXPERIMENTS

1. Modelling and rebar detailing for underground water tank
2. Modelling and rebar detailing for cantilever retaining wall
3. Modelling and rebar detailing for stair case
4. Modelling and rebar detailing for pile cap
5. Modelling and detailing for industrial building
6. Modelling and rebar detailing for single storey structure
7. Modelling and rebar detailing for multi storey structure

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply BIM model to detail connections, performing model checks, generating fabrication & erection drawings, generating bills of material.

CO2: Develop pre model settings, construction levels and gridlines, element releases, applying 2D loadings and validation, Analysis and viewing graphical results.

TEXT BOOKS:

1. Celfrey Salamanes, "Tekla Structures Structural Steel Modeling and Detailing (DIY)", Kindle Edition, 2017.
2. Krishnamurthy, D., "Structural Design & Drawing – Vol. II and III, CBS Publishers, 2018.

REFERENCES:

1. Shah V L and Veena Gore, "Limit State Design of Steel Structures IS800-2007", Structures Publications, 2009.
2. Sarma T S, "Staad Pro V8i for Beginners: With Indian Examples, Notion Press; First edition, 2014.
3. IS 456:2000, "Code of Practice for Plain and Reinforced Concrete"
4. IS 875(1-5):1987, "Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures".
5. SP (16): 1980, "Design Aids for Reinforced Concrete to IS: 456-1978".
6. IS 800:2007, "Code of Practice for General Construction in steel".
7. SP6: Part 1:1964 "Handbook for Structural Engineers".

21OCCE09	ANSYS	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To explain the Finite Element Analysis (FEA) concepts and make familiar with the tools and techniques of the ANSYS software package.
- To calculate deflection and stresses in 2D and 3D trusses and beams.

LIST OF EXPERIMENTS

1. Analysis of simply supported RCC beam.
2. Analysis of cantilever RCC beam.
3. Analysis of continuous RCC beam.
4. Analysis of simply supported Steel beam.
5. Analysis of continuous Steel beam.
6. Analysis of RCC columns with different end conditions.
7. Analysis of Steel columns with different end conditions.
8. Analysis of steel trusses.
9. Analysis of RCC portal frames.
10. Analysis of steel portal frames.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Analyze basic engineering analysis problems using FEA techniques.

CO2: Develop pre model settings and determination of deflections component and principal and Von-mises stresses in plane stress, plane strain and Axisymmetric components.

TEXT BOOKS:

1. Divya Zindani, "Working with ANSYS A Tutorial Approach", Dreamtech Press, 2020.
2. Ramamrutham S, Narayanan R, "Theory of structures", 12th edition, Dhanpat Rai Publishing Company Ltd., 2020.

REFERENCES:

1. Punmia. B.C, Ashok Kumar Jain & Arun Kumar Jain, "Theory of structures", 13th Edition, Laxmi Publications, New Delhi, 2017.
2. Khurmi R.S, "Theory of structures", 13th edition, S Chand, New Delhi, 2020.

J.P. [signature]

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY, MADURAI-625009

(Autonomous)

REGULATION - 2021

M.E. COMPUTER SCIENCE AND ENGINEERING

(WITH SPECIALIZATION IN NETWORKS)

CURRICULUM FOR SEMESTERS I TO IV

SEMESTER–I

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21MA121	Applied Probability and Statistics for Computer Science Engineers *(Common to M.E. CSE and M.E CSE(Specialisation in Networks))*	FC	3	2	0	4
2.	21RM101	Research Methodology and IPR for Telecom Engineers *(Common to M.E CSE(Specialisation in Networks) and M.E Communication Systems programmes)*	RM	3	0	0	3
3.	21CP101	Advanced Data Structures and Algorithms *(Common to M.E CSE and M.E CSE(Specialisation in Networks))*	PC	3	0	0	3
4.	21NE101	Network Technologies *(Common to M.E.CSE, M.E CSE (with Specialization in Networks))*	PC	3	0	0	3
5.	21NE102	Wireless Communications	PC	3	0	0	3
6.	21AC101	Audit Course – I* *(Common to all M.E. Programmes)*	AC	2	0	0	0
		THEORY CUM PRACTICAL COURSES					
7.	21CP104	Database Practices *(Common to M.E CSE and M.E CSE(Specialisation in Networks))*	PC	3	0	2	4
		PRACTICAL COURSES					
8.	21CP103	Advanced Data Structures and Algorithms Laboratory *(Common to M.E CSE and M.E CSE(Specialisation in Networks))*	PC	0	0	4	2
9.	21NE103	Networks Laboratory	PC	0	0	4	2
		Total Credits					**24**

BoS Chairman

SEMESTER- II

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21NE104	Network Security	PC	3	0	0	3
2.	21CP107	Machine Learning *(Common to M.E.CSE, M.E CSE (with Specialization in Networks))*	PC	3	2	0	4
3.	21NEPXX	Professional Elective I	PE	3	0	0	3
4.	21NEPXX	Professional Elective II	PE	3	0	0	3
5.	21AC102	Audit Course – II* *(Common to all M.E. Programmes)*	AC	2	0	0	0
		THEORY CUM PRACTICAL COURSES					
6.	21NE105	Internet of Things and Applications	PC	3	0	2	4
		PRACTICAL COURSES					
7.	21NE106	Network Design and Programming Laboratory	PC	0	0	4	2
8.	21NE107	Network Security Laboratory	PC	0	0	4	1
9.	21NE108	Term Paper and Seminar *(Common to M.E.CSE, M.E CSE (with Specialization in Networks))*	EE	0	0	2	1
		Total Credits					**21**

SEMESTER- III

S.No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21NE201	Multimedia Communication Networks	PC	3	0	0	3
2.	21NEXXX	Professional Elective III	PE	3	0	0	3
3.	21NEXXX	Professional Elective IV	PE	3	0	0	3
4.	21NEXXX	Professional Elective V	PE	3	0	0	3
		PRACTICAL					
6.	21NE202	Project Work I	EE	0	0	12	6
		Total Credits					**18**

SEMESTER- IV

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21NE203	Project Work II	EE	0	0	24	12
Total Credits							12

TOTAL NO. OF CREDITS: 75

*Audit Courses I & II is optional.

SUMMARY

Category	I	II	III	IV	Total
FC	4	-	-	-	4
PC	17	15	3	-	35
RM	2	-	-	-	2
PE	-	6	9	-	15
EE	-	1	6	12	19
Total	23	22	18	12	75

PROFESSIONAL ELECTIVES (PE)*

SEMESTER II, ELECTIVE 1

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	21NEP01	Wireless Sensor Networks and Protocols	PE	3	0	0	3
2.	21NEP02	Optical Networks	PE	3	0	0	3
3.	21NEP03	Multimedia Security	PE	3	0	0	3
4.	21NEP04	Image Processing and Analysis	PE	3	0	0	3
5.	21NEP05	Agile Methodologies	PE	3	0	0	3

SEMESTER II, ELECTIVE II

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	21NEP06	Mobile and Pervasive Computing	PE	3	0	0	3
2.	21NEP07	Advanced Software Engineering	PE	3	0	0	3
3.	21NEP08	High Speed switching architectures	PE	3	0	0	3
4.	21NEP09	Network Management	PE	3	0	0	3

SEMESTER III, ELECTIVE III

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	21NEP10	Software Quality Assurance	PE	3	0	0	3
2.	21NEP11	Performance Analysis of Computer Systems *(Common to M.E.CSE, M.E CSE (with Specialization in Networks))*	PE	3	0	0	3
3.	21NEP12	Simulation of Computer Systems and Networks	PE	3	0	0	3
4.	21NEP13	Next Generation Networks	PE	3	0	0	3
5.	21NEP14	IT Audit and Control	PE	3	0	0	3

SEMESTER III, ELECTIVE IV

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	21NEP15	Cyber Physical Systems	PE	3	0	0	3
2.	21NEP16	Bioinformatics *(Common to M.E.CSE, M.E CSE (with Specialization in Networks))*	PE	3	0	0	3
3.	21NEP17	Deep Learning	PE	3	0	0	3
4.	21NEP18	Mobile Application Development *(Common to M.E.CSE, M.E CSE (with Specialization in Networks))*	PE	3	0	0	3
5.	21NEP19	Ethical Hacking	PE	3	0	0	3

SEMESTER III, ELECTIVE V

S. No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	21NEP20	Web Engineering *(Common to M.E.CSE, M.E CSE (with Specialization in Networks))*	PE	3	0	0	3
2.	21NEP21	Security in IoT and Cloud	PE	3	0	0	3
3.	21NEP22	Software Defined Networks and Network Function Virtualization	PE	3	0	0	3
4.	21NEP23	Digital Forensics	PE	3	0	0	3
5.	21NEP24	Social Network Analysis *(Common to M.E.CSE, M.E CSE (with Specialization in Networks))*	PE	3	0	0	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS
			L	T	P	
1.	21AC101	English for Research Paper Writing	2	0	0	0
2.	21AC102	Constitution of India	2	0	0	0
3.	21AC103	Disaster Management	2	0	0	0

21MA121	APPLIED PROBABILITY AND STATISTICS FOR COMPUTER SCIENCE ENGINEERS *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To encourage students to develop a working knowledge of the central ideas of Linear Algebra.
- To enable students to understand the concepts of Probability and Random Variables.
- To understand the basic probability concepts with respect to two dimensional random variables.
- To apply the small / large sample tests through Tests of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principal components analysis.

UNIT I	LINEAR ALGEBRA	12
Vector spaces – Norms – Inner Products – Eigenvalues using QR transformations – QR factorization – generalized eigenvectors – Canonical forms – singular value decomposition and applications – pseudo inverse – least square approximations.		
UNIT II	**PROBABILITY AND RANDOM VARIABLES**	**12**
Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.		
UNIT III	**TWO DIMENSIONAL RANDOM VARIABLES**	**12**
Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.		
UNIT IV	**TESTING OF HYPOTHESIS**	**12**
Sampling distributions – Type I and Type II errors – Small and Large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.		
UNIT V	**MULTIVARIATE ANALYSIS**	**12**
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Population principal components – Principal components from standardized variables.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the concepts of Linear Algebra to solve practical problems.

CO2: Use the ideas of probability and random variables in solving engineering problems.

CO3: Familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.

CO4: Use statistical tests in testing hypothesis on data.

CO5: Develop critical thinking based on empirical evidence and the scientific approach to knowledge development.

REFERENCES:

1. Dallas E Johnson, "Applied multivariate methods for data Analysis",vol 42, Thomson and Duxbury press, Singapore, 1998.
2. Richard A. Johnson and Dean W. Wichern, "Applied multivariate statistical Analysis", 6th Edition, Pearson Education, New Delhi, 2013.
3. Bronson, R.,"Matrix Operation", Schaum's outline series, 2nd Edition ,Tata McGraw Hill, New York, 2011.
4. Oliver C. Ibe, "Fundamentals of Applied probability and Random Processes", 2nd Edition, Academic Press, Boston, 2014.
5. Johnson R. A. and Gupta C.B., "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson India Education, Asia, New Delhi, 2017.

21RM101	RESEARCH METHODOLOGY AND IPR FOR TELECOM ENGINEERS *(Common to M.E. CSE(Specialisation in Networks) and M.E. Communication Systems programmes)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand research methodology, process and design.
- To know the details of sampling designs and also different methods of data collections.
- To introduce the art of interpretation and writing research reports.
- To be familiar with various forms of the intellectual property, its relevance and business impact in the changing global business environment.
- To understand the law of patent and licensing.

UNIT I	RESEARCH DESIGN	9
Overview of research process and design, Use of secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.		
UNIT II	**DATA COLLECTION AND SOURCES**	**9**
Measurements, Measurement scales, Questionnaires and instruments, Sampling and methods. Data - Preparing, Exploring, Examining and Displaying.		
UNIT III	**DATA ANALYSIS AND REPORTING**	**9**
Overview of Multivariate analysis, Hypotheses testing and Measures of association. Presenting insights and findings using written reports and oral presentation. Case studies.		
UNIT IV	**INTELLECTUAL PROPERTY RIGHTS**	**9**
Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance. Case studies.		
UNIT V	**PATENTS**	**9**
Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents. Case studies.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the technique of defining a research problem

CO2: Outline the concepts of data collections and analysis.

CO3: Interpret data and write research reports.

CO4: Explain the concepts of IPR and rules of IPR practices.

CO5: Infer the law of patent and licensing.

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", 11th edition, Tata McGraw Hill Education,.2012.
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", 1st Edition, Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen, Matthew Rodgers, "Patent Searching: Tools & Techniques", 1st Edition, Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", 2013.

21CP101	ADVANCED DATA STRUCTURES AND ALGORITHMS *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the usage of algorithms in computing
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications
- To select and design data structures and algorithms that is appropriate for problems
- To study about NP Completeness of problems.

UNIT I	ROLE OF ALGORITHMS IN COMPUTING	9

Algorithms – Algorithms as a Technology -Time and Space complexity of algorithms- Asymptotic analysis-Average and worst-case analysis-Asymptotic notation-Importance of efficient algorithms-Program performance measurement - Recurrences: The Substitution Method – The Recursion-Tree Method- Data structures and algorithms.

UNIT II	HIERARCHICAL DATA STRUCTURES	9

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B - trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Heap – Heap Implementation – Disjoint Sets - Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT III	GRAPHS	9+3

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; Dynamic Programming - All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm.

UNIT IV	ALGORITHM DESIGN TECHNIQUES	9+3

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: – Elements of the Greedy Strategy- An Activity-Selection Problem - Huffman Coding.

UNIT V	NP COMPLETE AND NP HARD	9+3

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Design data structures and algorithms to solve computing problems.

CO2: Choose and implement efficient data structures and apply them to solve problems.

CO3: Design algorithms using graph structure and various string-matching algorithms to solve real-life problems.

CO4: Design one's own algorithm for an unknown problem.

CO5: Apply suitable design strategy for problem solving.

REFERENCES:

1. S.Sridhar," Design and Analysis of Algorithms", Oxford University Press, 1st Edition, 2014.
2. Adam Drozdex, "Data Structures and algorithms in C++", Cengage Learning, 4th Edition, 2013.
3. T.H. Cormen, C.E.Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", Prentice Hall of India, 3rd Edition, 2012.
4. Mark Allen Weiss, "Data Structures and Algorithms in C++", Pearson Education, 3rd Edition, 2009.
5. E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamentals of Computer Algorithms", University Press, 2nd Edition, 2008.
6. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

21NE101	**NETWORK TECHNOLOGIES** *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of networks
- To explore various technologies in the wireless domain
- To study about 4G and 5G cellular networks
- To understand the paradigm of Software defined networks
- To learn about Network Function Virtualization

UNIT I	NETWORKING CONCEPTS	9

Peer To Peer Vs Client-Server Networks. Network Devices. Network Terminology. Network Speeds. Network throughput, delay. OSI Model. Packets, Frames, And Headers. Collision And Broadcast Domains. LAN Vs WAN. Network Adapter. Hub. Switch. Router. Firewall, IP addressing.

UNIT II	WIRELESS NETWORKS	9

Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be, QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee

UNIT III	MOBILE DATA NETWORKS	9

4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access –Channel Modeling for 4G – Concepts of 5G – channel access –air interface -Cognitive Radio- spectrum management – C-RAN architecture - Vehicular communications-protocol – Network slicing – MIMO, mmWave, Introduction to 6G.

UNIT IV	SOFTWARE DEFINED NETWORKS	9

SDN Architecture. Characteristics of Software-Defined Networking. SDN- and NFV-Related Standards. SDN Data Plane. Data Plane Functions. Data Plane Protocols. OpenFlow Logical Network Device. Flow Table Structure. Flow Table Pipeline. The Use of Multiple Tables. GroupTable. OpenFlow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface. Northbound Interface. Routing. ITU-T Model. OpenDaylight. OpenDaylight Architecture. OpenDaylight Helium. SDN Application Plane Architecture. Northbound Interface. Network Services Abstraction Layer. Network Applications. User Interface.

UNIT V	NETWORK FUNCTIONS VIRTUALIZATION	9

Motivation-Virtual Machines –NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV Use Cases- NFV and SDN –Network virtualization – VLAN and VPN

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the networking concepts.

CO2: Understand various technologies in wireless domain

CO3: Classify 4G and 5G networks

CO4: Interpret the paradigm of Software defined networks.

CO5: Understand about Network Function Virtualization.

REFERENCES:

1. James Bernstein, "Networking made Easy", 2018. (UNIT I)
2. HoudaLabiod, Costantino de Santis, HossamAfifi –"Wi-Fi, Bluetooth, Zigbee and WiMax", Springer 2007 (UNIT 2)
3. Erik Dahlman, Stefan Parkvall, Johan Skold, —4G: LTE/LTE-Advanced for Mobile Broadband, Academic Press, 1st Edition ,2013 (UNIT 3)
4. Saad Z. Asif – "5G Mobile Communications Concepts and Technologies" CRC press , 1st Edition ,2019 (UNIT 3)
5. William Stallings –"Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" 1st Edition, Pearson Education, 1st Edition ,2016.(Unit 4 and 5)
6. Thomas D.Nadeau and Ken Gray, "SDN – Software Defined Networks" ,O"Reilly Publishers, 1st Edition ,2013.
7. Guy Pujolle, "Software Networks", Second Edition, Wiley-ISTE, 2020

BoS Chairman

21NE102	WIRELESS COMMUNICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts in cellular communication.
- To learn the characteristics of wireless channels.
- To understand the impact of digital modulation techniques in fading.
- To get exposed to diversity techniques in wireless communication.
- To acquire knowledge in multicarrier systems.

UNIT I	CELLULAR CONCEPTS	9

Frequency Reuse – Channel Assignment Strategies – Handoff Strategies – Interference and system capacity- Co-Channel Interference- Adjacent Channel Interference – Trunking and Grade of service – Improving coverage & capacity in cellular systems-Cell Splitting- Sectoring-Repeaters for Range Extension-Microcell Zone Concept

UNIT II	THE WIRELESS CHANNEL	9

Overview of wireless systems – Physical modeling for wireless channels – Time and Frequency coherence – Statistical channel models – Capacity of wireless Channel- Capacity of Flat Fading Channel – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver –Capacity comparisons – Capacity of Frequency Selective Fading channels

UNIT III	PERFORMANCE OF DIGITAL MODULATION OVER WIRELESSCHANNELS	9

Performance of flat fading and frequency selective fading – Impact on digital modulation techniques — Outage Probability– Average Probability of Error — Combined Outage and Average Error Probability – Doppler Spread – Inter symbol Interference.

UNIT IV	DIVERSITY TECHNIQUES	9

Realization of Independent Fading Paths – Receiver Diversity – Selection Combining – Threshold Combing – Maximal-Ratio Combining – Equal - Gain Combining – Capacity with Receiver diversity – Transmitter Diversity – Channel known at Transmitter – Channel unknownat Transmitter – The Alamouti Scheme– Transmit & Receive Diversity-MIMO Systems.

UNIT V	MULTICARRIER MODULATION	9

Data Transmission using Multiple Carriers – Multicarrier Modulation with Overlapping Sub channels – Mitigation of Subcarrier Fading – Discrete Implementation of Multicarrier Modulation– Peak to average Power Ratio- Frequency and Timing offset.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Design solutions for cellular communication.

CO2: Determine the capacity of wireless channels.

CO3: Understand the performance of the digital modulation techniques in fading channels.

CO4: Apply various diversity techniques in wireless communication.

CO5: Design multicarrier systems in wireless communication.

REFERENCES:

1. Theodore.S. Rappaport, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education. India, 2010
2. Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
3. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communication", Wiley Publication, 2nd Edition,2005.
4. Saad Z. Asif, "5G Mobile Communications Concepts and Technologies" 3rd Edition, CRC press –2019.
5. Keith Q. T. Zhang, "Wireless Communications: Principles, Theory and Methodology" 1st edition, John Wiley & Sons, 2016.
6. Ramjee Prasad, "OFDM for Wireless Communication Systems", Artech House,2nd edition, 2004.

21CP104	**DATABASE PRACTICES** *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To describe the fundamental elements of relational database management systems
- To explain the basic concepts of relational data model, entity-relationship model, relational database design, relational algebra and SQL.
- To understand query processing in a distributed database system
- To understand the basics of XML and create well-formed and valid XML documents.
- To distinguish the different types of NoSQL databases

UNIT I	RELATIONAL DATA MODEL	12

Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model to Relational Model – Relational Algebra – Structured Query Language – Database Normalization.

Suggested Activities:

Data Definition Language

- Create, Alter and Drop
- Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints
- Creating Views

Data Manipulation Language

- Insert, Delete, Update
- Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join
- Aggregate Functions
- Set Operations
- Nested Queries

Transaction Control Language

- Commit, Rollback and Save Points

UNIT II	DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASE CONNECTIVITY	12

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.

Suggested Activities:

- Distributed Database Design and Implementation
- Row Level and Statement Level Triggers
- Accessing a Relational Database using PHP, Python and R

UNIT III	XML DATABASES	12

Structured, Semi structured, and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying – XPath – XQuery

Suggested Activities:

- Creating XML Documents, Document Type Definition and XML Schema
- Using a Relational Database to store the XML documents as text
- Using a Relational Database to store the XML documents as data elements
- Creating or publishing customized XML documents from pre-existing relational databases
- Extracting XML Documents from Relational Databases
- XML Querying

UNIT IV	NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS	12

NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics – NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key-Value Distributed Data Store – Wide Column NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j – Big Data – MapReduce – Hadoop – YARN.

Suggested Activities:

- Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.
- Writing simple queries to access databases created using MongoDB, DynamoDB, Voldemort Key-Value Distributed Data Store Hbase and Neo4j.

UNIT V	DATABASE SECURITY	12

Privileges – Mandatory Access Control and Role-Based Access Control for Multilevel Security – SQL Injection – Statistical Database Security – Flow Control – Encryption and Public Key Infrastructures – Preserving Data Privacy – Challenges to Maintaining Database Security – Database Survivability – Oracle Label-Based Security.

Suggested Activities:

Implementing Access Control in Relational Databases

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Convert the ER-model to relational tables, populate relational database and formulate SQL queries on data.

CO2: Understand and write well-formed XML documents.

CO3: Apply methods and techniques for distributed query processing.

CO4: Design and Implement secure database systems.

CO5: Use the data control, definition, and manipulation languages of the NoSQL databases.

REFERENCES:

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Education 2016.
2. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts 7th Edition, McGraw Hill, 2019.
3. C.J.Date, A.Kannan, S.Swamynathan, —An Introduction to Database Systems, 8th Edition, Pearson Education, 2006.
4. Raghu Ramakrishnan , Johannes Gehrke "Database Management Systems", 4th Edition, McGraw Hill Education, 2015.

5. Harrison, Guy, "Next Generation Databases, NoSQL and Big Data" , 1st Edition, Apress publishers, 2015.
6. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", 6th Edition, Pearson Education, 2015.

21CP103	ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To acquire the knowledge of using advanced tree structures
- To learn the usage of heap structures
- To understand the usage of graph structures and spanning trees
- To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
- To understand the necessary mathematical abstraction to solve problems.

LIST OF EXPERIMENTS:

1. Implementation of recursive function for tree traversal and Fibonacci
2. Implementation of iteration function for tree traversal and Fibonacci
3. Implementation of Merge Sort and Quick Sort
4. Implementation of a Binary Search Tree
5. Red-Black Tree Implementation
6. Heap Implementation
7. Fibonacci Heap Implementation
8. Graph Traversals
9. Spanning Tree Implementation
10. Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)
11. Implementation of Matrix Chain Multiplication
12. Activity Selection and Huffman Coding Implementation

HARDWARE/SOFTWARE REQUIREMENTS

1. 64-bit Open source Linux or its derivative
2. Open Source C++ Programming tool like G++/GCC

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Design and implement basic and advanced data structures extensively

CO2: Design algorithms using graph structures

CO3: Design and develop efficient algorithms with minimum complexity using design techniques

CO4: Develop programs using various algorithms.

CO5: Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.

REFERENCES:

1. Lipschutz Seymour, "Data Structures Schaum's Outlines Series", Tata McGraw Hill, 3rd Edition, 2014.
2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint 2006.

21NE103	NETWORKS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To understand the functioning of various protocols in wired and wireless environments.
- To perform real time experiments using the existing infrastructure.
- To impart programming skills using NS2/QUALNET.
- To gain knowledge in constructing LAN, WLAN, and VLAN in a real-time environment.
- To understand the security algorithms for networks.

LIST OF EXPERIMENTS:

1. AODV/DSR routing
2. Security algorithms in wired networks
3. MAC protocols wired and wireless networks
4. Configuration of LAN
5. Configuration of VLAN- Tunneling
6. Configuration of WLAN
7. Mini Project

HARDWARE/SOFTWARE REQUIREMENTS:

1: C/Java/Python

2: NS2/ QUALNET /NS3/ OMNET/ equivalent

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Design MAC and routing protocols in Wired and Wireless Environment using NS2/QUALNET.

CO2: Acquire the technical competence to meet out the industry expectation on the state – of the art wired / wireless technologies.

CO3: Acquire the ability to design WLAN/ LAN systems meeting out real time requirements.

CO4: Design and configure a network.

CO5: Design VLAN for secured communication.

21NE104	NETWORK SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To understand the fundamentals of network security.
- To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
- To understand the various key distribution and management schemes.
- To understand how to deploy encryption techniques to secure data in transit across data networks.

UNIT I	INTRODUCTION	10
Services, Mechanisms and attacks-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields-Modular arithmetic-Euclid's algorithm- Finite fields- Polynomial Arithmetic –Prime numbers-Fermat's and Euler's theorem-Testing for primality -The Chinese remainder theorem- Discrete logarithms.		
UNIT II	**BLOCK CIPHERS & PUBLIC KEY ENCRYPTION**	**10**
Data Encryption Standard-Block cipher design principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm. Public key encryption: Principles of public key cryptosystems-The RSA algorithm – Key Management - Diffie Hellman Key exchange-Elliptic curve arithmetic-Elliptic curve cryptography.		
UNIT III	**HASH FUNCTIONS AND DIGITAL SIGNATURES**	**9**
Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC –MD5 - SHA - HMAC – CMAC - Digital signature and authenticationprotocols – DSS – EI Gamal – Schnorr.		
UNIT IV	**E-MAIL, IP & WEB SECURITY**	**8**
E-mail Security: Pretty Good Privacy-S/MIME. IPSecurity: Overview of IPSec - IP security policy-Encapsulation Security Payload (ESP)-Combining Security Associations-Internet Key Exchange. Web Security: Web Security Considerations-Secure Socket Layer(SSL)- Transport Layer Security(TLS)- -Secure Electronic Transaction (SET).		
UNIT V	**SYSTEM SECURITY**	**8**
Authentication applications – Kerberos – X.509 Authentication services - Firewalls – Types of Firewalls- Firewall design principles- Trusted System. Intruders – Intrusion detection – Viruses and related threats – Virus Countermeasures.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Compare various Security Techniques Design Secure applications Inject secure coding in the developed applications

CO2: Implement basic security algorithms required by any computing system.

CO3: Understand the vulnerabilities in any computing system and hence be able to design a security solution.

CO4: Suggest the possible security attacks in complex real time systems and their effective counter measures

CO5: Identify the security issues in the network and resolve it.

REFERENCES:

1. Behrouz A. Ferouzan, "Cryptography & Network Security", Tata Mc Graw Hill, 1st Edition 2007.
2. Bruce Schneier and Neils Ferguson,"Practical Cryptography", 1st Edition, Wiley Dreamtech India Pvt Ltd, 2003.
3. Charles Pfleeger,"Security in Computing", 4th Edition, Prentice Hall of India, 2006.
4. Charlie Kaufman and Radia Perlman, Mike Speciner,"Network Security", 2nd Edition, Private Communication in Public World, PHI 2002.
5. Douglas R Simson "Cryptography – Theory and practice", 1st Edition, CRC Press, 1995.
6. Man Young Rhee, "Internet Security: Cryptographic Principles, -Algorithms and Protocols" , Wiley Publications, 1st Edition, 2003.
7. Ulysess Black, "Internet Security Protocols", Pearson Education Asia, 1st Edition, 2000.
8. William Stallings, "Cryptography and Network Security", 6th Edition, PearsonEducation, March 2013.

21CP107	MACHINE LEARNING *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability-based learning techniques
- To understand dimensionality reduction and evolutionary models
- To understand graphical models of machine learning algorithms

TOPICS TO BE COVERED

UNIT I	INTRODUCTION	9
Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression		
UNIT II	**LINEAR MODELS**	**9**
Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.		
UNIT III	**TREE AND PROBABILISTIC MODELS**	**9**
Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map		
UNIT IV	**DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS**	**9**
Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process		
UNIT V	**GRAPHICAL MODELS**	**9**
Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods		
		TOTAL: 45 PERIODS

BoS Chairman

COURSE OUTCOMES::

At the end of the course, learners will be able to

CO1: Distinguish between supervised, unsupervised and semi-supervised learning.
CO2: Apply the appropriate machine learning strategy for any given problem.
CO3: Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem.
CO4: Design a system that uses the appropriate graph models of machine learning.
CO5: Modify existing machine learning algorithms to improve classification efficiency

REFERENCES:

1. EthemAlpaydin, —Introduction to Machine Learning , 3rd edition (Adaptive Computation and Machine Learning Series) , MIT Press, 2014 .
2. Jason Bell, —Machine learning – Hands on for Developers and Technical Professionals, 1st Edition, Wiley, 2014 .
3. Peter Flach, —Machine Learning: The Art and Science of Algorithms that Make Sense of Data, 1st Edition, Cambridge University Press, 2012.
4. Stephen Marsland, —Machine Learning – An Algorithmic Perspective, 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
5. Tom M Mitchell, —Machine Learning, 1st Edition, McGraw Hill Education, 2013.

21NE105	INTERNET OF THINGS AND APPLICATIONS	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To learn about various IoT architecture
- To learn about the basics of IOT protocols
- To build a small low cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real world scenario.

UNIT I	INTRODUCTION TO IoT	12

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

Suggested Activities :

Node MCU/ESP 32 - Temperature Sensor Interfacing (LM35) - Bluetooth Interfacing (HC05)- Motor driver Interfacing (L298) -LCD Interfacing (HD44780).

UNIT II	IoT ARCHITECTURE	12

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

Suggested Activities :

Implementation of IoT using BLYNK/CAYENNE - –Installation and Activation - Blinking an LED -Reading Analog Voltage - LCD Interfacing (HD44780) –Project.

UNIT III	IoT PROTOCOLS	12

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP – Security

Suggested Activities :

Implementation of Zigbee protocol using Arduino.

UNIT IV	BUILDING IoT WITH RASPBERRY PI & ARDUINO	12

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms – Arduino

Suggested Activities :

Implementation of IoT using Raspberry Pi & Python Programming: - LCD Interfacing (HD44780) - Motor driver Interfacing (L298) – Camera interface.

UNIT V	CASE STUDIES AND REAL-WORLD APPLICATIONS	12

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs – Cloud for IoT - Amazon Web Services for IoT.

Suggested Activities :

Study of various applications using IoT.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Analyze various protocols for IoT

CO2: Develop web services to access/control IoT devices.

CO3: Design a portable IoT using Rasperry Pi

CO4: Deploy an IoT application and connect to the cloud.

CO5: Analyze applications of IoT in real time scenario

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, 1st edition,2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), "Architecting the Internet of Things", Springer, 2011.
3. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 1st edition, 2012.
4. Jan Ho¨ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence",1st edition, Academic Press, Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley,2nd edition, 2012.

21NE106	NETWORK DESIGN AND PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To practice LAN and WAN design
- To learn network programming in UNIX C and Python
- To establish a LAN with a switch/hub with 3 PCs and check the connectivity and configuration
- To establish a internetwork with 2 routers and two or more LANs using static routes and check the connectivity and configuration
- To establish a dynamic routing based internetwork with 2 routers and two or more LANs using RIP/OSPF and check the connectivity and configuration.

LIST OF EXPERIMENTS:

1. Develop a C program that demonstrates inter process communication
2. Develop a TCP client/server application
3. Develop a UDP client/server application
4. Develop an Iterative UDP server with 2 or 3 clients
5. Develop a concurrent TCP server with 2 or 3 clients
6. Develop a multiprotocol server with TCP and UDP and 2 clients
7. Develop simple Python programs that use frequently used syntactic constructs
8. Develop a Socket based application in Python
9. Build client applications for major APIs (Amazon S3, Twitter etc) in Python
10. Develop an application that interacts with e-mail servers in python
11. Develop applications that work with remote servers using SSH, FTP etc in Python

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Design and implement LANs and internetworks.

CO2: Develop network based applications in UNIX C and Python.

CO3: Establish a LAN with a switch/hub.

CO4: Design a LANs using static routes.

CO5: Suggest the various critical parameters in deploying a WSN.

21NE107	NETWORK SECURITY LABORATORY	L	T	P	C
		0	0	4	1

COURSE OBJECTIVES:

- To learn about security protocols
- To implement security algorithms
- To learn and implement third party tools for security analysis.
- To implement security testing.
- To implement SQL Injection Technique.

LIST OF EXPERIMENTS:

1. Implementation of Known Plain text attack in Hill Cipher
2. Implementation of Data Encryption Standard
3. Implementation of Advanced Encryption Standard
4. Implementation of RSA
5. Implementation of Least Significant Bit method in Image Steganography
6. Security Analysis of Cryptographic algorithms using OPEN SSL
7. Analysis of Secure Socket Layer and IPSec protocol using wireshark
8. Simulation of SQL injection using DVWA
9. Simulation of Cross site Scripting using DVWA
10. Port Scanning using Nmap and Buffer overflow
11. Forensic Analysis using OSSEC
12. Email log Reports using Pflogsum

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand and implement various security protocols.

CO2: Compare the performances of various security protocols.

CO3: Understand about various third party tools used for security analysis.

CO4: Analyse those tools used for security testing.

CO5: Understand about SQL injection technique.

21NE108	**TERM PAPER AND SEMINAR** *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		0	0	2	1.

COURSE OBJECTIVES:

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing eachpaper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Activity	Instructions	Submission week	Evaluation
Selection ofarea of interest and Topic Stating an Objective	You are requested to select an area ofinterest, topic and state an objective	2^{nd} week	3 % Based on clarity of thought, current relevance and clarityin writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists,forums, news sites) 6. List 3 authors who publish regularly inyour area 7. Attach a call for papers (CFP) from your area.	3^{rd} week	3% (the selected information must bearea specific and of international and national standard)

Collection of Journal papers in the topic in the context of theobjective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: • Pick papers that are related to eachother in some ways and/or that are in the same field so that you can write a meaningful survey out of them,	4^{th} week	6% (the list of standard papers and reason forselection)
	• Favour papers from well-known journals and conferences, • Favour —first or —foundationall papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered		
Reading and notes for first 5 papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author	5th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

	said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	8% (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	6% (Clarity, purpose and conclusion) 6% Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	5% (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	10% (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	5% (conclusions – clarity and your ideas)

Final Draft	Complete the final draft of your paper	13th week	10% (formatting, English, Clarity and linking) 4% Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	10% (based on presentation and Viva-voce)

21NE201	MULTIMEDIA COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the multimedia communication models
- To study the multimedia transport in wireless networks
- To explore real-time multimedia network applications.
- To formulate real-time multimedia network applications.
- To analyse the various qualities of Wireless Networks.

UNIT I	MULTIMEDIA COMMUNICATION MODELS	9

Common Multimedia applications - VoIP- Video Conferencing- Military Surveillance-Interactive TV- Video on Demand- Smart Phone - Requirements and Design challenges of multimedia communications-Architecture of Internet Multimedia Communication- Protocol Stack-H.323.

UNIT II	BEST EFFORT AND GUARANTEED SERVICE MODEL	9

Best effort service model and its limitations-Resource allocation-Metrics-Max and Min fair sharingQueuing-FIFO-Priority queue-Fair queue- Waited fair queue-Traffic policing-Token bucket- leaky bucket-Admission control-Packet classification and scheduling.

UNIT III	MULTIMEDIA ON IP NETWORKS	9

QoS aware routing-RSVP-Integrated and Differentiated services-MPLS-Multicasting-IGMP-PIMDVMRP

UNIT IV	TRANSPORT LAYER SUPPORT FOR MULTIMEDIA	9

Multimedia over TCP-Significance of UDP- Multimedia Streaming- Audio and Video StreamingInteractive and non Interactive Multimedia-RTP/RTCP-SIP-RTSP.

UNIT V	MULTIMEDIA QOS ON WIRELESS NETWORKS	9

IEEE 802.11e, IEEE 802.16, 3G networks-UMTS, 3GPP, 4G networks-LTE-IMS

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: To select suitable multimedia communication model for the required application.

CO2: Deploy the right Multimedia Communication models.

CO3: Apply QoS to multimedia network applications with efficient routing techniques.

CO4: Develop the real-time multimedia network applications.

CO5: Compare the various qualities of Wireless Networks.

REFERENCES:

1. James F. Kurose and Keith W. Ross, —Computer Networking-A Top-Down Approach Featuring the Internet, Pearson, 2nd edition,2012.
2. Larry L. Peterson and Bruce S. Davie, —Computer Networks- A Systems Approach, Morgan Kaufmann Publishers,2nd edition, 2007.
3. Mario Marques da Silva, —Multimedia Communications and Networking, CRC Press, 3rd edition, 2012.

21NEP01	WIRELESS SENSOR NETWORKS AND PROTOCOLS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of wireless sensor networks and its application to critical real time scenarios.
- To study the various protocols at various layers and its differences with traditional protocols.
- To understand the issues pertaining to sensor networks and the challenges involved in managing a sensor network.
- To analyse the issues associated with routing protocols.
- To understand the issues and challenges in providing QoS and Energy Management.

UNIT I	INTRODUCTION	9

Fundamentals of wireless communication technology, the electromagnetic spectrum radio propagation, characteristics of wireless channels, modulation techniques, multiple access techniques, wireless LANs, PANs, WANs, and MANs, Wireless Internet.

UNIT II	INTRODUCTION TO ADHOC/SENSOR NETWORKS	9

Key definitions of adhoc/ sensor networks, unique constraints and challenges, advantages of ad-hoc/sensor network, driving applications, issues in adhoc wireless networks, issues in design of sensor network, sensor network architecture, data dissemination and gathering.

UNIT III	MAC PROTOCOLS	9

Issues in designing MAC protocols for adhoc wireless networks, design goals, classification of MAC protocols, MAC protocols for sensor network, location discovery, quality, other issues, S-MAC, IEEE 802.15.4.

UNIT IV	ROUTING PROTOCOLS	9

Issues in designing a routing protocol, classification of routing protocols, table-driven, on-demand, hybrid, flooding, hierarchical, and power aware routing protocols.

UNIT V	QOS AND ENERGY MANAGEMENT	9

Issues and Challenges in providing QoS, classifications, MAC, network layer solutions, QoS frameworks, need for energy management, classification, battery, transmission power, and system power management schemes.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Technically know how to build a WSN network.

CO2: Explain the working principle and applications of sensor networks.

CO3: Describe about MAC protocols.

CO4: Demonstrate the characteristics of routing protocols.

CO5: Analysis of various critical parameters in deploying a WSN.

TEXT BOOKS:

1. Siva Ram Murthy, and B. S. Manoj, "AdHoc Wireless networks ", Pearson Education - 2008.

REFERENCES:

1. Feng Zhao and Leonides Guibas, "Wireless sensor networks ", Elsevier publication - 2004.
2. Jochen Schiller, "Mobile Communications", Pearson Education, 2nd Edition, 2003.
3. William Stallings, "Wireless Communications and Networks ", Pearson Education 2nd ed, 2004.

21NEP02	OPTICAL NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To be well-versed in functionalities of various optical components and networking architectures like SONET /SDH used in Optical Networking.
- To be prepared for cost effective laying Access Networks like Fiber to the Home in India.
- To design and develop Optical Network Routing Algorithms.
- To apply basic Networking knowledge in optical domain.
- To analyze the optical networks in its configuration, fault and performance.

UNIT I	OPTICAL SYSTEM COMPONENTS	9

Light propagation in optical fibers – Loss & bandwidth, Dispersion effects, Non-Linear effects; Solitons-Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches,Wavelength Converters.

UNIT II	OPTICAL NETWORK ARCHITECTURES	9

Introduction to Optical Networks: SONET / SDH standards, Metropoliton Area Networks, Layered Architecture-Broadcast and Select Networks– Topologies for Broadcast Networks, Media Access Control Protocols, Test beds for WDM; Outline of Wavelength Routing Architecture.

UNIT III	WAVELENGTH ROUTING NETWORKS	9

Optical layer, Node Designs, Routing and Wavelength Assignment, Virtual topology design problem, Regular virtual topology design- Predetermined Virtual topology and Light path routes-Architectural variations.

UNIT IV	PACKET SWITCHING AND ACCESS NETWORKS	9

Photonic Packet Switching – OTDM, Multiplexing and Demultiplexing, Synchronisation, Broadcast OTDM networks, Switch-based networks- Access Networks – Network Architecture overview, OTDM networks- Optical Access Network Architectures- Future Access Networks, FTTH Scenario in India and Foreign Countries.

UNIT V	NETWORK DESIGN AND MANAGEMENT	9

Transmission System Engineering – System model, Power penalty - transmitter, receiver, Optical amplifiers, crosstalk, dispersion- Wavelength stabilization ; Overall design considerations- Control and Management– Network management functions, Configuration management, Performance management, Fault management, Optical safety. Simple simulations using OPTSIM software.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply knowledge ofbasic optical components for realizing any optical function.

CO2: Identify and formulate different networking Topologies.

CO3: Design Optical Network Routing Algorithms.

CO4: Apply the basic Networking knowledge to realize any sort of end to end communication and analyze the Time division multiplexing in optical domain.

CO5: Manage the optical networks in its configuration, fault and performance.

REFERENCES:

1. Rajiv Ramaswami, Kumar N. Sivarajan and Galen H. Sasaki "Optical Networks : A Practical Perspective", 3rd Edition ,Harcourt Asia Pvt. Ltd., 2010.
2. Mohammad Ilyas, Hussein T. Mouftah, "Handbook of Optical Communication Networks", 1st edition , Taylor and Francis, 2007.
3. C.Siva Ram Moorthy and Mohan Gurusamy, "WDM Optical Networks :Concept, Design and Algorithms",Prentice Hall of India, First Edition, 2002.
4. Biswanath Mukherjee, "Optical Communication Networks", McGrawHill Revised Edition 2006.
5. P.E. Green, Jr., "Fiber Optic Networks", Prentice Hall, NJ, 1993. 6. Rajiv Ramaswami and Kumar N. Sivarajan,"Optical Networks : A Practical Perspective", Harcourt Asia Pvt. Ltd., First Edition 1997.
6. Rajiv Ramaswami, Kumar N. Sivarajan and Galen H. Sasaki "Optical Networks : A Practical Perspective",Harcourt Asia Pvt. Ltd., First Edition 2005

21NEP03	MULTIMEDIA SECURITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental concepts of forensic science.
- To understand the application of forensic science principles to digital evidence examinations.
- To articulate the steps of the forensic process as applied to digital evidence.
- To draft a Standard Operating Procedure.
- To Conduct rudimentary digital forensic examinations

UNIT I — INTRODUCTION TO MULTIMEDIA — 9

Image, Video and Audio Formats and Standards, and Digital Rights Management Mathematical Preliminaries - Discrete Fourier Transform, Discrete Cosine Transform, Discrete Wavelet Transform ,Random Sequence Generation, The Chaotic Maps , Error Correction Codes.

UNIT II — MULTIMEDIA ENCRYPTION — 9

Requirements and Applications Approaches – Full Encryption, Selective Encryption, Joint Compression and Encryption, Syntax-Compliant Encryption,Scalable Encryption and Multi-Access Encryption. Attacks – Traditional Attacks, Statistical Attack, Error concealment attack.

UNIT III — DIGITAL WATER MARKING — 9

Requirements and Applications, Watermarking Algorithms-Spatial-Domain Watermarking - Substitution and Additive Watermarking. Frequency-Domain Watermarking - Substitution and Multiplicative Watermarking, Watermarking Based on Vector Quantization, Fragile Watermarking - Block-Based and Hierarchical Block-Based watermarking.

UNIT IV — WATER MARKING PROTOCOLS — 9

A Buyer-Seller Watermarking Protocol,Extensions of Watermarking Protocols, Protocols for Secure Computation Attacks -Filtering, Remodulation, JPEG Coding Distortion and JPEG 2000 Compression, Geometric Transformation -Image Scaling, Rotation, Image Clipping, Linear Transformation, Bending,
Warping and Perspective Projection, Cryptographic attacks and Protocol attacks, Watermarking Tools

UNIT V — LAWS AND ACTS — 9

Requirements and Applications, Types– Text, Audio, Video, Linguisticand Network steganography Algorithms – Least Significant Method, GIFshuffle, EzStego,Jsteg, Steganographic Tools Steganalysis - Statistical Properties of Images, The Visual Steganalytic System, IQM-Based Steganalytic System, Learning Strategies- Support Vector Machine, Neural Networks, Principle Component Analysis, Frequency-Domain Steganalytic System

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand an idea regarding the fundamental concepts of forensic science.
CO2: Apply the concepts and will be able to collect digital evidence.
CO3: Implement the forensic concepts in open platform.
CO4: Apply the Standard Operating Procedure.
CO5: Understand the forensic evidence in terms of Legal procedure.

REFERENCES:

1. Cox, Miller, Bloom, Fridrich, and Kalker, " Digital Watermarking and Steganography",2nd Edition, 2008
2. Wenjun Zeng, Heather Yu, Ching-Yung Lin, "Multimedia Security Technologies for Digital Rights Management", Elsevier, 2008
3. Borko Furht, Darko Kirovski "Multimedia Security Handbook", CRC Press,2nd edition, 2004

21NEP04	IMAGE PROCESSING AND ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the image processing concepts and analysis
- To understand the image processing techniques
- To familiarize the image processing environment and their applications
- To appreciate the use of image processing in various applications.
- To analyze the concept of image registration and visualization

UNIT I	IMAGE PROCESSING FUNDAMENTALS	9

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.

UNIT II	IMAGE ENHANCEMENT AND RESTORATION	9

Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.

UNIT III	IMAGE SEGMENTATION AND MORPHOLOGY	9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing OperationsDistance Transforms- Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.

UNIT IV	IMAGE ANALYSIS AND CLASSIFICATION	9

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

UNIT V	IMAGE REGISTRATION AND VISUALIZATION	9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Design and implement algorithms for image processing applications that incorporates different concepts of medical Image Processing.

CO2: Familiar with the use of MATLAB and its equivalent open source tools.

CO3: Critically analyze different approaches to image processing applications.

CO4: Explore the possibility of applying Image processing concepts in various applications.

CO5: Understand the concept of image registration and visualization.

REFERENCES:

1. Alasdair McAndrew, "Introduction to Digital Image Processing with Matlab", Cengage Learning 2011,2nd edition,India.
2. Anil J Jain, "Fundamentals of Digital Image Processing", PHI,2nd edition, 2006.
3. Kavyan Najarian and Robert Splerstor, "Biomedical signals and Image Processing", CRC – Taylor and Francis, New York, 2nd edition, 2006.
4. Rafael C.Gonzalez and Richard E.Woods, "Digital Image Processing", 3rd Edition, Pearson Education, 2008, New Delhi
5. S.Sridhar, "Digital Image Processing", Oxford University Press,2nd edition, 2011

21NEP05	AGILE METHODOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.
- To discuss about agile scrum framework..
- To do a detailed examination and demonstration of Agile development and testing techniques.
- To understand the benefits and pitfalls of working in an Agile team.
- To understand Agile development and testing.

UNIT I — FUNDAMENTALS OF AGILE — 9

The Genesis of Agile, Introduction and background, Agile Manifesto and Principles, Overview of Scrum, Extreme Programming, Feature Driven development, Lean Software Development, Agile project management, Design and development practices in Agile projects, Test Driven Development, Continuous Integration, Refactoring, Pair Programming, Simple Design, User Stories, Agile Testing, Agile Tools

UNIT II — AGILE SCRUM FRAMEWORK — 9

Introduction to Scrum, Project phases, Agile Estimation, Planning game, Product backlog, Sprint backlog, Iteration planning, User story definition, Characteristics and content of user stories, Acceptance tests and Verifying stories, Project velocity, Burn down chart, Sprint planning and retrospective, Daily scrum, Scrum roles – Product Owner, Scrum Master, Scrum Team, Scrum case study, Tools for Agile project management.

UNIT III — AGILE TESTING — 9

The Agile lifecycle and its impact on testing, Test-Driven Development (TDD), xUnit framework and tools for TDD, Testing user stories - acceptance tests and scenarios, Planning and managing testing cycle, Exploratory testing, Risk based testing, Regression tests, Test Automation, Tools to support the Agile tester.

UNIT IV — AGILE SOFTWARE DESIGN AND DEVELOPMENT — 9

Agile design practices, Role of design Principles including Single Responsibility Principle, Open Closed Principle, Liskov Substitution Principle, Interface Segregation Principles, Dependency Inversion Principle in Agile Design, Need and significance of Refactoring, Refactoring Techniques, Continuous Integration, Automated build tools, Version control.

UNIT V — INDUSTRY TRENDS — 9

Market scenario and adoption of Agile, Agile ALM, Roles in an Agile project, Agile applicability, Agile in Distributed teams, Business benefits, Challenges in Agile, Risks and Mitigation, Agile projects on Cloud, Balancing Agility with Discipline, Agile rapid development technologies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Experiment the Agile development practice.

CO2: Perform development with unit tests using Test Driven Development.

CO3: Apply design principles and refactoring to achieve Agility.

CO4: Deploy and justify automated build tools, version control and continuous integration

CO5: Build testing activities within an Agile project.

REFERENCES:

1. Ken Schawber, Mike Beedle," Agile Software Development with Scrum", Pearson publication,2nd edition,2010.
2. Lisa Crispin, Janet Gregory, "Agile Testing: A Practical Guide for Testers and Agile Teams", Publisher: Addison Wesley, 2nd edition,2009.
3. Robert C. Martin, "Agile Software Development, Principles, Patterns and Practices", Publisher: Prentice Hall,3rd edition,2002.
4. Alistair Cockburn ,"Agile Software Development: The Cooperative Game", Publisher: Addison Wesley, 2nd edition, 2008.

21NEP06	MOBILE AND PERVASIVE COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the basic architecture and concepts till Third Generation Communication systems..
- To understand the latest 4G Telecommunication System Principles.
- To introduce the broad perspective of pervasive concepts and management.
- To Explore the HCI in Pervasive environment.
- To explore the pervasive concepts in mobile environment

UNIT I	INTRODUCTION	9

History – Wireless communications: GSM – DECT – TETRA – UMTS – IMT – 2000 – Blue tooth, WiFi, WiMAX, 3G ,WATM.- Mobile IP protocols -WAP push architecture-Wml scripts and applications. Data networks – SMS – GPRS – EDGE – Hybrid Wireless100 Networks – ATM – Wireless ATM.

UNIT II	OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM	9

Introduction. LTE-A System Architecture. LTE RAN. OFDM Air Interface. Evolved Packet Core. LTE Requirements. LTE-Advanced. LTE-A in Release. OFDMA – Introduction. OFDM Principles. LTE Uplink—SC-FDMA. Summary of OFDMA..

UNIT III	PERVASIVE CONCEPTS AND ELEMENTS	9

Technology Trend Overview - Pervasive Computing: Concepts - Challenges - Middleware - Context Awareness - Resource Management - Human–Computer Interaction - Pervasive Transaction Processing - Infrastructure and Devices - Wireless Networks - Middleware for Pervasive Computing Systems - Resource Management - User Tracking- Context Management -Service Management. - Data Management - Security Management - Pervasive Computing Environments - Smart Car Space - Intelligent Campus

UNIT IV	HCI IN PERVASIVE COMPUTING	9

Prototype for Application Migration - Prototype for Multimodalities - Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - Context-Driven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm

UNIT V	PERVASIVE MOBILE TRANSACTIONS	9

Pervasive Mobile Transactions - Introduction to Pervasive Transactions – Mobile Transaction Framework - Unavailable Transaction Service - Pervasive Transaction Processing Framework - Context-Aware Pervasive Transaction Model - Context Model for Pervasive Transaction Processing - Context-Aware Pervasive Transaction Model - A Case of Pervasive Transactions - Dynamic Transaction Management - Context-Aware Transaction Coordination Mechanism - Coordination Algorithm for Pervasive Transactions - Participant Discovery - Formal Transaction Verification - Petri Net with Selective Transition.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Obtain a thorough understanding of Basic architecture and concepts of till Third Generation Communication systems.

CO2: Explain the latest 4G Telecommunication System Principles.

CO3: Incorporate the pervasive concepts.

CO4: Implement the HCI in Pervasive environment

CO5: Work on the pervasive concepts in mobile environment

REFERENCES:

1. Alan Colman, Jun Han, and Muhammad Ashad Kabir, "Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications", Springer, 2016.
2. J.Schiller, "Mobile Communication", Addison Wesley, 1st edition, 2000
3. Juha Korhonen, "Introduction to 4G Mobile Communications" , Artech HousePublishers, 2nd edition,2014
4. Kolomvatsos, Kostas, "Intelligent Technologies and Techniques for Pervasive Computing", IGI Global,2nd edition, 2013.
5. M. Bala Krishna, Jaime Lloret Mauri, "Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks", First edition,CRC press, 2016
6. Minyi Guo, Jingyu Zhou, Feilong Tang, Yao Shen,"Pervasive Computing: Concepts,Technologies and Applications ",First edition,CRC Press, 2016.

21NEP07	ADVANCED SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand Software Engineering Lifecycle Models..
- To do project management and cost estimation
- To gain knowledge of the System Analysis and Design concepts.
- To understand software testing approaches
- To be familiar with DevOps practices

UNIT I INTRODUCTION 9

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

UNIT II SOFTWARE REQUIREMENT SPECIFICATION 9

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram

UNIT III ARCHITECTURE AND DESIGN 9

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client-server - Tiered - Pipe and filter.- User interface design

UNIT IV TESTING 9

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking

UNIT V DEVOPS 9

DevOps:Motivation-Cloud as a platform-Operations- Deployment Pipeline:Overall Architecture-Building and Testing-Deployment- Case study: Migrating to Microservices

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the advantages of various Software Development Lifecycle Models.

CO2: Gain knowledge on project management approaches as well as cost and schedule estimation strategies.

CO3: Perform formal analysis on specifications.

CO4: Use UML diagrams for analysis and design

CO5: Architect and design using architectural styles and design patterns

REFERENCES:

1. Bernd Bruegge, Alan H Dutoit, "Object-Oriented Software Engineering", 2nd edition, Pearson Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, "Fundamentals of Software Engineering", 2nd edition, PHI Learning Pvt. Ltd., 2010.

3. Craig Larman, "Applying UML and Patterns", 3rd edition, Pearson Education, 2005.
4. Len Bass, Ingo Weber and Liming Zhu, "DevOps: A Software Architect's Perspective", Pearson Education,2nd edition, 2016.
5. Rajib Mall, "Fundamentals of Software Engineering", 3rd edition, PHI Learning Pvt. Ltd., 2009.
6. Stephen Schach," Software Engineering", 7th edition, McGraw-Hill, 2007

21NEP08	HIGH SPEED SWITCHING ARCHITECTURES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the basics of switching
- To explore the various space division switches
- To evaluate the performance of various switching architectures
- To study the architecture of IP routers
- To study about MPLS switches

UNIT I — SWITCHING BASICS — 9

Circuit switching, Message switching and Packet switching – Datagrams and Virtual circuits – Cell switching – Label switching – L2 switching Vs L3 switching – VLANs – Switching and Bridging – Loop resolution, Spanning tree algorithms – Cut through and Store and forward switches – Head of line blocking – Back pressure – Switch design goals.

UNIT II — SWITCHING ARCHITECTURES — 9

Shared medium switches – Shared memory switches – Space division switches – Cross bar based switching architecture – Input queued, Output queued and Combined input-output queued switches – Non blocking and blocking cross bar switches – Banyan networks – Batcher Banyan networks – Optical switches – Unbuffered and buffered switches – Buffering strategies – Optical packet switches and Optical burst switches – MEMS optical switches.

UNIT III — PACKET QUEUES AND DELAY ANALYSIS — 9

Littles theorem – Birth and death processes – Queuing disciplines – Markovian FIFO queuing – Non Markovian – PollaczekKhinchine formula –M/M/1, M/G/1 and M/D/1 models – Self similar models and Batch arrivals models – Network of queues – Burkes theorem and Jackson theorem.

UNIT IV — P ROUTER ARCHITECTURE — 9

Bus based router architecture with single processor and multiple processors – Architecture with multiple parallel forwarding engines – Switch based router architecture with multiple processors – Switch based router architecture with multiple processors – Switch based architecture with fully distributed processors – Critical and non critical data path processing – fast and slow path.

UNIT V — MPLS ROUTERS — 9

MPLS – Layer 2.5 - Labels – Switching and Distribution –Label Switched Path – Label Forwarding Instance Base – Label Stacking - IP Lookup vs Label lookup – Label Distribution Protocol – MPLS based VPNs– Label switching – Label switched path – Comparison with ATM technology.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply switching concepts to build networks.

CO2: Deploy the network with appropriate type of switches

CO3: Select and configure the appropriate type of IP router.

CO4: Design and implement MPLS networks

CO5: Architect and design using architectural styles and design patterns

REFERENCES:

1. Damitri P Bertsekas and Gallager, —Data Networks, 2nd edition, PHI, 1992
2. Elhanany, Itamar, Hamdi and Mounir, —High Performance Packet Switching Architectures,

Springer 2007

3. H.Jonathan Chao and Bin Liu, "High Performance Switches and Routers",2nd edition, John Wiley and Sons, 2007.
4. Howard C Berkowitz, "Designing Routing and Switching Architectures for Enterprise Networks",1st edition, Sams, 1999.

21NEP09	NETWORK MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To appreciate the need for interoperable network management as a typical distributed application
- To familiarize concepts and terminology associated with SNMP
- To be aware of current trends in network management technologies.
- To apply network management tools
- To analyze the web based management tools.

UNIT I	OSI NETWORK MANAGEMENT	9

OSI Network management model - Organizational model - Information model, Communication model. Abstract Syntax Notation - Encoding Structure, Macros Functional Model CMIP/CMIS.

UNIT II	BROADBAND NETWORK MANAGEMENT	9

Broadband networks and services, ATM Technology - VP, VC, ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN, ATM Network Management - ATM Network reference model, Integrated local Management Interface. ATM Management Information base, Role of SNMP and ILMI in ATM Management, M1, M2, M3, M4 interface. ATM Digital Exchange Interface Management.

UNIT III	SIMPLE NETWORK MANAGEMENT PROTOCOL	9

SNMPv1 Network Management: Communication and Functional Models. The SNMP Communication Model, Functional model. SNMP Management SNMPv2: Major Changes in SNMPv2, SNMPv2 System Architecture, SNMPv2 Structure of Management Information, The SNMPv2 Management Information Base,SNMPv2 Protocol, Compatibility With SNMPv1.Configuration management, Fault management, Performance management, Event Correlation Techniques 168 security management, Accounting management, Report Management, Policy Based Management, Services Level Management.

UNIT IV	NETWORK MANAGEMENT SYSTEMS	9

Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Commercial Network management Systems, System Management and Enterprise Management Solutions.

UNIT V	WEB-BASED MANAGEMENT	9

NMS with Web Interface and Web-Based Management, Web Interface to SNMP Management, Embedded Web-Based Management, Desktop management Interface, Web-Based Enterprise Management, WBEM: Windows Management Instrumentation, Java management Extensions, Management of a Storage Area Network.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Diagnose problems and make minor repairs to computer networks using appropriate diagnostics software

CO2: Demonstrate how to correctly maintain LAN computer systems

CO3: Maintain the network by performing routine maintenance tasks

CO4:Apply network management tools

CO5: Analyze the web based management tools.

REFERENCES:

1. Lakshmi G Raman, "Fundamentals of Telecommunication Network Management", Eastern Economy Edition IEEE Press, New Delhi, 1999.
2. Mani Subramanian, "Network Management - Principles and Practice", Pearson Education, 2nd edition, 2010.
3. Mark Burges, "Principles of Network System Administration", Wiley,2nd edition, 2000.
4. Salah Aiidarons and Thomas Plevayk, "Telecommunications Network Technologies and Implementations", Eastern Economy Edition IEEE press, New Delhi, 1998.
5. Stephen Morris, "Network Management, MIBs and MPLS - Principles, Design and Implementation", Pearson Education,2nd edition, 2003.

21NEP10	SOFTWARE QUALITY ASSURANCE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand the basic tenets of software quality and quality factors.
- Be exposed to the Software Quality Assurance (SQA) architecture and the details of SQA components.
- Understand of how the SQA components can be integrated into the project life cycle.
- Be familiar with the software quality infrastructure.
- Be exposed to the management components of software quality.

UNIT I	INTRODUCTION TO SOFTWARE QUALITY & ARCHITECTURE	9

Need for Software quality – Quality challenges – Software quality assurance (SQA) – Definition and objectives – Software quality factors- McCall?s quality model – SQA system and architecture – Software Project life cycle Components – Pre project quality components – Development and quality plans.

UNIT II	SQA COMPONENTS AND PROJECT LIFE CYCLE	9

Software Development methodologies – Quality assurance activities in the development process- Verification & Validation – Reviews – Software Testing – Software Testing implementations – Quality of software maintenance – Pre-Maintenance of software quality components – Quality assurance tools – CASE tools for software quality – Software maintenance quality – Project Management.

UNIT III	SOFTWARE QUALITY INFRASTRUCTURE	9

Procedures and work instructions - Templates - Checklists – 3S developmenting - Staff training and certification Corrective and preventive actions – Configuration management – Software change control – Configuration management audit -Documentation control – Storage and retrieval.

UNIT IV	SOFTWARE QUALITY MANAGEMENT & METRICS	9

Project process control – Computerized tools - Software quality metrics – Objectives of quality measurement – Process metrics – Product metrics – Implementation – Limitations of software metrics – Cost of software quality – Classical quality cost model – Extended model – Application of Cost model.

UNIT V	STANDARDS, CERTIFICATIONS & ASSESSMENTS	9

Quality manangement standards – ISO 9001 and ISO 9000-3 – capability Maturity Models – CMM and CMMI assessment methodologies - Bootstrap methodology – SPICE Project – SQA project process standards – IEEE st 1012 & 1028 – Organization of Quality Assurance – Department management responsibilities – Project management responsibilities – SQA units and other actors in SQA systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Utilize the concepts in software development life cycle.

CO2: Demonstrate their capability to adopt quality standards.

CO3: Assess the quality of software product.

CO4: Apply the concepts in preparing the quality plan & documents

CO5: Assess the SQA Project Process Standards.
REFERENCES: 1. Alan C. Gillies, "Software Quality: Theory and Management", International Thomson Computer Press,First edition, 1997. 2. Mordechai Ben-Menachem "Software Quality: Producing Practical Consistent Software",International Thompson Computer Press,2nd edition, 1997.

21NEP11	PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems
- To enable the students to develop new queuing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies

UNIT I	OVERVIEW OF PERFORMANCE EVALUATION	9

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queuing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little's Law and other Operational Laws – Modification for Closed Systems

UNIT II	MARKOV CHAINS AND SIMPLE QUEUES	9

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1.

UNIT III	MULTI-SERVER AND MULTI-QUEUE SYSTEMS	9

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke's Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues

UNIT IV	REAL-WORLD WORKLOADS	9

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Alalytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment Policies for Server Farms.

UNIT V	SMART SCHEDULING IN THE M/G/1	9

Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies -. Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the need for performance evaluation and the metrics used for it

CO2: Distinguish between open and closed queuing networks

CO3: Apply the operational laws to open and closed systems
CO4: Use discrete-time and continuous-time Markov chains to model real world systems
CO5: Develop analytical techniques for evaluating scheduling policies
REFERENCES:

1. K. S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd edition,2001.
2. Krishna Kant, "Introduction to Computer System Performance Evaluation", McGraw-Hill,2nd edition, 1992.
3. Lieven Eeckhout, "Computer Architecture Performance Evaluation Methods", Morgan and Claypool Publishers,2nd edition, 2010.
4. Mor Harchol - Balter, "Performance Modeling and Design of Computer Systems – Queueing Theory in Action", Cambridge University Press,3rd edition, 2013.
5. Paul J. Fortier and Howard E. Michel, "Computer Systems Performance Evaluation and Prediction", Elsevier, 2003.
6. Raj Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling", Wiley-Interscience, 1991

BoS Chairman

21NEP12	SIMULATION OF COMPUTER SYSTEMS AND NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand how simulators are built
- To understand the statistical models used in simulations
- To learn different ways of generating random numbers
- To learn modeling of the data given as input to simulators
- To understand how computer networks are simulated using case studies.

UNIT I STATISTICAL AND QUEUING MODELS 9

Statistical models – Discrete, continuous and empirical distributions – Characteristics of Queuing systems – Measures of performance of queuing systems – Markovian models.

UNIT II RANDOM NUMBER AND RANDOM VARIATE GENERATION 9

Properties of random numbers – Generating uniform random numbers – Generating non-uniform random numbers - Tests for random numbers – Random-variate generation

UNIT III ANALYSIS OF SIMULATION DATA 9

Input modeling – Identifying the distribution – Parameter estimation – Goodness-of-fit tests – Multivariate and time-series input models – Verification and validation of simulation models

UNIT IV SIMULATION OF COMPUTER NETWORKS 9

Introduction – Performance modeling – Modeling Techniques – Protocol modeling – Workload modeling – Network Topology modeling – Performance metrics in computer network simulation – Validation and verification – Discrete event simulation – GPU-based simulations – Multi-agent-based simulations –Network simulators

UNIT V CASE STUDIES OF NETWORK SIMULATORS 9

NS-3 based Simulative Platform - Evolved packet system – Differentiated services domain – ns-3 simulator – Simulation techniques for next generation wireless heterogeneous networks – Features of common network simulators - OpNet, mininet.

TOTAL: 45 PERIODS

COURSE OUTCOMES: At the end of the course, learners will be able to

CO1: Understand different queuing systems.

CO2: Understand the modeling and development of simulations and simulators.

CO3: Differentiate the different ways in which simulators are designed

CO4: Analyse how computer networks are simulated.

CO5: Compare the features of different simulators

REFERENCES:

1. J. B. Sinclair, "Simulation of Computer Systems and Computer Networks: A

Process-Oriented Approach",2nd edition, 2004.

2. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, "Discrete-event System Simulation", 5th Edition, Pearson, 2010.

3. Law, Averill, "Simulation Modeling and Analysis with Expert Software", Mc Graw Hill, 4th edition, 2006.

4. Mohammad S. Obaidat, Petros Nicopolitidis, Faouzi Zarai, "Modeling and Simulation of Computer Networks and Systems – Methodologies and Applications", Morgan Kaufmann, 3rd edition,2015.

5. Sheldon M. Ross, "Simulation", 5th Edition, Elsevier, 2013.

21NEP13	NEXT GENERATION NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the technical, economic and service advantages of next generation networks
- To learn the evolution of technologies of 4G and beyond
- To learn Software defined Mobile Network issues and integrating challenges with LTE
- To explore the NGN framework catering the services of end user with QoS provisioning
- To learn about the NGM management and standards.

UNIT I	INTRODUCTION	9

Evolution of public mobile services -motivations for IP based services, Wireless IP network architecture –3GPP packet data network architecture. Introduction to next generation networks - Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next Generation Society, future Trends..

UNIT II	4G and BEYOND	9

Introduction to LTE-A –Requirements and Challenges, network architectures –EPC, E-UTRAN architecture-mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT III	SDMN-LTE INTEGRATION	9

SDN paradigm and applications, SDN for wireless-challenges, Leveraging SDN for 5G networks-ubiquitous connectivity-mobile cloud-cooperative cellular network-restructuring mobile networks to SDN-SDN/LTE integration benefits.

UNIT IV	NGN ARCHITECTURE	9

Evolution towards NGN-Technology requirements, NGN functional architecture- Transport stratum, service stratum, service/ content layer and customer terminal equipment function. NGN entities, Network and Service evolution -fixed, mobile, cable and internet evolution towards NGN

UNIT V	NGN MANAGEMENT AND STANDARDIZATION	9

NGN requirements on Management-Customer, third party, Configuration, Accounting, performance, device and information management. Service and control management- End-to-End QoS and security. ITU and GSI-NGN releases, ETSI-NGN concept and releases, NGMN alliance and NGMN.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the issues and challenges of wireless domain in future generation network design.

CO2: Explore the LTE concepts and technologies.
CO3: Understand the integration of SDN with LTE.
CO4: Understand the NGN Architecture
CO5: Understand the NGN management and standardizations

REFERENCES:

1.Jingming Li Salina, Pascal Salina "Next Generation Networks-perspectives and potentials" Wiley, 2nd edition,January 2008.

2. Madhusanga Liyanage, Andrei Gurtov, Mika Ylianttila, "Software Defined Mobile Networks beyond LTE Network Architecture", 2nd edition, Wiley, June 2015.

3. Martin Sauter,"3G,4G and Beyond bringing networks, devices and web together", Wiley, 2nd edition, 2013.

4. Savo G Glisic," Advanced Wireless Networks- Technology and Business models", Wiley, 3rd edition, 2016.

5. Thomas Plavyk, "Next generation Telecommunication Networks, Services and Management", Wiley & IEEE Press Publications, 2013.

21NEP14	IT AUDIT AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Establish an understanding of the IT environment and the role of the IT auditor
- Understand about auditing Networks.
- Develop an understanding of the IT audit process in SDLC
- Understand about the database environments
- Understand about ERP Systems.

UNIT I	AUDITING AND INTERNAL CONTROL	9
Overview of Auditing, Role of the audit committee ,Audit Risk ,The IT Audit, Internal Control, Internal Control Objectives, Principles, and Models.		
UNIT II	**AUDITING OPERATING SYSTEMS AND NETWORKS**	**9**
Auditing Operating Systems, Auditing Networks, Auditing Electronic Data Interchange (EDI),Auditing PC-Based Accounting Systems.		
UNIT III	**SDLC RISKS AND CONTROLS**	**9**
Participants in Systems Development, the Systems Development Life Cycle, Controlling and Auditing the SDLC.		
UNIT IV	**AUDITING DATABASE SYSTEMS**	**9**
Data Management Approaches, Key Elements of the Database Environment, Databases in a Distributed Environment, Controlling and Auditing Data Management Systems, Access Controls		
UNIT V	**ENTERPRISE RESOURCE PLANNING SYSTEMS**	**9**
ERP, ERP System Configurations, Risks Associated with ERP Implementation, Implications for Internal Control and Auditing.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Establish an understanding of the IT environment and the role of the IT auditor

CO2: Understand about auditing Networks.

CO3: Develop an understanding of the IT audit process in SDLC

CO4: Understand about the database environments

CO5: Understand about ERP Systems.

REFERENCES:

1. James A. Hall, "Information Technology Auditing and Assurance", South-Western cengage learning ,3rd edition, 2011.
2. Chris Davis and Mike Schiller, "IT Auditing: Using Controls to protect Information Assets", Mc-Graw Hill, 2nd Edition, 2011.

21NEP15	CYBER PHYSICAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the concepts of cyber physical systems.
- To discuss various CPS platform components.
- To discuss various coordination protocols.
- To explore various security methods for CPS.
- To discuss various application scenarios of implementing CPS.

UNIT I	INTRODUCTION	9

Cyber-Physical System, Key Features of CPS, Application Domains of CPS, Basic principles of design and validation of CPS, Challenges in CPS.

UNIT II	CPS PLATFORM COMPONENTS	9

CPS HW platforms, Processors, Sensors and Actuators, CPS Network - Wireless, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks, Synchronous Model and Asynchronous Model.

UNIT III	SYNCHRONOUS AND ASYNCHRONOUS MODEL	9

Reactive Components, Components Properties, Components Composing, Synchronous Designs and Circuits, Asynchronous Processes and operations, Design Primitives in Asynchronous Process, Coordination Protocols in Asynchronous Process, Leader Election, Reliable Transmission.

UNIT IV	SECURITY OF CYBER-PHYSICAL SYSTEMS	9

Introduction to CPS Securities, Basic Techniques in CPSSecurities, Cyber Security Requirements, Attack Model and Countermeasures, advanced Techniques in CPS Securities.

UNIT V	CPS APPLICATION	9

Health care and Medical Cyber-Physical Systems, Smart grid and Energy Cyber-Physical Systems, WSN based Cyber-Physical Systems, Smart Cities

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Listen and comprehend key features of CPS.

CO2: Learn about various CPS platform components.

CO3: Learn about various coordination protocols.

CO4: Explore about security measures for CPS.

CO5: Explore various application implemented with CPS.

REFERENCES :

1. E. A. Lee and S. A. Seshia, "Introduction to Embedded Systems: A Cyber -Physical Systems Approach", 1st edition, 2011.
2. R. Alur, "Principles of Cyber-Physical Systems," MIT Press, 2015.
3. Raj Rajkumar, Dionisio de Niz and Mark Klein, "Cyber-Physical Systems", Addison-Wesley, 2nd Edition, 2017.
4. Fei Hu, "Cyber-Physical Systems", CRC Press , 2nd Edition,2013.

21NEP16	**BIO INFORMATICS** *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To get exposed to the fundamentals of bioinformatics.
- To analyze DNA sequencing data and detection of genomic variants.
- To learn and understand open problems, issues in replication, assemble genome, various clustering and multiple pattern matching.
- To study bio informatics pattern matching and clustering techniques.
- To study and be exposed to the domain of animal genomics.

UNIT I INTRODUCTION AND FUNDAMENTALS 9

Fundamentals of Genes, Genomics, Molecular Evolution – Genomic Technologies – Beginning of Bioinformatics - Genetic Data –Sequence Data Formats – Secondary Database – Examples – Data Retrieval Systems – Genome Browsers - Biomedical Data –Their Acquisition, Storage and Use, Electronic Health Records (EHR), Information Retrieval From Digital Libraries.

UNIT II GENOMICS AND EPIGENOMICS 9

Genomic Variants Detection and Genotyping - Computational approaches for Finding Long Insertions and Deletions with NGS Data- Computational Approaches in Next-Generation Sequencing Data Analysis for Genome-Wide DNA Methylation Studies- Bisulfite-Conversion-Based Methods for DNA Methylation Sequencing Data Analysis.

UNIT III DNA REPLICATION AND ASSEMBLE GENOME 9

Beginning of DNA Replication – Open Problems – Multiple Replication and Finding Replication – Computing Probabilities of Patterns in a String-The Frequency Array-Converting Patterns-Solving Problems- Finding Frequents Words-Big-O Notation –Case Study-The Tower Of Hanoi Problem-Assemble Genome-String Reconstruction Problem-Assembling Genomes from Read Pairs.

UNIT IV BIOINFORMATICS CLUSTERING AND PATTERN MATCHING 9

Introduction to Clustering- Good Clustering Principle-K-Means ClusteringLloyd Algorithm-Making Soft Decisions in Coin Flipping-Clustering Tumor Samples-Introduction to Multiple Pattern Matching-Burrows-Wheeler Transform-Pattern Matching with the Burrows-Wheeler Transform-Epilogue: Mismatch-Tolerant Read Mapping.

UNIT V ANIMAL GENOME 9

Human and Mouse Genomes-Random Breakage Model of Chromosome Evolution – Sorting by Reversals – Greedy Heuristic Approach – Break Points Graphs-Neighbor-Joining Algorithm-Character Based Tree Reconstruction.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Deploy the Genomics Technologies in Bioinformatics

CO2: Able to distinguish Epigenomics and Genomics

CO3: Deploy the replication and molecular clocks in Bioinformatics

CO4: Implement various Clustering and Pattern Matching techniques

CO5: Use the Breakpoint Graphs for Genome Expression

REFERENCES

1. Philip Compeau and Pavel Pevzner, "Bioinformatics Algorithms: An Active Learning Approach" 2nd Edition Volume I , Coursera, 2015.
2. Supratim Choudhuri, "Bioinformatics For Beginners", Elsevier, 2014.
3. Shortliffe EH, Ciminio JJ ,"Biomedical Informatics: Computer applications in Health care and Biomedicine", 3rd edition, 2000, New York Springer-Verlag, ISBN 0-387-28986-0.
4. Ion Mandoiu and Alexander Zelikovsky , "Computational Methods for Next Generation Sequencing Data Analysis " Wiley series, 2nd edition,2016.
5. Robert F.Coughlin, Istvan Miklos,Renyi Institute, "Introduction to algorithms in Bioinformatics",Springer 2016

21NEP17	DEEP LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic ideas and principles of neural networks.
- To understand the basic concepts of deep learning
- To familiarize with image processing facilities like TensorFlow and Keras.
- To appreciate the use of deep learning applications.
- To understand and implement deep learning architectures

UNIT I	BASICS OF NEURAL NETWORKS	9

Basic Concept of Neurons – Perceptron Algorithm – Feed Forward - Multilayer Perceptron. Gradient Descent .Back propagation Networks, Empirical Risk Minimization, regularization, autoencoders.

UNIT II	INTRODUCTION TO DEEP LEARNING	9

Deep Feed-Forward Neural Networks – Gradient Descent – Back-Propagation and Other Differentiation Algorithms – Vanishing Gradient Problem – Mitigation – Rectified Linear Unit (ReLU) – Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization for Deep Learning – Dropout – Adversial Training – Optimization for Training Deep Models.

UNIT III	CONVOLUTIONAL NEURAL NETWORK	9

CNN Architectures – Convolution – Pooling Layers – Transfer Learning – Image Classification using Transfer Learning – Recurrent and Recursive Nets – Recurrent Neural Networks – Deep Recurrent Networks – Recursive Neural Networks – Applications.

UNIT IV	ADDITIONAL DEEP LEARNING ARCHITECTURES	9

Long Short Term Memory (LSTM) Networks – Sequence Prediction – Gated Recurrent – Encoder/Decoder Architectures – Autoencoders – Standard – Sparse – Denoising – Contractive – Variational Autoencoders – Applications of Autoencoders – Representation Learning – Deep generative Models – Deep Belief Networks – Deep Generative Networks – Generative Schemes – Evaluating Generative Models.

UNIT V	APPLICATIONS OF DEEP LEARNING	9

Images segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative adversarial networks – Video to Text with LSTM models – Attention models for Computer Vision – Case Study: Named Entity Recognition – Opinion Mining using Recurrent Neural Networks – Parsing and Sentiment Analysis using Recursive Neural Networks – Sentence Classification using Convolutional Neural Networks – Dialogue Generation with LSTMs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the role of deep learning in machine learning applications.

CO2: Get familiar with the use of TensorFlow and Keras in deep learning applications.

CO3: Design and implement deep learning applications.

CO4: Design and implement convolutional neural networks.

CO5: Know about applications of deep learning in NLP and image processing. architectural styles and design.

REFERENCES

1. Phil Kim. "Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence", Apress, 2nd Edition,2017.

2. Ragav Venkatesan, Baoxin Li, "Convolutional Neural Networks in Visual Computing", CRC Press, 1st Edition 2018.

3. Navin Kumar Manaswi, "Deep Learning with Applications Using Python", Apress, 1st Edition,2018.

4. Joshua F. Wiley, "R Deep Learning Essentials", Packt Publications, 2nd Edition 2016.

21NEP18	**MOBILE APPLICATION DEVELOPMENT** *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand system requirements for mobile applications.
- Generate suitable design using specific mobile development frameworks.
- Generate mobile application design.
- Implement the design using specific mobile development frameworks.
- Deploy the mobile applications in marketplace for distribution.

UNIT I	INTRODUCTION	9

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.

UNIT II	BASIC DESIGN	9

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

UNIT III	ADVANCED DESIGN	9

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT IV	ANDROID	9

Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.

UNIT V	IOS	9

Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Describe the requirements for mobile applications.
CO2: Explain the challenges in mobile application design and development.
CO3: Develop design for mobile applications for specific requirements.
CO4: Implement the design using Android SDK.
CO5: Implement the design using Objective C and iOS.

REFERENCES

1. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", DreamTech, 1st Edition,2012.
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2nd edition,2013.
3. James Dovey and Ash Furrow, "Beginning Objective C", Apress,2nd edition, 2012.
4. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox,1st edition, 2012.
5. Reto Meier, "Professional android Development", Wiley-India Edition, 2012.

21NEP19	ETHICAL HACKING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand and analyse Information security threats & couter measures
- To perform security auditing & testing
- To understand issues relating to ethical hacking
- To study &employ network defense measures
- To understand penetration and security testing issues

UNIT I	ETHICAL HACKING OVERVIEW	9
Introduction to Hacking – Importance of Security – Elements of Security – Phases of an Attack – Types of Hacker Attacks – Hacktivism – Vulnerability Research – Introduction to Footprinting – Information Gathering Methodology – Footprinting Tools – WHOIS Tools – DNS Information Tools – Locating the Network Range – Meta Search Engines		
UNIT II	**SCANNING AND ENUMERATION**	**9**
Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools		
UNIT III	**SYSTEM HACKING**	**9**
Introduction to Scanning – Objectives – Scanning Methodology – Tools – Introduction to Enumeration – Enumeration Techniques – Enumeration Procedure – Tools		
UNIT IV	**PROGRAMMING FOR SECURITY PROFESSIONALS**	**9**
Programming Fundamentals – C language – HTML – Perl – Windows OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures – Linux OS Vulnerabilities – Tools for Identifying Vulnerabilities – Countermeasures.		
UNIT V	**PENETRATION TESTING**	**9**
Introduction – Security Assessments – Types of Penetration Testing- Phases of Penetration Testing – Tools – Choosing Different Types of Pen-Test Tools – Penetration Testing Tools		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand vulnerabilities, mechanisms to identify vulnerabilities/threats/attacks.

CO2: Learn about enumeration techniques.

CO3: Understand various system hacking methods.

CO4: Learn about security vulnerabilities in OS.

CO5: Perform penetration & security testing.

REFERENCES

1. EC-Council, "Ethical Hacking and Countermeasures: Attack Phases", Delmar Cengage Learning , 2nd Edition, 2009.

2. Jon Erickson, "Hacking: The Art of Exploitation", No Starch Press, 2nd Edition, 2008.

3. Michael T. Simpson, "Hands-on Ethical Hacking & Network Defense", Course Technology, 1st Edition,2010

4. Patrick Engebretson, " The Basics of Hacking and Penetration Testing – Ethical Hacking and Penetration Testing Made Easy", Syngress Media, 2nd Revised Edition, 2013.

5. RajatKhare, "Network Seuciry and Ethical Hacking", Luniver Press, 4th Edition,2006.

6. Ramachandran V,BackTrack ," Wireless Penetration Testing Beginner's Guide", 3rd edition, Packt Publishing, 2011.
7. Thomas Mathew, "Ethical Hacking", OSB publishers, 1st Edition,2003.

21NEP20	**WEB ENGINEERING** *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the characteristics of web applications
- Learn to Model web applications
- Be aware of Systematic design methods
- Be familiar with the testing techniques for web applications.
- Analyze the concept of promoting web applications and web project management.

UNIT I	INTRODUCTION TO WEB ENGINEERING	9

Motivation, Categories of Web Applications, Characteristics of Web Applications. Requirements of Engineering in Web Applications- Web Engineering-Components of Web Engineering-Web Engineering Process-Communication-Planning.

UNIT II	WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS	9

Introduction- Categorizing Architectures- Specifics of Web Application Architectures, Components of a Generic Web Application Architecture- Layered Architectures, 2-Layer Architectures, N-Layer Architectures-Data-aspect Architectures, Database-centric Architectures- Architectures for Web Document Management- Architectures for Multimedia Data- Modeling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling, Modelling Framework-Modeling languages Analysis Modeling for Web Apps-The Content Model-The Interaction Model-Configuration Model.

UNIT III	WEB APPLICATION DESIGN	9

Design for WebApps- Goals-Design Process-Interactive Design- Principles and Guidelines Workflow-Preliminaries-Design Steps- Usability- Issues- Information Design- Information Architecture- structuring- Accessing Information-Navigation Design- Functional Design WepApp Functionality- Design Process- Functional Architecture- Detailed Functional Design.

UNIT IV	TESTING WEB APPLICATIONS	9

Introduction-Fundamentals-Test Specifics in Web Engineering-Test ApproachesConventional Approaches, Agile Approaches- Testing concepts- Testing Process -Test Scheme- Test Methods and Techniques- Link Testing- Browser Testing-Usability TestingLoad, Stress, and Continuous Testing, Testing Security, Test-driven Development, -Content Testing-User Interface testing-Usability Testing-Compatibility Testing-Component Level Testing-Navigation Testing-Configuration testing-Security and Performance Testing- Test Automation.

UNIT V	PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT	9

Introduction-challenges in launching the web Application-Promoting Web ApplicationContent Management-Usage Analysis-Web Project Management-Challenges in Web Project Management-Managing Web Team-, Managing the Development Process of a Web Application- Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS - web sockets.

TOTAL : 45 PERIODS

Course Outcomes:

At the end of the course, learners will be able to

CO1: Explain the characteristics of web applications.

CO2: Model web applications.

CO3: Design web applications.

CO4: Test web applications.

CO5: Promote the Web Applications

REFERENCES:

1. Chris Bates, "Web Programming: Building Internet Applications", 3rd Edition, Wiley India Edition, 2007.
2. Gerti Kappel, Birgit Proll, "Web Engineering", John Wiley and Sons Ltd, 2nd edition, 2006.
3. Guy W. Lecky-Thompson, "Web Programming", Cengage Learning, 3rd edition, 2008.
4. John Paul Mueller, "Web Development with Microsoft Visual Studio" 2005, Wiley Dream tech, 2nd edition , 2006.
5. Roger S. Pressman, David Lowe, "Web Engineering", Tata McGraw Hill Publication, 2nd edition, 2007.

21NEP21	SECURITY IN IOT AND CLOUD	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the Security requirements in IoT
- To understand the cryptographic fundamentals for IoT
- To understand the authentication credentials and access control
- To understand the various types Of Trust models and Cloud Security
- To have a basic idea about IOT cloud security.

UNIT I	INTRODUCTION	9

Securing The Internet Of Things: IoT- Industry collaboration – Uses – IoT in the Enterprise – IoT Future and Need of Security – Vulnerabilities, Attacks and Countermeasures – Security Engineering for IoT Development – Security Life cycle.

UNIT II	CRYPTOGRAPHIC FUNDAMENTALS FOR IOT	9

Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes – Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – IoT Node Authentication.

UNIT III	IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR IOT	9

Identity lifecycle – Authentication credentials – IoT IAM infrastructure – Authorization with Publish / Subscribe schemes – access control.

UNIT IV	PRIVACY PRESERVATION AND TRUST MODELS FOR IOT	9

Privacy Challenges – IoT PIA – PbD principles – Privacy Engineering.recommendation.

UNIT V	CLOUD SECURITY FOR IOT	9

Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterpriseIoT cloud security architecture – New directions in cloud enabled IoT computing.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the security requirements in IoT.

CO2: Choose and implement efficient security algorithms in IoT.

CO3: Understand about the different access management solutions in IoT.

CO4: Understand about different trust models for IoT.

CO5: Understand about cloud security for IoT.

REFERENCES:

1. Brian Russell, Drew Van Duren, "Practical Internet of Things Security (Kindle Edition)", 2016.
2. Fei Hu, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations", 1st edition,2016.
3. Ben Halpert , Auditing Cloud Computing: A Security and Privacy Guide: , John Wiley Sons,3rd edition, 2011.
4. Ianlim, E.Coleen Coolidge, Paul Hourani, Securing Cloud and Mobility: A Practitioners Guide, Auerbach Publications,2nd edition, Feb 2013

21NEP22	SOFTWARE DEFINED NETWORKS AND NETWORK FUNCTION VIRTUALIZATION	L	T	P	C
		3	0	0	3

Course Objectives:

- To understand the concepts of software defined networks
- To learn the interface between networking devices and the software controlling them
- To learn network virtualization and tools
- To explore modern approaches like vmware, openflow, openstack.
- To explore security and visibility approaches in virtual networks.

UNIT I	SOFTWARE DEFINED NETWORK	9

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework

UNIT II	VIRTUALIZATION BASICS	9

Primer on Virtualization, Benefits of virtual machines, Hypervisors, Managing Virtual resources, Virtualized cloud/data center .

UNIT III	NETWORK FUNCTIONS VIRTUALIZED	9

Virtualize a Network, virtualizing appliances, virtualizing core networking functions, scalability and performance.

UNIT IV	MODERN NETWORKING APPROACHES	9

Openflow, VMware NSX, OpenDayLight project-ODL architecture & controller platform, control network, Business case for SDN

UNIT V	SECURITY & VISIBILITY	9

Security-Preventing Data leakage, Logging and auditing, Encryption in Virtual Networks Visibility-Overlay networks, Network management tools, Monitoring Traffic

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify/design software defined network for the required application/platform

CO2: Deploy network virtualization tool & design

CO3: Equip in various network security measures and tackle

CO4: Analyze networking functions in virtualization.

CO5: Use modern networking approaches.

REFERENCES:

1. Jim Doherty,"SDN and NFV Simplified", Addison Wesley,2nd edition, 2016.
2. SiamakAzodoimolky, "Software Defined Networking with OpenFlow". Packt Publishing Limited, 2nd edition 2013.
3. Thomas D.Nadeau and Ken Gray, "SDN – Software Defined Networks". O"Reilly Publishers, 2nd edition, 2013.
4. William Stallings, "Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" 2nd edition,Pearson,2015
5. Oswald Coker, Siamak Azodolmolky. Software-Defined Networking with OpenFlow - Second Edition, Packt Publishing, 2017.

21NEP23	DIGITAL FORENSICS	L	T	P	C
		3	0	0	3

Course Objectives:

- To learn about the fundamental concepts of forensic science.
- To understand about the application of forensic science principles to digital evidence examinations.
- To articulate the steps of the forensic process as applied to digital evidence.
- To draft a Standard Operating Procedure.
- To conduct rudimentary digital forensic examinations

UNIT I — INTRODUCTION — 9

Introduction - Digital Forensics - Digital Evidence - Increasing Awareness of Digital Evidence - Digital Forensics: Past, Present, and Future – Principles - Challenging Aspects of Digital Evidence – Cyber trail - Language of Computer Crime Investigation - Role of Computers in Crime

UNIT II — EVIDENCE AND INVESTIGATIONS — 9

Evidence in the Courtroom - Duty of Experts – Admissibility - Levels of Certainty in Digital Forensics - Direct versus circumstantial evidence - Scientific Evidence - Presenting Digital Evidence - Conducting Digital Investigations - Digital Investigation Process Models - Scaffolding for Digital Investigations - Applying the Scientific Method in Digital Investigations - Investigative Scenario: Security Breach

UNIT III — OPEN SOURCE EXAMINATION PLATFORM — 9

Open Source Examination Platform - Using Linux and Windows as the Host, Disk and File System Analysis, Media Analysis Concepts , Sleuth Kit, Partitioning and Disk Layouts, Special Containers, Hashing.

UNIT IV — DISK AND FILE SYSTEM ANALYSIS — 9

Imaging, Internet Artifacts, Browser & Mail Artifacts, File Analysis, Image, Audio, Video, Archives, Documents, Graphical Investigation Environments, PyFLAG, Fiwalk, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition.

UNIT V — LAWS AND ACTS — 9

Laws and Ethics, Digital Evidence Controls, Evidence Handling Procedures, Basics of Indian Evidence ACT IPC and CrPC , Electronic Communication Privacy ACT, Legal Policies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the fundamental concepts of forensic science.

CO2: Apply the concepts and will be able to collect digital evidence.

CO3: Implement the forensic concepts in open platform.

CO4: Apply the Standard Operating Procedure.

CO5: Identify the forensic evidence in terms of Legal procedure.

REFERENCES:

1. Cory Altheide and Harlan Carvey, "Digital Forensics with Open Source Tools" Elsevier publication, 3rd Edition, April 2011
2. Eoghan Casey , "Digital Evidence and Computer Crime", Forensic Science, Computers, and the Internet, Elsevier, 3rd Edition, 2011
3. Kevin Mandia, Chris Prosise, Matt Pepe, "Incident Response and Computer Forensics ".

TataMcGraw -Hill, New Delhi, 2nd edition ,2006
4. Nelson Phillips and Enfinger Steuart, "Computer Forensics and Investigations", Cengage Learning, New Delhi, 2nd edition, 2009.
5. Robert M Slade,"Software Forensics", Tata McGraw - Hill, New Delhi, 2nd edition, 2005

21NEP24	SOCIAL NETWORK ANALYSIS *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the components of the social network.
- To model and visualize the social network.
- To mine the users in the social network
- To understand the evolution of the social network
- To know the applications in real time systems

UNIT I	INTRODUCTION	9

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

UNIT II	MODELING AND VISUALIZATION	9

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling andaggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

UNIT III	MINING COMMUNITIES	9

Aggregating and reasoning with social network data, Advanced Representations –Extracting evolution of Web Community from a Series of Web Archive – Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks..

UNIT IV	EVOLUTION	9

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models

UNIT V	APPLICATIONS	9

A Learning Based Approach for Real Time Emotion Classification of Tweets, - A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, - Explaining Scientific and Technical - Emergence Forecasting, Social Network Analysis - for Biometric Template Protection.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand about the internal components of the social network

CO2: Summarise about Modelling and visualization of social network

CO3: Understand the behavior of the users in the social network

CO4: Identify the possible next outcome of the social network

CO5: Apply social network in real time applications

REFERENCES:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", Springer, 2nd edition 2012
2. Borko Furht, "Handbook of Social Network Technologies and Applications", Springer, 1st edition, 2011
3. Charu C. Aggarwal, "Social Network Data Analytics", Springer; 1st edition, 2014
4. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", Springer, 1st edition, 2010.
5. Guandong Xu , Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", Springer, 1st edition, 2012
6. Peter Mika, "Social Networks and the Semantic Web", Springer, 1st edition, 2007.
7. Przemyslaw Kazienko, Nitesh Chawla,"Applications of Social Media and Social Network Analysis", Springer, 1st edition ,2015

21AC101	ENGLISH FOR RESEARCH PAPER WRITING *(Common to all M.E. Programmes)*	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To explain writing skills and level of readability
- To outline content writing in each section
- To summarize the skills needed for framing a title
- To demonstrate the skills needed for writing the conclusion
- To compare the quality of paper with plagiarism report

UNIT I	INTRODUCTION TO RESEARCH PAPER WRITING	6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT II	PRESENTATION SKILLS	6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT III	TITLE WRITING SKILLS	6

Key skills –Title, Abstract, Introduction, Review of the Literature, Methods, Results, Discussion and Conclusions.

UNIT IV	RESULT WRITING SKILLS	6

Skills -Methods, Results, Discussion and Conclusions.

UNIT V	VERIFICATION SKILLS	6

Useful phrases, checking Plagiarism, ensuring quality paper submission.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Explain the writing skills and level of readability

CO2: Outline the contents of research paper in each section

CO3:Classify the skills needed for writing a title

CO4: Summarize the content for presenting research conclusion note.

CO5: Illustrate the quality of paper by checking plagiarism.

TEXT BOOKS:

1. Adrian Wallwork , "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011
2. Day R ,"How to Write and Publish a Scientific Paper", Cambridge University Press 2006.
3. Goldbort R , "Writing for Science", Yale University Press ,2006
4. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM. Highman's book 1998.

REFERENCES

1. Stephen Howe, Kristina Henriksson, "Phrase Book for Writing Papers and Research in English", 4th Edition, CreateSpace Independent Publishing Platform,2007.
2. Adrian Wallwork ,"English for Research: Usage, Style, and Grammar", Springer,2012.
3. John Flowerdew, PejmanHabibie, "Introducing English for Research Publication Purposes", 1st Edition,Routledge, ,2021.
4. Wendy Laura Belcher, Writing Your Journal Article in Twelve Weeks: A Guide to Academic Publishing Success, 1st Edition, SAGE Publications, Inc., , 2009

21AC102	CONSTITUTION OF INDIA *(Common to all M.E. Programmes)*	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nationhood in the early years of Indian nationalism
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917and its impact on the initial drafting of the Indian Constitution.
- To understand the importance of local body administration
- To know the role and function of election commission

UNIT I	HISTORY AND PHILOSOPHY OF THE INDIAN CONSTITUTION	6

History - Drafting Committee - (Composition & Working)- Philosophy - Preamble, Salient Features

UNIT II	CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES	6

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III	ORGANS OF GOVERNANCE	6

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT IV	LOCAL ADMINISTRATION	6

District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT V	ELECTION COMMISSION	6

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO2: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO3: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO4: Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO5: Discuss the passage of the Hindu Code Bill of 1956.

CO6: Familiarize with basic Structure and functions of Election Commission.

REFERENCES:

2. Dr. S. N. Busi, "Dr. B. R. Ambedkar, Framing of Indian Constitution", 1st Edition, Ava Publishers, 2016.
3. M.P. Jain, "Indian Constitution Law", 7th Edition, Lexis Nexis, 2014.
4. D.D. Basu, "Introduction to the Constitution of India", 26th Edition, Lexis Nexis, 2022.

21AC103	DISASTER MANAGEMENT *(Common to all PG Programmes)*	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To summarize the basics of disaster
- To explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- To illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- To describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- To develop the strengths and weaknesses of disaster management approaches

UNIT I	INTRODUCTION	6

Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Man-made Disasters: Difference, Nature, Types and Magnitude

UNIT II	REPERCUSSIONS OF DISASTERS AND HAZARDS	6

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes,Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts

UNIT III	DISASTER PRONE AREAS IN INDIA	6

Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

UNIT IV	DISASTER PREPAREDNESS AND MANAGEMENT	6

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V	RISK ASSESSMENT	6

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize basics of disaster.

CO2: Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

CO5: Develop the strengths and weaknesses of disaster management approaches.

REFERENCES:

1. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" 1st Edition, New Royal book Company, 2007.
2. Sahni, Pardeep, "Disaster Mitigation Experiences and Reflections", 4th Edition, Prentice Hall Of India, New Delhi, 2011.
3. Goel S. L., "Disaster Administration and Management Text and Case Studies", 3rd Edition, Deep & Deep Publication Pvt. Ltd., 2009.

Velammal College of Engineering and Technology, Madurai – 625 009

(Autonomous)

REGULATIONS - 2021

M.E. COMPUTER SCIENCE AND ENGINEERING (CBCS)

CURRICULUM AND SYLLABI

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY, MADURAI-625009
(Autonomous)
REGULATIONS - 2021
M.E. COMPUTER SCIENCE AND ENGINEERING (CBCS)
CURRICULUM FOR SEMESTERS I TO IV

SEMESTER - I

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1	21MA121	Applied Probability and Statistics for Computer Science Engineers	FC	3	2	0	4
2.	21RM102	Research Methodology and IPR	RM	3	0	0	3
3.	21CP101	Advanced Data Structures and Algorithms	PC	3	0	0	3
4.	21NE101	Network Technologies (Common to M.E.CSE, M.E CSE (with Specialization in Networks))	PC	3	0	0	3
5.	21CP102	Principles of Programming Languages	PC	3	0	0	3
6.	21ACXXX	Audit Course – I*	AC	2	0	0	0
		THEORY WITH PRACTICAL COURSE					
7.	21CP104	Database Practices (Common to M.E.CSE, M.E CSE (with Specialization in Networks))	PC	3	0	2	4
		PRACTICAL					
8.	21CP103	Advanced Data Structures and Algorithms Laboratory	PC	0	0	4	2
		Total Credits					**22**

SEMESTER- II

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
		THEORY					
1.	21CP105	Internet of Things	PC	3	0	0	3
2.	21CP106	Security Practices	PC	3	2	0	4
3.	21CP107	Machine Learning (Common to M.E.CSE, M.E CSE (with Specialization in Networks))	PC	3	2	0	4
4.	21CP108	Big Data Analytics	PC	3	2	0	4
5.	21CP109	Advanced Computer Architecture	PC	3	0	0	3
6.	21CPPXX	Professional Elective I	PE	3	0	0	3
7.	21ACXXX	Audit Course – II*	AC	2	0	0	0

PRACTICAL							
8.	21NE108	Term Paper and Seminar (Common to M.E.CSE, M.E CSE (with Specialization in Networks))	EE	0	0	2	1
9.	21CP110	Data Analytics Laboratory	PC	0	0	4	2
10.	21CP111	Machine Learning Laboratory	PC	0	0	4	2
Total Credits							**26**

SEMESTER- III

S. No.	**COURSE CODE**	**COURSE TITLE**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1.	21CPPXX	Professional Elective II	PE	3	0	0	3
2.	21CPPXX	Professional Elective III	PE	3	0	0	3
3.	21CPPXX	Professional Elective IV	PE	3	0	0	3
PRACTICAL							
4.	21CP201	Project Work (Phase-I)	EE	0	0	12	6
Total Credits							**15**

SEMESTER- IV

S. No.	**COURSE CODE**	**COURSE TITLE**	**Category**	**L**	**T**	**P**	**C**
PRACTICAL							
1	21CP202	Project Work (Phase-II)	EE	0	0	24	12
Total Credits							12

TOTAL NO. OF CREDITS: 75

PROFESSIONAL ELECTIVES - II SEMESTER - ELECTIVE I

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21CPP01	Cloud Computing Technologies	PE	3	0	0	3
2.	21CPP02	Image Processing and Analysis	PE	3	0	0	3
3.	21NEP20	Web Engineering (Common to M.E.CSE, M.E CSE (with Specialization in Networks))	PE	3	0	0	3
4.	21CPP03	Real Time Systems	PE	3	0	0	3
5.	21CPP04	Software Architectures and Design	PE	3	0	0	3

PROFESSIONAL ELECTIVES –III SEMESTER - ELECTIVE II

S. No.	COURSE CODE	COURSE TITLE	Category	L	T	P	C
1.	21NEP11	Performance Analysis of Computer Systems	PE	3	0	0	3
2.	21CPP05	Language Technologies	PE	3	0	0	3
3.	21CPP06	Computer Vision	PE	3	0	0	3
4.	21CPP07	Software Quality Assurance and Testing	PE	3	0	0	3
5.	21NEP24	Social Network Analysis	PE	3	0	0	3

PROFESSIONAL ELECTIVES –III SEMESTER - ELECTIVE III

S.No.	COURSEC ODE	COURSE TITLE	Category	L	T	P	C
1.	21CPP08	Formal models of software Systems	PE	3	0	0	3
2.	21CPP09	Embedded Software Development	PE	3	0	0	3
3.	21CPP10	Bio-inspired Computing	PE	3	0	0	3
4.	21CPP11	Compiler Optimization Techniques	PE	3	0	0	3
5.	21CMP13	Speech Processing and Synthesis (Common to M.E. CS, M.E.CSE, M.E CSE (with Specialization in Networks))	PE	3	0	0	3

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PROFESSIONAL ELECTIVES - III SEMESTER - ELECTIVE IV

S.No.	COURSEC ODE	COURSE TITLE	Category	L	T	P	C
1.	21CPP12	Data Visualization Techniques	PE	3	0	0	3
2.	21CPP13	Reconfigurable Computing	PE	3	0	0	3
3.	21NEP18	Mobile Application Development (Common to M.E.CSE, M.E CSE (with Specialization in Networks))	PE	3	0	0	3
4.	21CPP14	Bio Informatics	PE	3	0	0	3
5.	21CPP15	Information Storage Management	PE	3	0	0	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

S.No.	COURSECODE	COURSE TITLE	L	T	P	C
1.	21AC101	English for Research Paper Writing	2	0	0	0
2.	21AC102	Constitution of India	2	0	0	0
3.	21AC103	Disaster Management	2	0	0	0

SEMESTER-WISE CREDIT DISTRIBUTION

	I SEM	II SEM	III SEM	IV SEM	Total Credits
FC	4	-	-	-	4
PC	15	22	-	-	37
PE	-	3	9	-	12
EE	-	1	6	12	19
RM	3	-	-	-	3
Total	22	26	15	12	75

S.No	Topic
FC	Foundation Course (FC)
PC	Professional Core Courses (PC)

PE	Professional Electives : Courses relevant to chosen specialization / branch (PE)
EE	Project Work, Seminar and Internship in Industry – Employability Enhancement Courses (EE)
RM	Research Methodology(RM)

21MA121	APPLIED PROBABILITY AND STATISTICS FOR COMPUTER SCIENCE ENGINEERS *(Common to M.E (CSE)& M. E(CSE with Network Specialization))*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES

- To encourage students to develop a working knowledge of the central ideas of Linear Algebra.
- To enable students to understand the concepts of Probability and Random Variables.
- To understand the basic probability concepts with respect to two dimensional random variables.
- To apply the small / large sample tests through Tests of hypothesis.
- To enable the students to use the concepts of multivariate normal distribution and principal components analysis.

UNIT I	LINEAR ALGEBRA	12

Vector spaces – norms – Inner Products – Eigenvalues using QR transformations – QR factorization – generalized eigenvectors – Canonical forms – singular value decomposition and applications – pseudo inverse – least square approximations.

UNIT II	PROBABILITY AND RANDOM VARIABLES	12

Probability – Axioms of probability – Conditional probability – Baye's theorem – Random variables – Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT III	TWO DIMENSIONAL RANDOM VARIABLES	12

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT IV	TESTING OF HYPOTHESIS	12

Sampling distributions – Type I and Type II errors – Small and Large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT V	MULTIVARIATE ANALYSIS	12

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components – Population principal components – Principal components from standardized variables.

TOTAL: 60 PERIODS

BOS CHAIRMAN

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the concepts of Linear Algebra to solve practical problems

CO2: Use the ideas of probability and random variables in solving engineering problems.

CO3: Be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.

CO4: Use statistical tests in testing hypothesis on data.

CO5: Develop critical thinking based on empirical evidence and the scientific approach to knowledge development

REFERENCES:

1. Dallas E Johnson, "Applied multivariate methods for data Analysis",vol 42, 1st Thomson and Duxbury press, Singapore, 1998.
2. Richard A. Johnson and Dean W. Wichern, "Applied multivariate statistical Analysis", 6th Edition, Pearson Education, New Delhi, 2013.
3. Bronson, R.,"Matrix Operation", Schaum's outline series, 2nd Edition ,Tata McGraw Hill, New York, 2011.
4. Oliver C. Ibe, "Fundamentals of Applied probability and Random Processes", 2nd Edition, Academic Press, Boston, 2014.
5. Johnson R. A. and Gupta C.B., "Miller and Freund's Probability and Statistics for Engineers", 9th Edition, Pearson India Education, Asia, New Delhi, 2017.

21RM102	**RESEARCH METHODOLOGY AND IPR** *(Common to M.E (Manufacturing Engineering), M.E (Computer Science Engineering), M.E. (Power Systems))*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To apply knowledge of collecting data for carrying out research work effectively.
- To predict optimization technique for problem solving.
- To assess decision making skills using statistical tool.
- To construct exposure to write research reports.
- To apply knowledge about the procedure for filing patents and protecting intellectual property rights.

UNIT I	FUNDAMENTALS AND DATA COLLECTION	9

Research methodology - definition, COURSE OBJECTIVES, mathematical tools for analysis, Research design. Types of research, exploratory research, conclusive research, modelling research, algorithmic research, Research process- steps. Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design.

UNIT II	HYPOTHESES TESTING AND ANALYSIS	9

Hypotheses testing – Testing of hypotheses concerning means, concerning variance – one tailed Chi-square test. Introduction to Discriminant analysis, Factor analysis, cluster analysis, multidimensional scaling, conjoint analysis.

UNIT III	REPORT WRITING AND PRESENTATION	9

Report writing- Types of report, guidelines to review report, report format, typing instructions, oral presentation, power point presentation, Data analysis using excel sheet, Proposal submission for funding agencies. Plagiarism, tools to avoid plagiarism, research ethics.

Case study: (Use software) report format, Prepare review paper, Reference formation end note, Grammar verification, Sample plagiarism report using Urkund/ Turnitin.

UNIT IV	PATENT RIGHTS	9

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.

UNIT V	NATURE OF INTELLECTUAL PROPERTY	9

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Relate the fundamental search concepts and data collection methods for conducting Research work.

CO2: Experiment the test hypothesis and analyze the outcome

CO3: Report the research work and write research proposals for various funding agencies.

CO4: Analyse the procedure for filing patent rights, licensing and transfer of technology.

CO5: Analyse the nature of intellectual property

REFERENCES:

1. Ranjith Kumar, "Research Methodology", 4th Edition, SAGE publication, 2018.
2. Robert Coe, Michael Waring, Larry V Hadges, James Arthur, "Research Method and Methodology in Education", 2nd Edition, SAGE Publication, 2017.
3. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age, 3rd Edition, Wolters Kluwer Publications, 2016.
4. T. Ramappa, "Intellectual Property Rights Under WTO", 3rd Edition, Asia Law house, 2022.

21CP101	ADVANCED DATA STRUCTURES AND ALGORITHMS *(Common to M.E.CSE, M.E CSE (with Specialization in Networks)*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the usage of algorithms in computing
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications
- To select and design data structures and algorithms that is appropriate for problems
- To study about NP Completeness of problems.

TOPICS TO BE COVERED

UNIT I	ROLE OF ALGORITHMS IN COMPUTING & COMPLEXITY ANALYSIS	9

Algorithms – Algorithms as a Technology -Time and Space complexity of algorithms- Asymptotic analysis-Average and worst-case analysis-Asymptotic notation-Importance of efficient algorithms-Program performance measurement - Recurrences: The Substitution Method – The Recursion-Tree Method- Data structures and algorithms.

UNIT II	HIERARCHICAL DATA STRUCTURES	9

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B - trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Heap – Heap Implementation – Disjoint Sets - Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT III	GRAPHS	9

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First

Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; Dynamic Programming - All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm

UNIT IV	ALGORITHM DESIGN TECHNIQUES	9

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: – Elements of the Greedy Strategy- An Activity-Selection Problem - Huffman Coding.

UNIT V	NP COMPLETE AND NP HARD	9

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Design data structures and algorithms to solve computing problems.

CO2: Choose and implement efficient data structures and apply them to solve Problems.

CO3: Design algorithms using graph structure and various string-matching algorithms to solve real- life problems

CO4: Design one's own algorithm for an unknown problem.

CO5: Apply suitable design strategy for problem solving

REFERENCES:

1. S.Sridhar," Design and Analysis of Algorithms", 1st Edition, Oxford University Press,2014.
2. Adam Drozdex, "Data Structures and algorithms in C++",4th Edition, Cengage Learning, 2013.
3. T.H. Cormen, C.E.Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2012.
4. Mark Allen Weiss, "Data Structures and Algorithms in C++",3rd Edition, Pearson Education 2009.
5. E. Horowitz, S. Sahni and S. Rajasekaran, "Fundamentals of Computer Algorithms", 2nd Edition, University Press, 2008.
6. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", 3rd Edition, Pearson Education, Reprint, 2006.

21NE101	NETWORK TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts of networks
- To explore various technologies in the wireless domain
- To study about 4G and 5G cellular networks
- To understand the paradigm of Software defined networks
- To learn about Network Function Virtualization

UNIT I	NETWORKING CONCEPTS	9

Peer To Peer Vs Client-Server Networks. Network Devices. Network Terminology. Network Speeds. Network throughput, delay. OSI Model. Packets, Frames, And Headers. Collision And Broadcast Domains. LAN Vs WAN. Network Adapter. Hub. Switch. Router. Firewall, IP addressing.		
UNIT II	**WIRELESS NETWORKS**	**9**
Wireless access techniques- IEEE 802.11a, 802.11g, 802.11e, 802.11n/ac/ax/ay/ba/be. QoS – Bluetooth – Protocol Stack – Security – Profiles – zigbee		
UNIT III	**MOBILE DATA NETWORKS**	**9**
4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Channel Modeling for 4G – Concepts of 5G – channel access –air interface -Cognitive Radio-spectrum management – C-RAN architecture - Vehicular communications-protocol – Network slicing – MIMO, mmWave, Introduction to 6G.		
UNIT IV	**SOFTWARE DEFINED NETWORKS**	**9**
SDN Architecture. Characteristics of Software-Defined Networking. SDN- and NFV-Related Standards. SDN Data Plane. Data Plane Functions. Data Plane Protocols. OpenFlow Logical Network Device. Flow Table Structure. Flow Table Pipeline. The Use of Multiple Tables. GroupTable. OpenFlow Protocol. SDN Control Plane Architecture. Control Plane Functions. Southbound Interface. Northbound Interface. Routing. ITU-T Model. OpenDaylight. OpenDaylight Architecture. OpenDaylight Helium. SDN Application Plane Architecture. Northbound Interface. Network Services Abstraction Layer. Network Applications. User Interface.		
UNIT V	**NETWORK FUNCTIONS VIRTUALIZATION**	**9**
Motivation-Virtual Machines –NFV benefits-requirements – architecture- NFV Infrastructure - Virtualized Network Functions - NFV Management and Orchestration- NFV Use Cases- NFV and SDN –Network virtualization – VLAN and VPN		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the networking concepts.

CO2: Understand various technologies in wireless domain

CO3: Classify 4G and 5G networks

CO4: Interpret the paradigm of Software defined networks.

CO5: Understand about Network Function Virtualization.

REFERENCES:

1. James Bernstein, "Networking made Easy", 1st Edition,Kindle Publishers,2018.
2. HoudaLabiod, Costantino de Santis, HossamAfifi –"Wi-Fi, Bluetooth, Zigbee and WiMax", 1st Edition ,Springer 2007.
3. Erik Dahlman, Stefan Parkvall, Johan Skold, —4G: LTE/LTE-Advanced for Mobile Broadband, 1st Edition, Academic Press, 2013.
4. Saad Z. Asif – "5G Mobile Communications Concepts and Technologies" 1st Edition ,CRC press – 2019
5. William Stallings –"Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" 1st Edition, Pearson Education, 2016.

6. Thomas D.Nadeau and Ken Gray, "SDN – Software Defined Networks", 1st Edition, O"Reilly Publishers, 2013.
7. Guy Pujolle, "Software Networks", 2nd Edition, Wiley-ISTE, 2020.

21CP102	PRINCIPLES OF PROGRAMMING LANGUAGES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand and describe syntax and semantics of programming languages
- To understand data, data types, and basic statements
- To understand call-return architecture and ways of implementing them
- To understand object-orientation, concurrency, and event handling in programming languages
- To understand functional and logic programming languages

TOPICS TO BE COVERED

UNIT I	SYNTAX AND SEMANTICS	9
Evolution of programming languages – describing syntax – context – free grammars –attribute grammars – describing semantics – lexical analysis – parsing – recursive-descent – bottom- up parsing		
UNIT II	DATA, DATA TYPES, AND BASIC STATEMENTS	9
Names – variables – binding – type checking – scope – scope rules – lifetime and garbage collection –primitive data types–strings–array types– associative arrays–record types– union types – pointers and references – Arithmetic expressions – overloaded operators – type conversions – relational and Boolean expressions – assignment statements – mixed- mode assignments – control structures – selection – iterations – branching – guarded statements		
UNIT III	SUBPROGRAMS AND IMPLEMENTATIONS	9
Subprograms – design issues – local referencing – parameter passing – overloaded methods – generic methods – design issues for functions – semantics of call and return – implementing simple subprograms – stack and dynamic local variables – nested subprograms – blocks – dynamic scoping		
UNIT IV	OBJECT-ORIENTATION, CONCURRENCY, AND EVENT HANDLING	9
Object-orientation – design issues for OOP languages – implementation of object-oriented constructs – concurrency – semaphores – monitors – message passing – threads – statement level concurrency – exception handling – event handling		
UNIT V	FUNCTIONAL AND LOGIC PROGRAMMING LANGUAGES	9
Introduction to lambda calculus – fundamentals of functional programming languages – Programming with Scheme – Programming with ML – Introduction to logic and logic programming – Programming with Prolog – multi-paradigm languages		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Describe syntax and semantics of programming languages

CO2: Explain data, data types, and basic statements of programming languages

CO3: Design and implement subprogram constructs

CO4: Apply object-oriented, concurrency, and event handling programming constructs

CO5: Develop programs in Scheme, ML, and Prolog

REFERENCES:

R1. Robert W. Sebesta, "Concepts of Programming Languages", 11th Edition, Addison

Wesley 2012.
R2.W. F. Clocksin and C. S. Mellish, "Programming in Prolog: Using the ISO Standard", 5th Edition, Springer, 2003.
R3. Michael L.Scott, "Programming Language Pragmatics", 4th Edition, Morgan Kaufmann, 2009.
R4. R.Kent Dy bvig," The Scheme programming language", 4th Edition, MIT Press, 2009.

21CP103	ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY *(Common to M.E.CSE, M.E CSE (with Specialization in Networks))*	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To acquire the knowledge of using advanced tree structures
- To learn the usage of heap structures
- To understand the usage of graph structures and spanning trees
- To understand the problems such as matrix chain multiplication, activity selection and Huffman coding
- To understand the necessary mathematical abstraction to solve problems

LIST OF EXPERIMENTS:

1: Implementation of recursive function for tree traversal and Fibonacci
2: Implementation of iteration function for tree traversal and Fibonacci
3: Implementation of Merge Sort and Quick Sort
4: Implementation of a Binary Search Tree
5: Red-Black Tree Implementation
6: Heap Implementation
7: Fibonacci Heap Implementation
8: Graph Traversals
9: Spanning Tree Implementation
10: Shortest Path Algorithms (Dijkstra's algorithm, Bellman Ford Algorithm)
11: Implementation of Matrix Chain Multiplication
12: Activity Selection and Huffman Coding Implementation

HARDWARE/SOFTWARE REQUIREMENTS

1. 64-bit Open-source Linux or its derivative
2. Open-Source C++ Programming tool like G++/GCC

TOTAL:60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1: Design and implement basic and advanced data structures extensively
CO2: Design algorithms using graph structures
CO3: Design and develop efficient algorithms with minimum complexity using design techniques
CO4: Develop programs using various algorithms.
CO5: Choose appropriate data structures and algorithms, understand the ADT/libraries,and use it to design algorithms for a specific problem

REFERENCES:

1. Lipschutz Seymour, "Data Structures Schaum's Outlines Series", 3rd Edition, Tata McGraw Hill, 2014.

2. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, "Data Structures and Algorithms", 3rd Edition, Pearson Education, Reprint 2006.
3. S.Sridhar," Design and Analysis of Algorithms", 1st Edition, Oxford University Press,2014.
4. Adam Drozdex, "Data Structures and algorithms in C++",4th Edition, Cengage Learning, 2013.
5. T.H. Cormen, C.E.Leiserson, R.L. Rivest and C.Stein, "Introduction to Algorithms", 3rd Edition, Prentice Hall of India, 2012.

21CP104	DATABASE PRACTICES *(Common to M.E CSE, M.E CSE (with Specialization in Networks)*	L	T	P	C
		3	0	2	4

COURSE OBJECTIVES:

- To describe the fundamental elements of relational database management systems
- To understand query processing in a distributed database system
- To understand the basics of XML and create well-formed and valid XML documents.
- To distinguish the different types of NoSQL databases
- To understand the different models involved in database security and their applications in real time world to protect the database and information associated with them.

TOPICS TO BE COVERED

UNIT I	RELATIONAL DATA MODEL	12

Entity Relationship Model – Relational Data Model – Mapping Entity Relationship Model To Relational Model – Relational Algebra – Structured Query Language – Database normalization

Suggested Activities:

Data Definition Language

- Create, Alter and Drop
- Enforce Primary Key, Foreign Key, Check, Unique and Not Null Constraints
- Creating Views

Data Manipulation Language

- Insert, Delete, Update
- Cartesian Product, Equi Join, Left Outer Join, Right Outer Join and Full Outer Join
- Aggregate Functions
- Set Operations
- Nested Queries

Transaction
Control
Language
Commit, Rollback and Save Points

UNIT II	DISTRIBUTED DATABASES, ACTIVE DATABASES AND OPEN DATABASECONNECTIVITY	12

Distributed Database Architecture – Distributed Data Storage – Distributed Transactions – Distributed Query Processing – Distributed Transaction Management – Event Condition Action Model – Design and Implementation Issues for Active Databases – Open Database Connectivity.

Suggested Activities:

- Distributed Database Design and Implementation
- Row Level and Statement Level Triggers
- Accessing a Relational Database using PHP, Python and R

UNIT III	XML DATABASES	12

Structured, Semi structured, and Unstructured Data – XML Hierarchical Data Model – XML Documents – Document Type Definition – XML Schema – XML Documents and Databases – XML Querying – XPath – XQuery

Suggested Activities:

- Creating XML Documents, Document Type Definition and XML Schema
- Using a Relational Database to store the XML documents as text
- Using a Relational Database to store the XML documents as data elements
- Creating or publishing customized XML documents from pre-existing relational databases
- Extracting XML Documents from Relational Databases XML Querying

UNIT IV	NOSQL DATABASES AND BIG DATA STORAGE SYSTEMS	12

NoSQL – Categories of NoSQL Systems – CAP Theorem – Document-Based NoSQL Systems and MongoDB – MongoDB Data Model – MongoDB Distributed Systems Characteristics – NoSQL Key-Value Stores – DynamoDB Overview – Voldemort Key-Value Distributed Data Store – Wide Column NoSQL Systems – Hbase Data Model – Hbase Crud Operations – Hbase Storage and Distributed System Concepts – NoSQL Graph Databases and Neo4j – Cypher Query Language of Neo4j – Big Data – MapReduce – Hadoop – YARN

Suggested Activities:

- Creating Databases using MongoDB, DynamoDB, Voldemort Key-Value Distributed DataStore Hbase and Neo4j.
- Writing simple queries to access databases created using MongoDB, DynamoDB,Voldemort Key-Value Distributed Data Store Hbase and Neo4j.

UNIT V	DATABASE SECURITY	12

Database Security Issues – Discretionary Access Control Based on Granting and Revoking Privileges – Mandatory Access Control and Role-Based Access Control for Multilevel Security – SQL Injection – Statistical Database Security – Flow Control – Encryption and Public Key Infrastructures – Preserving Data Privacy – Challenges to Maintaining Database Security – Database Survivability – Oracle Label-Based Security

Suggested Activities:

Implementing Access Control in Relational Databases

TOTAL:60 PERIODS

COURSE OUTCOMES

At the end of the course, learners will be able to

CO1: Convert the ER-model to relational tables, populate relational databases and formulate SQL queries on data.

CO2: Understand and write well-formed XML documents

CO3: Be able to apply methods and techniques for distributed query processing.

CO4: Design and Implement secure database systems.

CO5: Use the data control, definition, and manipulation languages of the NoSQL databases

REFERENCES:

1. R.Elmasri, S.B. Navathe, "Fundamentals of Database Systems", 7th Edition, Pearson Education, 2016.

2. Henry F. Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", 7th

Edition, McGraw Hill, 2019.
3. C.J. Date, A.Kannan, S.Swamynathan, —An Introduction to Database Systems, 8th Edition, Pearson Education, 2006.
4. Raghu Ramakrishnan, Johannes Gehrke "Database Management Systems", 4th Edition, McGraw Hill Education, 2015.
5. Harrison, Guy, "Next Generation Databases, NoSQL and Big Data", 1st Edition, Apress publishers, 2015.
6. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design,Implementation and Management", 6th Edition, Pearson Education, 2015.

21CP105	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of Internet of Things
- To understand the different architecture of IoT
- To learn about the basics of IOT protocols
- To build a small low-cost embedded system using Raspberry Pi.
- To apply the concept of Internet of Things in the real-world scenario.

TOPICS TO BE COVERED

UNIT I	INTRODUCTION TO IoT	9

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

UNIT II	IoT ARCHITECTURE	9

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture

UNIT III	IoT PROTOCOLS	9

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security

UNIT IV	BUILDING IoT WITH RASPBERRY PI & ARDUINO	9

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

UNIT V	CASE STUDIES AND REAL-WORLD APPLICATIONS	9

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

TOTAL:45 PERIODS

COURSE OUTCOMES:
At the end of the course, learners will be able to
CO1: Analyze various protocols for IoT
CO2: Develop web services to access/control IoT devices.
CO3: Design a portable IoT using Rasperry Pi and Arduino.
CO4: Deploy an IoT application and connect to the cloud.
CO5: Analyze applications of IoT in real time scenario.

REFERENCES:

1. Arshdeep Bahga, Vijay Madisetti, —Internet of Things – A hands-on approach, 1st Edition, Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), Architecting the Internet of Things, 1st Edition, Springer, 2011.
3. Honbo Zhou, —The Internet of Things in the Cloud: A Middleware Perspective, 1st Edition, CRC Press, 2012.
4. Jan Ho" ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand, David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", 1st Edition, Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , —The Internet of Things - Key applications and Protocols‖, 1st Edition,,Wiley, 2012.

21CP106	SECURITY PRACTICES	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:
- To learn the core fundamentals of system and web security concepts
- To have through understanding in the security concepts related to networks
- To deploy the security essentials in IT Sector
- To be exposed to the concepts of Cyber Security and encryption Concepts
- To perform a detailed study of Privacy and Storage security and related Issues.

TOPICS TO BE COVERED

UNIT I	SYSTEM SECURITY	9

Building a secure organization- A Cryptography primer- detecting system Intrusion Preventing system Intrusion- Fault tolerance and Resilience in cloud computing environments- Security web applications, services and servers.

UNIT II	NETWORK SECURITY	9

Internet Security - Botnet Problem- Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security Optical Network Security- Optical wireless Security

UNIT III	SECURITY MANEGEMENT	9

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System - Intrusion and Detection and Prevention System

UNIT IV	CYBER SECURITY AND CRYPTOGRAPHY	9

Cyber Forensics- Cyber Forensics and Incidence Response - Security e-Discovery - Network Forensics - Data Encryption- Satellite Encryption - Password based authenticated Key establishment Protocols.

UNIT V	PRIVACY AND STORAGE SECURITY	9

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage

Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the core fundamentals of system security

CO2: Apply the security concepts related to networks in wired and wireless scenario

CO3: Implement and Manage the security essentials in IT Sector

CO4: Explain the concepts of Cyber Security and encryption Concepts

CO5: Discuss to attain a thorough knowledge in the area of Privacy and Storage security and related Issues.

REFERENCES:

1. John R.Vacca, Computer and Information Security Handbook, 2nd Edition, Elsevier 2013.
2. Michael E. Whitman, Herbert J. Mattord, Principal of Information Security, 4th Edition, Cengage Learning, 2012.
3. Richard E.Smith, Elementary Information Security, 2nd Edition, Jones and Bartlett Learning, 2016.
4. Sanil Nadkarni ,"Fundamentals of Information Security" 1st Edition Publications,2020

21CP107	**MACHINE LEARNING** *(Common to M.E CSE, M.E CSE (with Specialization in Networks))*	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability-based learning techniques
- To understand dimensionality reduction and evolutionary models
- To understand graphical models of machine learning algorithms

TOPICS TO BE COVERED

UNIT I — INTRODUCTION — 9

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression

UNIT II — LINEAR MODELS — 9

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

UNIT III — TREE AND PROBABILISTIC MODELS — 9

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map

UNIT IV — DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS — 9

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process

UNIT V	GRAPHICAL MODELS	9

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Distinguish between supervised, unsupervised and semi-supervised learning.

CO2: Apply the appropriate machine learning strategy for any given problem.

CO3: Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem.

CO4: Design a system that uses the appropriate graph models of machine learning.

CO5: Modify existing machine learning algorithms to improve classification efficiency

REFERENCES:

1. Ethem Alpaydin, —Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series) 3rd Edition, MIT Press, 2014 .
2. Jason Bell, —Machine learning – Hands on for Developers and Technical Professionalsl, 1st Edition, Wiley, 2014 .
3. Peter Flach, —Machine Learning: The Art and Science of Algorithms that Make Sense of Data, 1st Edition, Cambridge University Press, 2012.
4. Stephen Marsland, —Machine Learning – An Algorithmic Perspective, 2nd Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
5. Tom M Mitchell, —Machine Learningl, 1st Edition, McGraw Hill Education, 2013.

21CP108	BIG DATA ANALYTICS	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytic

TOPICS TO BE COVERED

UNIT I	INTRODUCTION TO BIG DATA	12

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.

UNIT II	HADOOP FRAMEWORK	12

Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN

UNIT III	DATA ANALYSIS	12
Statistical Methods: Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.		
UNIT IV	**MINING DATA STREAMS**	**12**
Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.		
UNIT V	**BIG DATA FRAMEWORKS**	**12**
Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples. Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts. Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand how to leverage the insights from big data analytics

CO2: Understand the basics of Hadoop Framework

CO3: Analyze data by utilizing various statistical and data mining approaches

CO4: Make use of analytics on real-time streaming data

CO5: Understand the various NoSql alternative database models

REFERENCES:

1. Bill Franks, —Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics, 1st Edition, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 1st Edition, Morgan Kaufmann, 2013.
3. Michael Berthold, David J. Hand, —Intelligent Data Analysisl, 2nd Edition, Springer, 2007.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", 1st Edition, Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", 1st Edition, Addison-Wesley Professional, 2012.
6. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, 1st Edition, O'Reilly Media, 2013.

21CP109	ADVANCED COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To understand the memory hierarchy design
- To learn the different multiprocessor issues.
- To expose the different types of multicore architectures.

- To understand the design of the memory hierarchy.

TOPICS TO BE COVERED

UNIT I	**FUNDAMENTALS OF COMPUTER DESIGN AND ILP**	9
Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP – Multithreading		
UNIT II	**MEMORY HIERARCHY DESIGN**	9
Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.		
UNIT III	**MULTIPROCESSOR ISSUES**	9
Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks.		
UNIT IV	**MULTICORE ARCHITECTURES**	9
Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers-Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer		
UNIT V	**VECTOR, SIMD AND GPU ARCHITECTURES**	9
Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the limitations of ILP.

CO2: Discuss the issues related to multiprocessing and suggest solutions

CO3: Point out the salient features of different multicore architectures and how they exploit parallelism.

CO4: Discuss the various techniques used for optimizing the cache performance

CO5: Point out how data level parallelism is exploited in architectures

REFERENCES:

1. Darryl Gove, —Multicore Application Programming: For Windows, Linux, and Oracle Solaris‖, 1st Edition, Pearson, 2011.
2. David B. Kirk, Wen-mei W. Hwu, —Programming Massively Parallel Processors,1st Edition, Morgan Kauffman, 2013.
3. David E. Culler, Jaswinder Pal Singh, —Parallel computing architecture: A Hardware /software approach, 1st Edition ,Morgan Kaufmann /Elsevier Publishers, 1999.
4. John L. Hennessey and David A. Patterson, —Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier, 5th edition, 2012.
5. Kai Hwang and Zhi.WeiXu, —Scalable Parallel Computing, 1st Edition, Tata McGraw Hill, New Delhi, 2003.

21NE108	TERM PAPER AND SEMINAR *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtaininformation from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (at least 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analyzing eachpaper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an area ofinterest, topic and state an objective	2nd week	3 % Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3. List 2 conferences, symposia or workshops 4. List 1 thesis title 5. List 3 web presences (mailing lists,forums, news sites) 6. List 3 authors who publish regularly inyour area 7. Attach a call for papers (CFP) from your area.	3rd week	3% (the selected information must bearea specific and of international and national standard)

Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them,	4^{th} week	6% (the list of standard papers and reason forselection)
	• Favour papers from well-known journals and conferences, • Favour first or foundationall papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered		
Reading and notes for first 5 papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion?	5th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

	• What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (From the perspective of your survey)		
Reading and notes for next5 papers	Repeat Reading Paper Process	6th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	8% (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	8% (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	6% (Clarity, purpose and conclusion) 6% Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	5% (clarity)

Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	10% (This component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	5% (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	10% (formatting, English, Clarity and linking) 4% Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	10% (Based on presentation and Viva- voce)

21CP110	DATA ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To implement Map Reduce programs for processing big data
- To realize storage of big data using H base, Mongo DB
- To analyze big data using linear models
- To analyze big data using machine learning techniques such as SVM / Decision tree classification and clustering
- To implement clustering techniques

LIST OF EXPERIMENTS

Hadoop

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an MR program that processes a weather dataset

R

4. Implement Linear and logistic Regression
5. Implement SVM / Decision tree classification techniques
6. Implement clustering techniques
7. Visualize data using any plotting framework
8. Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Interpret big data using Hadoop framework

CO2: Build linear and logistic regression models

CO3: Examine data analysis with machine learning methods

CO4: Apply and Build clustering techniques

CO5: Assess graphical data analysis

LIST OF SOFTWARE FOR A BATCH OF 30 STUDENTS:

Hadoop/YARN/R Package/ Hbase /MongoDB

21CP111	MACHINE LEARNING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To enable the students to use optimization technique for problem solving.
- To impart decision making skills using statistical tool.
- To apply back propagation algorithm
- To implement clustering algorithm.
- To apply reinforcement learning for developing a game

LIST OF EXPERIMENTS

1. 1. Study and usage of python and R tool.
2. Study of Python Libraries for ML application such as Statistics, Math, Numpy, Scipy,Pandas and Matplotlib.
3. Write a Python program to implement Simple Linear Regression.
4. Implementation of Multiple Linear Regression for House Price Prediction using sklearn.
5. Implementation of Decision tree using sklearn and its parameter tuning.
6. Implementation of KNN using sklearn.
7. Implementation of Logistic Regression using sklearn.
8. Write a program to construct a Bayesian network considering medical data.Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set.
9. Implement the FIND-S algorithm. Verify that it successfully produces the trace in for the Enjoy sport example.
10. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate datasets.
11. Implementation of K-Means Clustering.
12. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Mean"s algorithm. Compare the results of these two algorithms and comment on the quality of clustering.
13. Write a program to implement Reinforcement Learning and Model-Based Reinforcement Learning.

NOTE :

Datasets for the above exercises available in Kaggle and UCI repository mentioned below

i. https://www.kaggle.com

ii. ii. http://archive.ics.uci.edu/ml/datasets.html

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply various classification techniques for problems using tools like R and Python.

CO2: Apply various clustering techniques for problems using tools like R and Python.

CO3: Determine the solutions for various prediction problems using tools.

CO4: Develop and Design of programs using reinforcement learning

CO5: Develop and Design of programs using Model-Based reinforcement Learning.

PROFESSIONAL ELECTIVE-I

21CPP01	CLOUD COMPUTING TECHNOLOGIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing
- To understand the various issues in cloud computing

TOPICS TO BE COVERED

UNIT I	VIRTUALIZATION	9

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines – Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization — Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization

UNIT II	VIRTUALIZATION INFRASTRUCTURE	9

Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization -Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation

UNIT III	CLOUD PLATFORM ARCHITECTURE	9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design, Layered cloud, Architectural Development- Virtualization Support and Disaster Recovery- Architectural Design Challenges - Public Cloud Platforms: GAE, AWS – Inter-cloud Resource Management

UNIT IV	PROGRAMMING MODEL	9

Introduction to Hadoop Framework – Map reduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus

UNIT V	CLOUD SECURITY	9

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud – Cloud Security and Trust Management

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the concepts of storage virtualization, network virtualization and its management

CO2: Apply the concept of virtualization in the cloud computing

CO3: Identify the architecture, infrastructure and delivery models of cloud computing

CO4: Develop services using Cloud computing

CO5: Apply the security models in the cloud environment

REFERENCES

1. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner"s Guidel, 1st Edition, McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", 1st Edition, Elsevier/Morgan Kaufmann, 2005.
3. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", 1st Edition, CRC Press, 2010.
4. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", 1st Edition, Morgan Kaufmann Publishers, 2012.
5. Tim Mather, Subra Kumaraswamy, and Shahed Latif,"Cloud Security and Privacy", 1st Edition, O'Reilly Media, Inc.,2009.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", 1st Edition, McGraw-Hill Osborne Media, 2009.
7. Tom White, "Hadoop: The Definitive Guide", 1st Edition, Yahoo Press, 2012.

21CPP02	IMAGE PROCESSING AND ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the image processing concepts
- To understand the image processing techniques
- To familiarize the image processing environment and their applications,
- To appreciate the use of image processing in various applications
- To Understand Image analysis and classification.

TOPICS TO BE COVERED

UNIT I	IMAGE PROCESSING FUNDAMENTALS	9
Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations		
UNIT II	**IMAGE ENHANCEMENT AND RESTORATION**	**9**
Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.		
UNIT III	**IMAGE SEGMENTATION AND MORPHOLOGY**	**9**
Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.		
UNIT IV	**IMAGE ANALYSIS AND CLASSIFICATION**	**9**
Image segmentation- pixel based, edge based, region-based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.		
UNIT V	**IMAGE REGISTRATION AND VISUALIZATION**	**9**

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Examine and implement algorithms for image processing applications that incorporates different concepts of medical Image Processing

CO2: Discuss with the use of MATLAB and its equivalent open-source tools

CO3: Discuss image segmentation and morphology

CO4: Analyze different approaches to image processing applications

CO5: Apply Image processing concepts in various Applications

REFERENCES:

1. Alasdair McAndrew, Introduction to Digital Image Processing with Matlab, 1st Edition ,Cengage Learning, India 2011.
2. Anil J Jain, —Fundamentals of Digital Image Processingl, 1st Edition, PHI, 2006.
3. Kavyan Najarian and Robert Splerstor, Biomedical signals and Image processing, 1st Edition,,CRC – Taylor and Francis, New York, 2006.
4. Rafael C.Gonzalez and Richard E.Woods, —Digital Image Processing, Third Edition, Pearson Education, New Delhi,2008.
5. S.Sridhar, —Digital Image Processing, 1st Edition, Oxford University Press, 2011.

21NEP20	WEB ENGINEERING *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	0	0	3

Course Objectives:

- Understand the characteristics of web applications
- Learn to Model web applications
- Be aware of Systematic design methods
- Be familiar with the testing techniques for web applications
- Learn to face the challenges in Web Project Management

UNIT I INTRODUCTION TO WEB ENGINEERING 9

Motivation, Categories of Web Applications, Characteristics of Web Applications. Requirements of Engineering in Web Applications- Web Engineering-Components of Web Engineering-Web Engineering Process-Communication-Planning.

UNIT II WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS 9

Introduction- Categorizing Architectures- Specifics of Web Application Architectures, Components of a Generic Web Application Architecture- Layered Architectures, 2-Layer Architectures, N-Layer Architectures-Data-aspect Architectures, Database-centric Architectures-Architectures for Web Document Management- Architectures for Multimedia Data- Modeling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling, Modelling Framework-Modeling languages Analysis Modeling for Web Apps-The Content Model-The Interaction Model-Configuration Model.

UNIT III WEB APPLICATION DESIGN 9

Design for WebApps- Goals-Design Process-Interactive Design- Principles and Guidelines Workflow-Preliminaries-Design Steps- Usability- Issues- Information Design- Information Architecture- structuring- Accessing Information-Navigation Design- Functional Design WepApp Functionality- Design Process- Functional Architecture- Detailed Functional Design.

UNIT IV	TESTING WEB APPLICATIONS	9

Introduction-Fundamentals-Test Specifics in Web Engineering-Test ApproachesConventional Approaches, Agile Approaches- Testing concepts- Testing Process -Test Scheme- Test Methods and Techniques- Link Testing- Browser Testing-Usability TestingLoad, Stress, and Continuous Testing, Testing Security, Test-driven Development, -Content Testing-User Interface testing-Usability Testing-Compatibility Testing-Component Level Testing-Navigation Testing-Configuration testing-Security and Performance Testing- Test Automation.

UNIT V	PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT	9

Introduction-challenges in launching the web Application-Promoting Web Application Content Management-Usage Analysis-Web Project Management-Challenges in Web Project Management-Managing Web Team- Managing the Development Process of a Web Application- Risk, developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS - web sockets.

TOTAL : 45 PERIODS

Course Outcomes:

At the end of the course, learners will be able to

CO1: Explain the characteristics of web applications.

CO2: Model and design various web applications.

CO3: Develop various testing web applications.

CO4: Deduct the various web applications.

CO5: Interpret the Web Applications

REFERENCES:

1. Chris Bates, "Web Programming: Building Internet Applications", 3rd Edition, Wiley India Edition, 2007.
2. Gerti Kappel, Birgit Proll, "Web Engineering", 1st Edition, John Wiley and Sons Ltd, 2006.
3. Guy W. Lecky-Thompson, -Web Programmingl, 1st Edition, Cengage Learning, 2008.
4. John Paul Mueller, —Web Development with Microsoft Visual Studio 2005, 1st Edition, Wiley Dream tech, 2006.
5. Roger S. Pressman, David Lowe, —Web Engineering, 1st Edition Tata McGraw Hill Publication, 2007.

21CPP03	REAL TIME SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn real time operating system concepts, the associated issues & Techniques.
- To understand design and synchronization problems in Real Time System.
- To explore the concepts of real time databases.
- To understand the evaluation techniques, present in Real Time System
- To understand the Real time system and Scheduling

TOPICS TO BE COVERED

UNIT I	REAL TIME SYSTEM AND SCHEDULING	9

Introduction– Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task

Assignment and Scheduling – Classical uniprocessor scheduling algorithms –Fault Tolerant Scheduling.

UNIT II | SOFTWARE REQUIREMENTS ENGINEERING 9

Requirements engineering process – types of requirements – requirements specification for real time systems – Formal methods in software specification – structured Analysis and Design – object oriented analysis and design and unified modelling language – organizing the requirements document – organizing and writing documents – requirements validation and revision

UNIT III | INTERTASK COMMUNICATION AND MEMORY MANAGEMEN 9

Buffering data – Time relative Buffering- Ring Buffers – Mailboxes – Queues – Critical regions – Semaphores – other Synchronization mechanisms – deadlock – priority inversion – process stack management – run time ring buffer – maximum stack size – multiple stack arrangement – memory management in task control block - swapping – overlays – Block page management – replacement algorithms – memory locking – working sets – real time garbage collection – contiguous file systems.

UNIT IV | REAL TIME DATABASES 9

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two– phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

UNIT V | EVALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION 9

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy–Software error models. Clock Synchronization–Clock, A Nonfault–Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.

Total: 45 Periods

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply principles of real time system design techniques to develop real time Applications

CO2: Make use of database in real time applications.

CO3: Make use of architectures and behavior of real time operating systems.

CO4: Apply evaluation techniques in application.

CO5: Understand the Intertask Communication and Memory Management

REFERENCES:

1. C.M. Krishna, Kang G. Shin, —Real-Time Systems, 1st Edition, McGraw-Hill International Editions, 1997.
2. Philip.A.Laplante, —Real Time System Design and Analysis, 3rd Edition Prentice Hall of India, 2004.
3. Rajib Mall, —Real-time systems: theory and practice, 1st Edition, Pearson Education, 2009.
4. R.J.A Buhur, D.L Bailey, —An Introduction to Real-Time Systems, 1st Edition, Prentice Hall International, 1999.
5. Stuart Bennett, —Real Time Computer Control-An Introduction, 1st Edition, Prentice Hall of India, 1998.
6. Allen Burns, Andy Wellings, —Real Time Systems and Programming Languages, 1st Edition, Pearson Education, 2003.

21CPP04	SOFTWARE ARCHITECTURES AND DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
- To learn the design principles and to apply for large scale systems
- To design architectures for distributed heterogeneous systems, environment through brokerage interaction
- To build design knowledge on service oriented and model driven architectures and the aspect-oriented architecture.
- To develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services

TOPICS TO BE COVERED

UNIT I	INTRODUCTION	10

Introduction to Software Architecture-Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes, Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).

UNIT II	OBJECT-ORIENTED PARADIGM	8

Object-Oriented Paradigm -Design Principles. Data-Centered Software Architecture: Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main-Subroutine, Master-Slave, Layered, Virtual Machine. Interaction-Oriented Software Architectures: Model-View-Controller (MVC), Presentation-Abstraction-Control (PAC).

UNIT III	DISTRIBUTED ARCHITECTURE	9

Distributed Architecture: Client-Server, Middleware, Multi-tiers, Broker Architecture –MOM, CORBA Message Broker Architecture- Service-Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architecture- Methodology of Architecture Decision, Quality Attributes.

UNIT IV	USER INTERFACES	9

Architecture of User Interfaces containers, case study-web service. Product Line Architectures - methodologies, processes and tools. Software Reuse and Product Lines -Product Line Analysis, Design and implementation, configuration Models. Model Driven Architectures (MDA) –why MDA-Model transformation and software architecture, SOA and MDA. Eclipse modeling framework.

UNIT V	ASPECT ORIENTED ARCHITECTURES	9

Aspect Oriented Architectures- AOP in UML.AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture &shipping –inventory, supply chain cloud service Management, semantic web services

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the need of software architecture for sustainable dynamic systems.

CO2: Make use of the knowledge on design principles and to apply for large scale systems

CO3: Model architectures for distributed heterogeneous systems

CO4: Make use of the knowledge on service oriented and model driven architectures and the aspect-oriented architecture.

CO5: Determine a working knowledge to develop appropriate architectures through various case studies.

REFERENCES:

1. Ion Gorton, "Essentials of software Architecture" , 2nd Edition, Springer-Verlag, 2011.
2. Kai Qian, Software Architecture Design Illuminated, 1st Edition, Jones and Bartlett Publishers, Canada, 2010.
3. Len Bass, Paul Clements,"Software Architecture in Practice",3rd Edition,Pearson Education,2012
4. Mark Richards,Neal Ford, "Fundamentals of Software Architecture,, 1st Edition,O'Reilly,2020

PROFESSIONAL ELECTIVE-II

21NEP11	PERFORMANCE ANALYSIS OF COMPUTER SYSTEMS *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the mathematical foundations needed for performance evaluation of computer systems
- To understand the metrics used for performance evaluation
- To understand the analytical modeling of computer systems
- To enable the students to develop new queuing analysis for both simple and complex systems
- To appreciate the use of smart scheduling and introduce the students to analytical techniques for evaluating scheduling policies

UNIT I	OVERVIEW OF PERFORMANCE EVALUATION	9

Need for Performance Evaluation in Computer Systems – Overview of Performance Evaluation Methods – Introduction to Queuing – Probability Review – Generating Random Variables for Simulation – Sample Paths, Convergence and Averages – Little's Law and other Operational Laws – Modification for Closed Systems

UNIT II	MARKOV CHAINS AND SIMPLE QUEUES	9

Discrete-Time Markov Chains – Ergodicity Theory – Real World Examples – Google, Aloha – Transition to Continuous-Time Markov Chain – M/M/1.

UNIT III	MULTI-SERVER AND MULTI-QUEUE SYSTEMS	9

Server Farms: M/M/k and M/M/k/k – Capacity Provisioning for Server Farms – Time Reversibility and Burke's Theorem – Networks of Queues and Jackson Product Form – Classed and Closed Networks of Queues

UNIT IV	REAL-WORLD WORKLOADS	9

Case Study of Real-world Workloads – Phase-Type Distributions and Matrix-Alalytic Methods – Networks with Time-Sharing Servers – M/G/1 Queue and the Inspection Paradox – Task Assignment Policies for Server Farms.		
UNIT V	**SMART SCHEDULING IN THE M/G/1**	9
Performance Metrics – Scheduling Non-Preemptive and Preemptive Non-Size-Based Policies - . Scheduling Non-Preemptive and Preemptive Size-Based Policies – Scheduling - SRPT and Fairness		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Identify the need for performance evaluation and the metrics used for it

CO2: Compare between open and closed queuing networks

CO3: Apply the operational laws to open and closed systems

CO4: Make Use of discrete-time and continuous-time Markov chains to model real world systems

CO5: Develop analytical techniques for evaluating scheduling policies

REFERENCES:

1. K. S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", 1st Edition ,John Wiley and Sons, 2001.
2. Krishna Kant, "Introduction to Computer System Performance Evaluation", 1st Edition ,McGraw-Hill, 1992.
3. Lieven Eeckhout, "Computer Architecture Performance Evaluation Methods", 1st Edition ,Morgan and Claypool Publishers, 2010.
4. Mor Harchol - Balter, "Performance Modeling and Design of Computer Systems – Queueing Theory in Action", 1st Edition ,Cambridge University Press, 2013.
5. Paul J. Fortier and Howard E. Michel, "Computer Systems Performance Evaluation and Prediction", 1st Edition ,Elsevier, 2003.
6. Raj Jain, "The Art of Computer Systems Performance Analysis: Techniques for Experimental Design, Measurement, Simulation and Modeling", 1st Edition ,Wiley-Interscience, 1991

21CPP05	**LANGUAGE TECHNOLOGIES**	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the fundamentals of natural language processing
- To appreciate the use of CFG and PCFG in NLP
- To understand the role of semantics and pragmatics
- To understand the Computational Phonology
- To Understand Machine Translation

TOPICS TO BE COVERED

UNIT I	**INTRODUCTION**	9
Words - Regular Expressions and Automata - Words and Transducers - N-grams - Part-of-Speech – Tagging - Hidden Markov and Maximum Entropy Models.		

UNIT II	SPEECH	9
Speech – Phonetics - Speech Synthesis - Automatic Speech Recognition - Speech Recognition: - Advanced Topics - Computational Phonology.		
UNIT III	SYNTAX	9
Formal Grammars of English - Syntactic Parsing - Statistical Parsing - Features and Unification - Language and Complexity.		
UNIT IV	SEMANTICS AND PRAGMATICS	9
The Representation of Meaning - Computational Semantics - Lexical Semantics - Computational Lexical Semantics-Computational Discourse		
UNIT V	APPLICATIONS	9
Information Extraction - Question Answering and Summarization - Dialogue and Conversational Agents - Machine Translation		
		Total Periods:45

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize a given text with basic Language features

CO2: Build an innovative application using NLP components

CO3: Develop a rule-based system to tackle morphology/syntax of a language

ÇO4: Develop a tag set to be used for statistical processing for real-time applications

CO5 :Compare and contrast use of different statistical approaches for different types of NLP applications

REFERENCES:

1.Breck Baldwin, "Language Processing with Java and LingPipe Cookbook", 1st Edition Atlantic Publisher, 2015.

2.Daniel Jurafsky, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech", 1st Edition, Pearson Publication, 2014.

3.Nitin Indurkhya and Fred J. Damerau, "Handbook of Natural Language Processing", 2nd Edition, Chapman and Hall/CRC Press, 2010.

4. Richard M Reese, "Natural Language Processing with Java", 1st Edition, O_Reilly Media, 2015.

5. Steven Bird, Ewan Klein and Edward Loper, -"Natural Language Processing with Python,1st Edition, O_Reilly Media, 2009.

21CPP06	COMPUTER VISION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To review image processing techniques for computer vision.
- To analyze shape and region analysis.
- To understand Hough Transform to detect lines, circles, ellipses.
- To understand three-dimensional image analysis techniques.
- To understand motion analysis.

TOPICS TO BE COVERED

UNIT I	IMAGE PROCESSING FOUNDATIONS	9
Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture.		
UNIT II	SHAPES AND REGIONS	9

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments.

UNIT III	HOUGH TRANSFORM	9

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection

UNIT IV	3 D VISION AND MOTION	9

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

UNIT V	APPLICATIONS	9

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.

TOTAL:45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the fundamental image processing techniques required for computer vision.

CO2: Examine shape analysis and Implement boundary tracking techniques.

CO3: Apply Hough Transform for line, circle, and ellipse detections.

CO4: Apply 3D vision techniques.

CO5: Develop applications using computer vision techniques.

REFERENCES:

1. D. L. Baggio et al., —Mastering OpenCV with Practical Computer Vision Projects, 1st Edition, Packt Publishing, 2012.
2. E. R. Davies, —Computer & Machine Vision, 4th Edition, Academic Press, 2012.
3. Jan Erik Solem, —Programming Computer Vision with Python: Tools and algorithms for analyzing images, 1st Edition, O'Reilly Media, 2012.
4. Mark Nixon and Alberto S. Aquado, —Feature Extraction & Image Processing for Computer Vision, 3rd Edition, Academic Press, 2012.
5. R. Szeliski, —Computer Vision: Algorithms and Applications, 1st Edition, Springer 2011.
6. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, 1st Edition Cambridge University Press, 2012.

21CPP07	SOFTWARE QUALITY ASSURANCE AND TESTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of testing, test planning &design and test team organization
- To compare the various types of tests in the life cycle of the software product.
- To build design concepts for system testing and execution
- To understand the software quality assurance, metrics, defect prevention techniques
- To learn the techniques for quality assurance.

	TOPICS TO BE COVERED	
UNIT I	**SOFTWARE TESTING - CONCEPTS, ISSUES, AND TECHNIQUES**	9
Quality Revolution, Verification and Validation, Failure, Error, Fault, and Defect, Objectives of Testing, Testing Activities, Test Case Selection White-Box and Black, test Planning and design, Test Tools and Automation, . Power of Test. Test Team Organizatic and Management-Test Groups, Software Quality Assurance Group, System Test Team Hierarchy, Team Building.		
UNIT II	**SYSTEM TESTING**	9
System Testing - System Integration Techniques-Incremental, Top Down Bottom Up Sandwich and Big Bang, Software and Hardware Integration, Hardware Design Verification Tests, Hardware and Software Compatibility Matrix Test Plan for System Integration. Built-in Testing. functional testing - Testing a Function in Context. Boundary Value Analysis, Decision Tables. acceptance testing - Selection of Acceptance Criteria, Acceptance Test Plan, Test Execution Test. software reliability - Fault and Failure, Factors Influencing Software, Reliability Models		
UNIT III	**SYSTEM TEST CATEGORIES**	9
System test categories Taxonomy of System Tests, Interface Tests Functionality Tests.GUI Tests, Security Tests Feature Tests, Robustness Tests, Boundary Value Tests Power Cycling Tests Interoperability Tests, Scalability Tests, Stress Tests, Load and Stability Tests, Reliability Tests, Regression Tests, Regulatory Tests. Test Generation from FSM models- State-Oriented Model. Finite-State Machine Transition Tour Method, Testing with State Verification. Test Architectures-Local, distributed,Coordinated, Remote. system test design- Test Design Factors Requirement Identification, modeling a Test Design Process Test Design Preparedness, Metrics, Test Case Design Effectiveness, system test execution- Modeling Defects, Metrics for Monitoring Test Execution .Defect Reports, Defect Causal Analysis, Beta testing, measuring Test Effectiveness.		
UNIT IV	**SOFTWARE QUALITY**	9
Software quality - People 's Quality Expectations, Frameworks and ISO-9126, McCall's Quality Factors and Criteria – Relationship. Quality Metrics. Quality Characteristics ISO 9000:2000 Software Quality Standard. Maturity models- Test Process Improvement, Testing Maturity Model		
UNIT V	**SOFTWARE QUALITY ASSURANCE**	9
Quality Assurance - Root Cause Analysis, modeling, technologies, standards and methodologies for defect prevention. Fault Tolerance and Failure Containment - Safety Assurance and Damage Control, Hazard analysis using fault-trees and event-trees. Comparing Quality Assurance Techniques and Activities. QA Monitoring and Measurement, Risk Identification for Quantifiable Quality Improvement. Case Study: FSM-Based Testing of Web-Based Applications.		
		Total:45 Periods

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of functional and nonfunctional tests in the life cycle of the software product. CO2: Understand system testing and test execution process. CO3: Compare the various defect prevention techniques CO4: Understand the different software quality assurance metrics CO5: Apply techniques of quality assurance for typical applications.
REFERENCES: 1. Kshirasagar Nak Priyadarshi Tripathy, Software Testing and Quality Assurance-Theory and Practice, 1st Edition, John Wiley & Sons Inc,2008. 2. Jeff Tian, Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, 1st Edition John Wiley & Sons, Inc., Hoboken, New Jersey. 2005. 3. Daniel Galin, Software Quality Assurance - From Theory to Implementation, 1st Edition Pearson Education Ltd UK, 2004. 4. Milind Limaye, Software Quality Assurance, 1st Edition , TMH ,New Delhi, 2011.

21NEP24	**SOCIAL NETWORK ANALYSIS** *(Common to M.E.CSE, M.E.CSE (with Specialization in Networks))*	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**
COURSE OBJECTIVES: • To understand the components of the social network. • To model and visualize the social network. • To understand the users in the social network • To understand the evolution of the social network • To understand the applications in real time systems					
UNIT I	**INTRODUCTION**			**9**	
Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.					
UNIT II	**MODELING AND VISUALIZATION**			**9**	
Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix-Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling andaggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.					
UNIT III	**MINING COMMUNITIES**			**9**	
Aggregating and reasoning with social network data, Advanced Representations –Extracting evolution of Web Community from a Series of Web Archive – Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks..					
UNIT IV	**EVOLUTION**			**9**	
Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks -Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models					
UNIT V	**APPLICATIONS**			**9**	
A Learning Based Approach for Real Time Emotion Classification of Tweets, - A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, - Explaining Scientific and Technical - Emergence Forecasting, Social Network Analysis - for					

Biometric Template Protection.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Define the Work on the internals components of the social network

CO2: Model and visualize the social network

CO3: Summarize the behavior of the users in the social network

CO4: Estimate the possible next outcome of the social network

CO5: Apply social network in real time applications

REFERENCES:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, "Computational Social Network Analysis: Trends, Tools and Research Advances", 1st Edition, Springer, 2012
2. Borko Furht, "Handbook of Social Network Technologies and Applications", 1st Edition Springer, 2011
3. Charu C. Aggarwal, "Social Network Data Analytics", 1st Edition, Springer; 2014
4. Giles, Mark Smith, John Yen, "Advances in Social Network Mining and Analysis", 1st Edition,Springer, 2010.
5. Guandong Xu, Yanchun Zhang and Lin Li, "Web Mining and Social Networking – Techniques and applications", 1st Edition, Springer, 2012
6. Peter Mika, "Social Networks and the Semantic Web", , 1st Edition, Springer,2007.
7. Przemyslaw Kazienko, Nitesh Chawla,"Applications of Social Media and Social Network Analysis", 1st Edition, Springer,2015

PROFESSIONAL ELECTIVE –III

		L	T	P	C
21CPP08	**FORMAL MODELS OF SOFTWARE SYSTEMS**	3	0	0	3

COURSE OBJECTIVES:

- To understand the goals, complexity of software systems, the role of Specification activities and qualities to control complexity.
- To understand the fundamentals of abstraction and formal systems
- To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models' systems
- To understand formal specification models based on set theory, calculus and algebra and apply to a case study
- To learn Specification languages with case studies.

TOPICS TO BE COVERED

UNIT I **SPECIFICATION FUNDAMENTALS** **10**

Role of Specification- Software Complexity - Size, Structural, Environmental, Application, domain, Communication Complexity, How to Control Complexity. Software specification, Specification Activities-Integrating Formal Methods into the Software Life-Cycle. Specification Qualities- Process Quality Attributes of Formal Specification Languages, Model of Process Quality, Product Quality and Utility, Conformance to Stated Goals Quality Dimensions and Quality Model.

UNIT II **FORMAL METHODS** **8**

Abstraction- Fundamental Abstractions in Computing, Abstractions for Software Construction.Formalism Fundamentals - Formal Systems, Formalization Process in Software Engineering Components of a Formal System- Syntax, Semantics, and Inference Mechanism. Properties of Formal Systems - Consistency.Automata-Deterministic Finite Accepters, State

Machine Modeling Nondeterministic Finite Accepters, Finite State Transducers Extended Finite State Machine. Case Study—Elevator Control. Classification of C Methods-Property-Oriented Specification Methods, Model-Based Specification Techniques

UNIT III	LOGIC	9

Propositional Logic - Reasoning Based on Adopting a Premise, Inference Based on Natural Deduction. Predicate Logic - Syntax and Semantics, Policy Language Specification, knowledge Representation Axiomatic Specification. Temporal Logic -.Temporal Logic for Specification and Verification, Temporal Abstraction Propositional Temporal Logic (PTL), First Order Temporal Logic (FOTL).Formal Verification, Verification of Simple FOTL, Model Checking, Program Graphs, Transition Systems.

UNIT IV	SPECIFICATION MODELS	9

Mathematical Abstractions for Model-Based Specifications-Formal Specification Based on Set Theory, Relations and Functions. Property-Oriented Specifications- Algebraic Specification, Properties of Algebraic Specifications, Reasoning, Structured Specifications. Case Study—A Multiple Window Environment: requirements, Modeling Formal Specifications. Calculus of Communicating Systems: Specific Calculus for Concurrency. Operational Semantics of Agents, Simulation and Equivalence, Derivation Trees, Labeled Transition Systems.

UNIT V	FORMAL LANGUAGES	9

The Z Notation, abstractions in Z, Representational Abstraction, Types, Relations and Functions, Sequences, Bags. Free Types-Schemas, Operational Abstraction -Operations Schema Decorators, Generic Functions, Proving Properties from Z specifications, Consistency of Operations. Additional Features in Z. Case Study: An Automated Billing System. The Object-Z Specification Language- Basic Structure of an Object-Z, Specification. Parameterized Class, Object-Orientation, composition of Operations-Parallel Communication Operator, Nondeterministic Choice Operator, and Environment Enrichment. The B-Method - Abstract Machine Notation (AMN), Structure of a B Specification, arrays, statements. Structured Specifications, Case Study- A Ticketing System in a Parking.

Total Periods:45

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the complexity of software systems, the need for formal Specifications activities and qualities to control complexity.

CO2: Make use of the knowledge on fundamentals of abstraction and formal systems

CO3: Make use of the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to model's systems

CO4: Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study

CO5: Develop working knowledge on Z, Object Z and B Specification languages with case studies.

REFERENCES:

1. M.Ben-Ari, Mathematical Logic for computer science ,2nd Edition, Springer,2003.
2. Logic in Computer Science- modeling and reasoning about systems, 2nd Edition, Cambridge University Press, 2004.
3. V.S. Alagar, K. Periyasamy, David Grises and Fred B Schneider, Specification of Software Systems, Springer –Verlag London, 2011
4. Jonathan Jacky, The ways Z: Practical programming with formal methods, Cambridge University Press,1996.
5. Jim Woodcock and Jim Devies, Using Z-Specification Refinement and Proof, 1st Edition, Prentice Hall, 1996
6. Antoi Diller, Wiley, Z: An introduction to formal methods, 2nd Edition, 1994.

21CPP09	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the architecture of embedded processor, microcontroller and peripheral devices.
- To interface memory and peripherals with embedded systems.
- To understand the embedded network environment and its Performance Analysis.
- To understand challenges in Real time operating systems.
- To design and analyze applications on embedded systems.

TOPICS TO BE COVERED

UNIT I	EMBEDDEDROCESSORS	9

Embedded Computers - Characteristics of Embedded Computing Applications - Challenges in Embedded Computing System Design - Embedded System Design Process- Formalism for System Design - Structural Description - Behavioral Description - ARM Processor - Intel ATOM Processor

UNIT II	EMBEDDED COMPUTING PLATFORM	9

CPU Bus Configuration - Memory Devices and Interfacing - Input/Output Devices and Interfacing - System Design - Development and Debugging – Emulator – Simulator - JTAG Design Example – Alarm Clock - Analysis and Optimization of Performance - Power and Program Size.

UNIT III	EMBEDDED NETWORK ENIVIRONMENT	9

Distributed Embedded Architecture - Hardware And Software Architectures - Networks for Embedded Systems - I2C - CAN Bus - SHARC Link Supports – Ethernet – Myrinet – Internet - Network-based Design - Communication Analysis - System Performance Analysis - Hardware Platform Design - Allocation and Scheduling - Design Example - Elevator Controller.

UNIT IV	REAL-TIME CHARACTERISTICS	9

Clock Driven Approach - Weighted Round Robin Approach - Priority Driven Approach - Dynamic versus Static Systems - Effective Release Times and Deadlines - Optimality of the Earliest Deadline First (EDF) Algorithm - Challenges in Validating Timing Constraints in Priority Driven Systems - Off-Line versus On-Line Scheduling.

UNIT V	SYSTEM DESIGN TECHNIQUES	9

Design Methodologies - Requirement Analysis – Specification - System Analysis and Architecture Design - Quality Assurance - Design Examples - Telephone PBX - Ink jet printer - Personal Digital Assistants - Set-Top Boxes.

Total Periods:45

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand different architectures of embedded processor, microcontroller and peripheral devices. Interface memory and peripherals with embedded systems.

CO2: Examine with the Embedded Computing Platform

CO3: Develop an embedded network environment.

CO4: Understand challenges in Real time operating systems.

CO5: Analyze applications on embedded systems.

REFERENCES:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" 1st Edition ,Wiley Publication, 2013.

2. Andrew NSloss, D. Symes, C. Wright, Arm system developers guide, 1st Edition,

Morgan Kauffman/Elsevier, 2006.
3. ArshdeepBahga, Vijay Madisetti, " Internet of Things: A Hands-on-Approach" 1st Edition VPT, 2014.
4. C. M. Krishna and K. G. Shin, —Real-Time Systems , 1st Edition, McGraw-Hill, 1997.
5. Frank Vahid and Tony Givargis, —Embedded System Design: A Unified Hardware / Software Introduction, 1st Edition ,John Wiley & Sons.
6. Jane.W.S. Liu, —Real-Time systems, 1st Edition, Pearson Education Asia, 2015.
7. Michael J. Pont, —Embedded C, 1st Edition, Pearson Education ,2007.
8. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, "The AVR Microcontroller and Embedded Systems: Using Assembly and C" 1st Edition ,Pearson Education, 2014.
9. Steve Heath, —Embedded System Design , 1st Edition ,Elsevier, 2005.
10. Wayne Wolf, —Computers as Components: Principles of Embedded Computer System Design, 1st Edition, Elsevier, 2006.

21CPP10	BIO-INSPIRED COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To Learn bio-inspired theorem and algorithms
- To Understand random walk and simulated annealing
- To Learn genetic algorithm and differential evolution
- To Learn swarm optimization and ant colony for feature selection
- To understand bio-inspired application in image processing

TOPICS TO BE COVERED

UNIT I	INTRODUCTION	9

Introduction to algorithm - Newton's method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Mataheuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control

UNIT II	RANDOM WALK AND ANEALING	9

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling.

UNIT III	GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION	9

Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA varients - schema theorem - convergence analysis - introduction to differential evolution - varients - choice of parameters - convergence analysis - implementation.

UNIT IV	SWARM OPTIMIZATION AND FIREFLY ALGORITHM	9

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - varients- Ant colony optimization toward feature selection

UNIT V	APPLICATIONS IN IMAGE PROCESSING	9

Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine-Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search

Total : 45 Periods

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Implement bio-inspired algorithms

CO2: Explain random walk and simulated annealing

CO3: Apply genetic algorithms for various applications

CO4: Explain swarm intelligence and ant colony for feature selection

CO5: Apply bio-inspired techniques in image processing

REFERENCES:

1. Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", 1st Edition ,Springer 2015.
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", 1st Edition, Intech 2013.
3. Xin-She Yang , Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing",1st Edition ,Elsevier 2016.
4. Xin-She Yang, "Nature Ispired Optimization Algorithm,, 1st Edition ,Elsevier 2014.
5.Yang ,Cui,XIao, Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing",1st Edition, Elsevier, 2013.

21CPP11	COMPILER OPTIMIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To be aware of different forms of intermediate languages and analyzing programs.
- To understand optimizations techniques for simple program blocks.
- To apply optimizations on procedures, control flow and parallelism.
- To learn the interprocedural analysis and optimizations.
- To explore the knowledge about resource utilization.

TOPICS TO BE COVERED

UNIT I INTERMEDIATE REPRESENTATIONS AND ANALYSIS 9

Review of Compiler Structure- Structure of an Optimizing Compiler – Intermediate Languages - LIR, MIR, HIR – Control Flow Analysis – Iterative Data Flow Analysis – Static Single Assignment – Dependence Relations - Dependences in Loops and Testing-Basic Block Dependence DAGs – Alias Analysis.

UNIT II EARLY AND LOOP OPTIMIZATIONS 9

Importance of Code Optimization Early Optimizations: Constant-Expression Evaluation - Scalar Replacement of Aggregates - Algebraic Simplifications and Re-association - Value Numbering - Copy Propagation - Sparse Conditional Constant Propagation. Redundancy Elimination: Common - Subexpression Elimination - Loop-Invariant Code Motion - Partial-Redundancy Elimination - Redundancy Elimination and Reassociation - Code Hoisting. Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking Elimination.

UNIT III PROCEDURE OPTIMIZATION AND SCHEDULING 9

Procedure Optimizations: Tail-Call Optimization and Tail-Recursion Elimination - Procedure Integration - In-Line Expansion - Leaf-Routine Optimization and Shrink Wrapping. Code Scheduling: Instruction Scheduling - Speculative Loads and Boosting - Speculative Scheduling - Software Pipelining - Trace Scheduling - Percolation Scheduling. Control-Flow and Low-Level Optimizations: Unreachable-Code Elimination - Straightening - If Simplifications - Loop Simplifications -Loop Inversion – Un-switching - Branch Optimizations Tail Merging or Cross Jumping - Conditional Moves - Dead-Code Elimination - Branch Prediction - Machine Idioms and Instruction Combining.

UNIT IV	INTER PROCEDURAL OPTIMIZATION	9
Symbol table – Runtime Support - Interprocedural Analysis and Optimization: Interprocedural Control Flow Analysis - The Call Graph - Interprocedural Data-Flow Analysis Interprocedural Constant Propagation - Interprocedural Alias Analysis - Interprocedural Optimizations - Interprocedural Register Allocation - Aggregation of Global References		
UNIT V	REGISTER ALLOCATION AND OPTIMIZING FOR MEMORY	9
Register Allocation: Register Allocation and Assignment - Local Methods - Graph Coloring – Priority Based Graph Coloring - Other Approaches to Register Allocation. Optimization for the Memory Hierarchy: Impact of Data and Instruction Caches - Instruction-Cache Optimization - Scalar Replacement of Array Elements - Data-Cache Optimization - Scalar vs. Memory-Oriented Optimizations.		
		Total:45 Periods

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand intermediate representations and analysis

CO2: Identify the different optimization techniques for simple program blocks.

CO3: Develop performance enhancing optimization techniques.

CO4: Examine the optimization on procedures.

CO5: Understand the better utilization of resources

REFERENCES:

1.Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques, and Tools", 2nd Edition ,Addison Wesley , 2007.

2.Andrew W. Appel, Jens Palsberg, "Modern Compiler Implementation in Java", 2nd Edition , Cambridge University Press, , 2002.

3.Keith Cooper, Linda Torezon, "Engineering a Compiler", 2nd Edition, Morgan Kaufmann, 2011.

4.. Randy Allen and Ken Kennedy, —Optimizing Compilers for Modern Architectures: A Dependence based Approach, 1st Edition, Morgan Kaufman, 2001.

5.Robert Morgan ,‖Building an Optimizing Compiler, 1st Edition, Digital Press, 1998.

6.Steven Muchnick, —Advanced Compiler Design and Implementation, 1st Edition, Morgan Kaufman Publishers, 1997.

21CMP13	SPEECH PROCESSING AND SYNTHESIS *(Common to M.E CS, M.E CSE,&M.E(CSE with Network Specialization))*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce speech production and related parameters of speech.
- To illustrate the concepts of speech signal representations and coding.
- To understand different speech modeling procedures such Markov and their implementation issues.
- To gain knowledge about text analysis and speech synthesis.

UNIT I	FUNDAMENTALS OF SPEECH PROCESSING	9
Introduction – Spoken Language Structure – Phonetics and Phonology – Syllables and Words – Syntax and Semantics – Probability, Statistics and Information Theory – Probability Theory – Estimation Theory – Significance Testing – Information Theory.		
UNIT II	SPEECH SIGNAL REPRESENTATIONS AND CODING	9
Overview of Digital Signal Processing – Speech Signal Representations – Short time Fourier Analysis– Acoustic Model of Speech Production – Linear Predictive Coding – Cepstral Processing – Formant Frequencies – The Role of Pitch – Speech Coding – LPC Coder, CELP, Vocoders.		

UNIT III	SPEECH RECOGNITION	9
Hidden Markov Models – Definition – Continuous and Discontinuous HMMs – Practical Issues – Limitations. Acoustic Modeling – Variability in the Speech Signal – Extracting Features – Phonetic Modeling – Adaptive Techniques – Confidence Measures – Other Techniques.		
UNIT IV	TEXT ANALYSIS	9
Lexicon – Document Structure Detection – Text Normalization – Linguistic Analysis – Homograph Disambiguation – Morphological Analysis – Letter-to-sound Conversion – Prosody – Generation schematic – Speaking Style – Symbolic Prosody – Duration Assignment – Pitch Generation		
UNIT V	SPEECH SYNTHESIS	9
Attributes – Formant Speech Synthesis – Concatenative Speech Synthesis – Prosodic Modification of Speech – Source-filter Models for Prosody Modification – Evaluation of TTS Systems.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Build speech production system and describe the fundamentals of speech.
CO2: Compare different speech parameters.
CO3: Select an appropriate statistical speech model for a given application.
CO4: Develop a speech recognition system.
CO5: Make use of different text analysis and speech synthesis techniques.

REFERENCES:

1. Ben Gold and Nelson Morgan, "Speech and Audio Signal Processing, Processing and Perception of Speech and Music", 1st Edition, Wiley- India Edition, 2006
2. Claudio Becchetti and Lucio Prina Ricotti, "Speech Recognition", 1st Edition ,John Wiley and Sons, 1999.
3. Daniel Jurafsky and James H Martin, "Speech and Language Processing – An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", 1st Edition ,Pearson Education, 2002.
4. Frederick Jelinek, "Statistical Methods of Speech Recognition", 1st Edition, MIT Press, 1997.
5. Lawrence Rabiner and Biing-Hwang Juang, "Fundamentals of Speech Recognition", 1st Edition ,Pearson Education, 2003.
6. Steven W. Smith, "The Scientist and Engineer"s Guide to Digital Signal Processing", 1st Edition, California Technical Publishing, 1997.
7. Thomas F Quatieri, "Discrete-Time Speech Signal Processing – Principles and Practice", 1st Edition,Pearson Education, 2004.

PROFESSIONAL ELECTIVE –IV

21CPP12	DATA VISUALIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop skills to both design and critique visualizations.
- To introduce visual perception and core skills for visual analysis.
- To understand visualization for time-series analysis.
- To understand visualization for ranking analysis.
- To understand visualization for deviation analysis.

TOPICS TO BE COVERED

UNIT I	CORE SKILLS FOR VISUAL ANALYSIS	9
Information visualization – effective data analysis – traits of meaningful data – visual perception –making abstract data visible – building blocks of information visualization – analytical		

8-7-24

interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.		
UNIT II	**TIME-SERIES, RANKING, AND DEVIATION ANALYSIS**	**9**
Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.		
UNIT III	**DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS**	**9**
Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.		
UNIT IV	**INFORMATION DASHBOARD DESIGN**	**9**
Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.		
UNIT V	**GRAPHICS**	**9**
Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together- Unveiling the dashboard.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain principles of visual perception

CO2: Apply core skills for visual analysis

CO3: Apply visualization techniques for various data analysis tasks

CO4: Develop an information dashboard.

CO5: Apply core skills for graphics

REFERENCES:

1.Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", 1st Edition, O'Reilly, 2008.

2. Edward R. Tufte, "The visual display of quantitative information", 2nd Edition, Graphics Press, 2001.

3.Evan Stubbs, "The value of business analytics: Identifying the path to profitability", 1st Edition Wiley, 2011.

4.Gert H. N. Laursen and JesperThorlund, "Business Analytics for Managers: Taking business Intelligence beyond reporting", 1st Edition ,Wiley, 2010.

5.Nathan Yau, "Data Points: Visualization that means something", 1st Edition ,Wiley, 2013.

6.Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", 2nd edition, Analytics Press, 2013.

7.Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis",1st Edition, Analytics Press, 2009.

8.Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, 1st Edition, CRC Press, Nov 2014.

21CPP13	RECONFIGURABLE COMPUTING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the need for reconfigurable computing
- To expose the students to various device architectures

- To examine the various reconfigurable computing systems
- To understand the different types of compute models for programming reconfigurable architectures
- To expose the students to HDL programming and familiarize with the development environment
- To expose the students to the various placement and routing protocols
- To develop applications with FPGAs.

TOPICS TO BE COVERED

UNIT I	DEVICE ARCHITECTURE	9
General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.		
UNIT II	RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS	9
Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.		
UNIT III	PROGRAMMING RECONFIGURABLE SYSTEMS	9
Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing – Operating System Support for Reconfigurable Computing.		
UNIT IV	MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS	9
The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools.		
UNIT V	APPLICATION DEVELOPMENT WITH FPGAS	9
Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.		
		Total Periods:45

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the need for reconfigurable architectures.

CO2: Discuss the architecture of FPGAs.

CO3: Understand the salient features of different reconfigurable architectures.

CO4: Develop applications using any HDL and appropriate tools.

CO5: Build an SoPC for a particular application

REFERENCES:

1.Christophe Bobda, —Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications, 1st Edition, Springer, 2010.

2.Maya B. Gokhale and Paul S. Graham, —Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays, 1st Edition, Springer, 2005.

3. Nicole Hemsoth, Timothy Prickett Morgan FPGA Frontiers: New Applications in Reconfigurable Computing, 1st Edition, Next Platform ,2017.

4. Joao Cardoso, Michael Hübne, Reconfigurable Computing: From FPGAs to Hardware/Software Codesign , 1st Edition ,Springer, 2011.

5.Scott Hauck and Andre Dehon ,Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation, 1st Edition, Elsevier / Morgan Kaufmann, 2008.

21NEP18	MOBILE APPLICATION DEVELOPMENT *(Common to M.E CSE, M.E.CSE (with Specialization in Networks))*	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- Understand system requirements for mobile applications.
- Generate suitable design using specific mobile development frameworks.

R.Priya

- Generate mobile application design.
- Implement the design using specific mobile development frameworks.
- Deploy the mobile applications in marketplace for distribution.

UNIT I	INTRODUCTION	9
Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.		
UNIT II	**BASIC DESIGN**	**9**
Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.		
UNIT III	**ADVANCED DESIGN**	**9**
Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.		
UNIT IV	**ANDROID**	**9**
Introduction – Establishing the development environment – Android architecture – Activities and views – Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications.		
UNIT V	**IOS**	**9**
Introduction to Objective C – iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Describe the requirements for mobile applications.

CO2: Explain the challenges in mobile application design and development.

CO3: Develop design for mobile applications for specific requirements.

CO4: Develop the design using Android SDK.

CO5: Develop and Implement the design using Objective C and iOS.

REFERENCES

1. Charlie Collins, Michael Galpin and Matthias Kappler, "Android in Practice", 1st Edition, DreamTech, ,2012.
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", 1st Edition ,Apress, 2013.
3. James Dovey and Ash Furrow, "Beginning Objective C", 1st Edition ,Apress, 2012.
4. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", 1st Edition ,Wrox,2012.
5. 5.Reto Meier, "Professional android Development", 1st Edition ,Wiley-India Edition, 2012.

21CPP14	BIO INFORMATICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To get exposed to the fundamentals of bioinformatics.
- To learn bio-informatics algorithm and phylogenetic concept.
- To understand open problems and issues in replication and molecular clocks.
- To learn assemble genomes and corresponding theorem.
- To study and exposed to the domain of human genomics.

TOPICS TO BE COVERED

UNIT I	INTRODUCTION AND FUNDAMENTALS	9

Fundamentals of genes , genomics , molecular evolution – genomic technologies – beginning of bioinformatics - genetic data –sequence data formats – secondary database – examples – data retrival systems – genome browsers.

UNIT II	BIOINFORMATICS ALGORITHM AND ANALYSIS	9

Sequence alignment and similarity searching in genomic databases: BLAST and FASTA – additional bioinformatics analysis involving nucleic acid sequences-additional bioinformatics analysis involving protein sequences – Phylogenetic Analysis.

UNIT III	DNA REPLICATION AND MOLECULAR CLOCKS	9

Beginning of DNA replication – open problems – multiple replication and finding replication – computing probabilities of patterns in a string-the frequency array-converting patterns- solving problems- finding frequents words-Big-O notation –case study-The Tower of Hanoi problem.

UNIT IV	ASSEMBLE GENOMES AND SEQUENCES	12

Methods of assemble genomes – string reconstruction – De Bruijn graph – Euler's theorem – assembling genomes –DNA sequencing technologies – sequence antibiotics – Brute Force Algorithm – Branch and Bound algorithm – open problems – comparing biological sequences- Case Study –Manhattan tourist Problem.

UNIT V	HUMAN GENOME	12

Human and mouse genomes-random breakage model of chromosome evolution – sorting by reversals – greedy heuristic approach – break points- rearrangements in tumor and break point genomes-break point graps- synteny block construction -open problems and technologies.

Total: 45 Periods

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the genomics technologies in Bioinformatics.
CO2: Distinguish efficient algorithm and their issues.
CO3: Deduct the replication and molecular clocks in bioinformatics.
CO4: Apply on assemble genomes and sequences.
CO5: Make Use of the Microarray technologies for genome expression.

REFERENCES:

1.Ion Mandoiu and Alexander Zelikovsky , "Computational Methods for Next Generation Sequencing Data Analysis , 1st Edition, Wiley series 2016.

2.Istvan Miklos "Introduction to algorithms in bioinformatics, 1st Edition, Springer, 2016.

3. Philip Compeau and Pavel pevzner, —Bioinformatics Algorithms: An Active Learning Approach, Second edition volume I , Cousera, 2015.

4.SupratimChoudhuri, —Bioinformatics For Beginners, 1st Edition ,Elsevier, 2014.

21CPP15	INFORMATION STORAGE MANAGEMENT	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the storage architecture and available technologies.
- To learn to establish & manage datacenter.
- To learn security aspects of storage & data center.
- To understand information availability, monitoring & managing datacenters
- To learn about securing storage and storage virtualization

TOPICS TO BE COVERED

UNIT I	STORAGE TECHNOLOGY	9

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities

UNIT II	STORAGE SYSTEMS ARCHITECTURE	9

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,High-level architecture and working of an intelligent storage system.

UNIT III	INTRODUCTION TO NETWORKED STORAGE	9

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments

UNIT IV	INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS	9

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime - Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identifysingle points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center

UNIT V	SECURING STORAGE AND STORAGE VIRTUALIZATION	12

Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

Total Periods:45

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Select from various storage technologies to suit for required application.

CO2: Apply security measures to safeguard storage & farm.

CO3: Analyze QoS on Storage

CO4: Understand information availability, monitoring & managing datacenters

CO5: Understand how securing storage and storage virtualization

REFERENCES:

1.EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", 1st Edition ,Wiley, India, 2010.

2. R.Marc Farley, —Building Storage Networks, 1st Edition, Tata McGraw Hill ,Osborne, 2001.

3.Robert Spalding, —Storage Networks: The Complete Reference, 1st Edition ,Tata McGraw Hill Osborne, 2003.

4.Jerald J.Kowalski, Mark T.Maybury,"Information Storage and Retrieval systems"2nd Edition,Kluwer Academic Publishers

AUDIT COURSES

21AC101	**ENGLISH FOR RESEARCH PAPER WRITING** *Common to M.E. (Communication Systems)& M.E. (Computer Science Engineering), M.E. (Computer Science and Engineering with specialization in Networks), M.E. (Manufacturing Engineering) and M.E. (Power Systems)*	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To explain writing skills and level of readability
- To outline content writing in each section
- To summarize the skills needed for framing a title
- To demonstrate the skills needed for writing the conclusion
- To compare the quality of paper with plagiarism report

UNIT I	INTRODUCTION TO RESEARCH PAPER WRITING	6
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness		
UNIT II	**PRESENTATION SKILLS**	6
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction		
UNIT III	**TITLE WRITING SKILLS**	6
Key skills –Title, Abstract, Introduction, Review of the Literature, Methods, Results, Discussion and Conclusions.		
UNIT IV	**RESULT WRITING SKILLS**	6
Skills -Methods, Results, Discussion and Conclusions.		
UNIT V	**VERIFICATION SKILLS**	6
Useful phrases, checking Plagiarism, ensuring quality paper submission.		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the writing skills and level of readability

CO2: Outline the contents of research paper in each section

CO3: Classify the skills needed for writing a title

CO4: Summarize the content for presenting research conclusion note.

CO5: Illustrate the quality of paper by checking plagiarism.

TEXT BOOKS:

1. Adrian Wallwork , "English for Writing Research Papers", 1st Edition ,Springer New York Dordrecht Heidelberg, London, 2011
2. Day R ,"How to Write and Publish a Scientific Paper", 1st Edition ,Cambridge University Press 2006.
3. Goldbort R , "Writing for Science", 1st Edition, Yale University Press ,2006
4. Highman N, "Handbook of Writing for the Mathematical Sciences", 1st Edition, SIAM. Highman's book 1998.

REFERENCES

1. Stephen Howe, Kristina Henriksson, "Phrase Book for Writing Papers and Research in English", 4th Edition, Create Space Independent Publishing Platform, 2007.
2. Adrian Wallwork ,"English for Research: Usage, Style, and Grammar", 1st Edition ,Springer,2012.
3. John Flowerdew, Pejman Habibie, "Introducing English for Research Publication

Purposes", 1st Edition, Routledge, ,2021.

4. Wendy Laura Belcher, Writing Your Journal Article in Twelve Weeks: A Guide to Academic Publishing Success, 1st Edition, SAGE Publications, Inc, 2009

21AC102	CONSTITUTION OF INDIA *Common to all PG Programmes*	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nationhood in the early years of Indian nationalism
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.
- To understand the importance of local body administration
- To know the role and function of election commission

UNIT I — HISTORY AND PHILOSOPHY OF THE INDIAN CONSTITUTION — 6

History - Drafting Committee - (Composition & Working)- Philosophy - Preamble, Salient Features

UNIT II — CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES — 6

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III — ORGANS OF GOVERNANCE — 6

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions

UNIT IV — LOCAL ADMINISTRATION — 6

District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT V — ELECTION COMMISSION — 6

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3: Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4: Discuss the passage of the Hindu Code Bill of 1956.

CO5: Familiarize with basic Structure and functions of Election Commission.
REFERENCES:
1. Dr. S. N. Busi, "Dr. B. R. Ambedkar, Framing of Indian Constitution", 1st Edition, Ava Publishers, 2016.   2. M.P. Jain, "Indian Constitution Law", 7th Edition, Lexis Nexis, 2014.   3. D.D. Basu, "Introduction to the Constitution of India", 26th Edition, Lexis Nexis, 2022.

21AC103	**DISASTER MANAGEMENT** ***Common to all PG Programmes***	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

COURSE OBJECTIVES:

- To summarize the basics of disaster
- To explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- To illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- To describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- To develop the strengths and weaknesses of disaster management approaches

UNIT I	**INTRODUCTION**	**6**
Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Man-made Disasters: Difference, Nature, Types and Magnitude		
UNIT II	**REPERCUSSIONS OF DISASTERS AND HAZARDS**	**6**
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts		
UNIT III	**DISASTER PRONE AREAS IN INDIA**	**6**
Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.		
UNIT IV	**DISASTER PREPAREDNESS AND MANAGEMENT**	**6**
Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other Agencies, Media Reports: Governmental and Community Preparedness.		
UNIT V	**RISK ASSESSMENT**	**6**
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize basics of disaster.

CO2: Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO4: Describe an understanding of standards of humanitarian response and practical

relevance in specific types of disasters and conflict situations. CO5: Develop the strengths and weaknesses of disaster management approaches.
REFERENCES:
1. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" 1st Edition, New Royal book Company, 2007. 2. Sahni, Pardeep, "Disaster Mitigation Experiences and Reflections", 4th Edition, Prentice Hall Of India, New Delhi, 2011. 3. Goel S. L., "Disaster Administration and Management Text and Case Studies", 3rd Edition, Deep & Deep Publication Pvt. Ltd., 2009.

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY (AUTONOMOUS), MADURAI

M.E. COMMUNICATION SYSTEMS

REGULATIONS – 2021

(CHOICE BASED CREDIT SYSTEM)

I TO IV SEMESTERS SYLLABUS

SEMESTER I

21MA122	LINEAR ALGEBRA PROBABILITY AND QUEUEING THEORY	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To encourage students to develop a working knowledge of the central ideas of linear algebra.
- To grasp the basic concepts of probability, random variables, correlation and regression.
- To understand the basic concepts of random processes.
- To acquire skills in analyzing queueing models.
- To develop a fundamental understanding of linear programming models and apply simplex method for solving linear programming problems.

UNIT I	LINEAR ALGEBRA	12

Vector spaces – Norms – Inner products – Eigenvalues using QR transformations – QR factorization – Generalized eigenvectors – Jordan canonical forms – Singular value decomposition and applications – Pseudo inverse – Least Square approximations.

UNIT II	PROBABILITY AND RANDOM VARIABLES	12

Probability concepts – Axioms of probability – Conditional probability – Bayes theorem – Random variables – Probability functions – Two-dimensional random variables – Joint distributions –Marginal and conditional distributions – Correlation – Linear regression.

UNIT III	RANDOM PROCESSES	12

Classification – Stationary random process – Markov process – Markov chain – Poisson process –Gaussian process – Auto correlation – Cross correlation.

UNIT IV	QUEUEING THEORY	12

Markovian queues – Single and multi-server models – Little's formula – Steady state analysis –Self-service queue.

UNIT V	LINEAR PROGRAMMING	12
Formulation – Graphical solution – Simplex method – Big M method – Variants of Simplex method – Transportation problems – Assignment models.		
	TOTAL: 60 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply various methods in Linear algebra to solve the system of linear equations.

CO2: Examine the performance in terms of probability achieved by the determined solutions and compute the correlation and regression.

CO3: Estimate the functions of time when the probability measure is associated through random process.

CO4: Understand the basic characteristic features of a queueing system and acquire skills in analyzing queueing models.

CO5: Predict an optimal solution of an optimization problem using Linear programming concepts.

REFERENCES:

1. Miller.S.L. and Childers D.G., "Probability and Random Processes with Applications to Signal Processing and Communications", 2nd Edition, Academic Press, 2004.
2. Friedberg A.H, Insel A.J. and Spence L, "Linear Algebra", 4th Edition, Prentice Hall of India, New Delhi, 2004.
3. Gross, D., Shortie, J.F., Thompson, J.M and Harris, C.M., "Fundamentals of Queuing Theory", 4th Edition, Wiley, 2014.
4. Taha H.A., "Operations Research: An Introduction", 9th Edition, Pearson Education Asia, New Delhi, 2016.
5. Richard Bronson, "Matrix Operations- Schaum's outline series", 2nd Edition, McGraw Hill, New York, 2011.
6. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes, 2nd Edition, Academic Press, Boston, 2014.

21RM101	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand research methodology, process and design.
- To know the details of sampling designs, and also different methods of data collections.
- To introduce the art of interpretation and writing research reports.
- To be familiar with various forms of the intellectual property, its relevance and business impact in the changing global business environment.
- To understand the law of patent and licensing.

UNIT I	RESEARCH DESIGN	9

Overview of research process and design. Use of secondary and exploratory data to answer the research question. Qualitative research. Observation studies, Experiments and Surveys.

UNIT II	DATA COLLECTION AND SOURCES	9

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data: preparing, exploring, examining and displaying.

UNIT III	DATA ANALYSIS AND REPORTING	9

Overview of Multivariate analysis, Hypotheses testing and Measures of association. Presenting insights and findings using written reports and oral presentation. Case studies.

UNIT IV	INTELLECTUAL PROPERTY RIGHTS	9

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, Utility models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of property, Common rules of IPR practices, Types and features of IPR agreement, Trademark, Functions of UNESCO in IPR maintenance. Case studies.

UNIT V	PATENTS	9

Patents – objectives and benefits of patent, Concept, Features of patent, Inventive step, Specification, Types of patent application, Process: E-filing, Examination of patent, Grant of patent, Revocation, Equitable assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents. Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the technique of defining a research problem.

CO2: Outline the concepts of data collection and analysis.

CO3: Interpret data and write research reports.

CO4: Explain the concepts of IPR and rules of IPR practices.

CO5: Infer the law of patent and licensing.

REFERENCES:

1. Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", 11th Edition, Tata McGraw Hill Education, 2012.
2. Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
3. David Hunt, Long Nguyen and Matthew Rodgers, "Patent searching: Tools & Techniques", Wiley, 2007.
4. The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and Practice", September 2013.

21CM101	STATISTICAL SIGNAL PROCESSING	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To introduce the basics of random signal processing.
- To learn the concept of estimation and signal modeling.
- To familiarize with the spectrum estimation.
- To know about the design of optimum filters.
- To understand adaptive filtering and its applications.

UNIT I	DISCRETE RANDOM SIGNAL PROCESSING	12

Discrete random processes – Ensemble averages – Wide sense stationary process – Properties - Ergodic process – Sample mean & variance - Auto-correlation and Auto-correlation matrices- Auto covariance and Cross covariance- Properties – White noise process – Wiener Khintchine relation - Power spectral density – Filtering random process – Spectral factorization theorem – Special types of random processes – AR, MA, ARMA processes – Yule-Walker equations.

UNIT II	PARAMETER ESTIMATION THEORY	12

Principle of estimation and applications-Properties of estimates-unbiased and consistent estimators, Minimum Variance Unbiased Estimates (MVUE)-Cramer Rao bound- Efficient estimators; Criteria of estimation: Methods of maximum likelihood and its properties; Bayesian estimation: Mean square error and MMSE, Mean absolute error, Hit and Miss cost function and MAP estimation.

UNIT III	SPECTRUM ESTIMATION	12

Estimation of spectra from finite duration signals, Bias and Consistency of estimators - Non-Parametric methods: Periodogram, Modified periodogram, Bartlett, Welch and Blackman-Tukey methods, Parametric methods: AR, MA and ARMA spectrum estimation - Detection of harmonic signals - Performance analysis of estimators. MUSIC and ESPRIT algorithms.

UNIT IV	SIGNAL MODELING AND OPTIMUM FILTERS	12

Introduction- Least Square method – Pade approximation – Prony's method – Levinson recursion– Lattice filter - FIR Wiener filter – Filtering – Linear prediction – Non causal and causal IIR Wiener filter – MSE – State-space model and the optimal state estimation problem, discrete Kalman filter, continuous-time Kalman filter, extended Kalman filter.

UNIT V	ADAPTIVE FILTERS	12

FIR Adaptive filters - Newton's steepest descent method – Widrow Hoff LMS adaptive algorithm – Convergence – Normalized LMS – Applications: Noise cancellation, channel equalization, echo canceller, Adaptive recursive filters: RLS adaptive algorithm, Exponentially weighted RLS-sliding window RLS, Matrix inversion Lemma, Initialization tracking of non-stationarity.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Analyze discrete time random processes.

CO2: Apply appropriate model for estimation and signal modeling for the given problem.

CO3: Analyze non-parametric and parametric methods for spectral estimation.

CO4: Design optimum filter for the given application.

CO5: Design adaptive filters for different applications.

REFERENCES:

1. Monson. H. Hayes, "Statistical Digital Signal Processing and Modeling", John Willey and Sons, Reprint, 2008
2. Simon Haykin, "Adaptive Filter Theory", 5th Edition, Pearson Prentice Hall, 2014
3. D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", 1st Edition, Artech House Publishers, 2005.
4. Steven. M. Kay, "Modern Spectral Estimation, Theory and Application", 1st Edition, Pearson India,2009
5. A.Veloni, N I. Miridakis and E Boukouvala, "Digital and Statistical Signal Processing", CRC Press, 2019
6. S Nandi and D Kundu, "Statistical Signal Processing- Frequency Estimation", Springer Nature Singapore, 2nd Edition , 2020
7. M.D. Srinath, P.K. Rajasekaran and R. Viswanathan, "Statistical Signal Processing with Applications", 1st Edition, PHI, 1996.

21CM102	MODERN DIGITAL COMMUNICATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the coherent and non-coherent receivers and their performance under various channel conditions.
- To know the effect of signaling through band limited channels and the use of equalization techniques to overcome ISI.
- To familiarize with channel capacity theorem and different block coding techniques to mitigate channel errors.
- To understand the principle of convolutional coding to alleviate channel errors and different decoding techniques.
- To learn the basics of OFDM as a multicarrier communication and CDMA as a multiuser communication technique.

UNIT I	COHERENT AND NON-COHERENT COMMUNICATION	9

Coherent receivers – Optimum receivers in WGN – IQ modulation & demodulation – QAM modulation and demodulation Non-coherent receivers in random phase channels; MFSK receivers – Rayleigh and Rician channels – Partially coherent receivers – DPSK; M-PSK; M-DPSK-BER Performance analysis. Carrier synchronization, Bit synchronization

UNIT II	EQUALIZATION TECHNIQUES	9

Band limited channels- ISI – Nyquist criterion- Controlled ISI-Partial response signals-Equalization algorithms– Linear equalizer – Decision feedback equalization – Adaptive equalization algorithms

UNIT III	BLOCK CODED DIGITAL COMMUNICATION	9

Architecture and performance – Binary block codes; – Shannon's channel coding theorem; Channel capacity; Matched filter; Concepts of spread spectrum communication – Coded BPSK and DPSK demodulators– Linear block codes; Hamming; Golay; Cyclic; BCH ; Reed–Solomon codes. Space time block codes.

UNIT IV	CONVOLUTIONAL CODED DIGITAL COMMUNICATION	9

Representation of codes using Polynomial, State diagram, Tree diagram, and Trellis diagram – Decoding techniques using Maximum likelihood, Viterbi algorithm, Sequential and Threshold methods – Error probability performance for BPSK and Viterbi algorithm, Turbo coding.

UNIT V	MULTICARRIER AND MULTIUSER COMMUNICATIONS	9

Single vs Multicarrier modulation, orthogonal frequency division multiplexing (OFDM). Modulation and demodulation in an OFDM system, FFT algorithmic implementation of an OFDM system, Bit and power allocation in multicarrier modulation, Peak-to-average ratio in multicarrier modulation. Introduction to CDMA systems, multiuser detection in CDMA systems – optimum multiuser receiver, suboptimum detectors, successive interference cancellation.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

- CO1: Differentiate various receivers such as coherent, non-coherent and partially coherent receivers and analyze their performance under various channel conditions.
- CO2: Illustrate the effect of signaling through band-limited channels and equalization techniques used to overcome ISI.
- CO3: Determine the channel capacity and apply various block coding techniques to combat channel errors.
- CO4: Construct convolutional coders and analyze the performance of different decoding techniques.
- CO5: Describe the basics of OFDM as a multicarrier communication and CDMA as a multiuser communication technique.

REFERENCES:

1. John G. Proakis and Masoud Salehi "Digital Communication", 5th Edition, McGraw Hill Publication, 2014.
2. Simon Haykin, "Digital Communication Systems", 1st Edition, John Wiley and Sons, 2014.
3. Bernard Sklar and Pabitra Kumar Ray, "Digital Communications Fundamentals & Applications", 2nd Edition, Pearson Education, 2009.
4. Richard Van Nee and Ramjee Prasad, "OFDM for Multimedia Communications", 1st Edition, Artech House Publication, 2001.
5. Theodore S.Rappaport, 'Wireless Communications", 2nd Edition, Pearson Education, 2002.

21CM103	ADVANCED WIRELESS COMMUNICATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the concepts of wireless channels and models.
- To estimate channel capacity.
- To study the characteristics of diversity.
- To understand the concepts of MIMO systems
- To know the operation of multiple antennas and multiple user techniques.

UNIT I	WIRELESS CHANNEL PROPAGATION AND MODEL	9

Propagation of EM signals in wireless channel – Reflection, diffraction and Scattering-free space, two ray model. Small scale fading- channel classification- channel models – COST - 231 Hatamodel, NLOS Multipath Fading models: Rayleigh, Rician, Nakagami. 5G Channel model requirements and measurements, propagation scenarios, METIS channel models, Map-based model, stochastic model.

UNIT II	CAPACITY OF WIRELESS CHANNELS	9

Capacity in AWGN, Capacity of flat fading channel, Capacity of frequency selective fading channels. Capacity of MISO and SIMO systems.

UNIT III	DIVERSITY	9

Realization of independent fading paths. Receiver diversity: Selection combining, Threshold combining, Maximum-ratio combining, Equal gain combining. Transmitter diversity: Channel known at transmitter, Channel unknown at the transmitter.

UNIT IV	MIMO COMMUNICATIONS	9

Narrowband MIMO model, Parallel decomposition of the MIMO channel, MIMO channel capacity, MIMO Diversity gain: Beam forming, Diversity-Multiplexing trade-offs, Space time modulation and coding: STBC, STTC, Spatial multiplexing and BLAST architectures.

UNIT V	MULTIUSER SYSTEMS	9

Introduction to MUD, Linear de-correlator, MMSE MUD, Adaptive MUD, MIMO-MUD Application of convex optimization to wireless design.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Analyze the wireless channel characteristics and identify appropriate channel models.

CO2: Explain the mathematics behind the capacity calculation under different channel conditions.

CO3: Interpret the implication of diversity combining methods based on the knowledge of channel at the transmitter

CO4: Outline the concepts in MIMO communications.

CO5: Infer multiple access techniques and their use in different multi-user scenarios.

REFERENCES:

1. David Tse and Pramod Viswanath, "Fundamentals of Wireless Communications", 5th Edition, Cambridge University Press, 2012.
2. Andrea Goldsmith, "Wireless Communications", 1st Edition, Cambridge University Press, 2007.
3. Harry R. Anderson, "Fixed Broadband Wireless System Design", 1st Edition, John Wiley, India, 2003.
4. Andreas.F. Molisch, "Wireless Communications", 4th Edition, John Wiley, India, 2006.
5. Simon Haykin and Michael Moher, "Modern Wireless Communications", 1st Edition, Pearson Education, 2007.
6. Rappaport. T.S., "Wireless Communications", 6th Edition, Pearson Education, 2003.
7. Gordon L. Stuber, "Principles of Mobile Communication", Springer International Ltd., 2001.
8. Upena Dalal, "Wireless Communication", 2nd Edition, Oxford Higher Education, 2009.

21CM104	RADIATING SYSTEMS	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To understand the fundamental concepts and parameters behind the different types of antennas.
- To learn about various antenna arrays.
- To interpret the performance of aperture and microstrip antennas.
- To be familiar with modern antennas and measurement techniques
- To study about different optimization techniques for designing application specific antennas.

UNIT I	ANTENNA FUNDAMENTALS & WIRE ANTENNAS	12

Introduction –Types of antennas – Radiation mechanism – Current distribution on wire antennas – Maxwell's equations – Antenna fundamental parameters – Radiation integrals – Radiation from surface and line current distributions – dipole, monopole, loop antenna.

UNIT II	ANTENNA ARRAYS	12

Linear array –uniform array, end fire and broad side array, gain, beam width, side lobe level; Linear array synthesis techniques – Binomial and Chebyshev distributions; Two dimensional uniform arrays; phased array antennas, smart antennas, switched beam and adaptive arrays, Mutual coupling in finite arrays.

UNIT III	APERTURE ANTENNAS	12

Field equivalence principle, Radiation from rectangular and circular apertures, Babinets principle, Slot antenna; Horn antenna; Reflector antenna, aperture blockage, and design consideration. Radiation mechanism and excitation techniques, Microstrip dipole; Patch, Rectangular patch, Circular patch – Microstrip array and feed network; Lens antennas.

UNIT IV	MODERN ANTENNAS & MEASUREMENT TECHNIQUES	12

Base station antennas, PIFA – Antennas for WBAN – RFID antennas – Automotive antennas, MIMO antennas, Diversity techniques – Antenna impedance and radiation pattern measurements.

UNIT V	RECENT TRENDS IN ANTENNA DESIGN	12

UWB antenna arrays – Vivaldi antenna arrays – Artificial magnetic conductors/High impedance surfaces – Antennas in medicine – Plasma antennas – Antennas for millimeter wave communication - optimization techniques – Numerical methods.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Evaluate and analyze various parameters of antennas.

CO2: Analyse the performance of different types of arrays.

CO3: Design microstrip antennas for the given specifications.

CO4: Demonstrate the performance of application specific antennas.

CO5: Optimise the parameters of various antennas using numerical techniques.

REFERENCES:

1. Balanis.A, "Antenna Theory Analysis and Design", 4th Edition, John Wiley and Sons, New York, 2012.
2. Frank B. Gross, "Frontiers in Antennas", 2nd Edition, Mc Graw Hill, 2011.
3. S. Drabowitch, A. Papiernik, H.D.Griffiths, J.Encinas and B.L.Smith, "Modern Antennas", 2nd Edition, Springer Publications, 2007.
4. Krauss.J.D, "Antennas", 2nd Edition, John Wiley and sons, New York, 1997.
5. I.J. Bahl and P. Bhartia, "Microstrip Antennas", 1st Edition, ArtechHouse,Inc.,1980
6. W.L.Stutzman and G.A.Thiele, "Antenna Theory and Design", 2nd Edition, John Wiley& Sons Inc., 1998.

21CM105	DIGITAL COMMUNICATION SYSTEMS LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To perform digital modulation & detection using SDR
- To evaluate the performance of CDMA, OFDM & MIMO systems
- To design channel equalizer using LMS / RLS algorithms
- To perform spectral estimation using non-parametric methods
- To construct channel encoder / decoder using MATLAB

LIST OF EXPERIMENTS

LIST OF EXPERIMENTS

1. Generation and detection of binary digital modulation techniques using SDR
2. Spread spectrum communication system-pseudo random binary sequence generation and baseband DSSS.
3. MIMO system transceiver design using MATLAB/SCILAB/LABVIEW.
4. Performance evaluation of simulated CDMA system.

5. Channel coder/decoder design (block codes / convolutional codes/ turbo codes).
6. OFDM transceiver design using MATLAB /SCILAB/LABVIEW.
7. Channel equalizer design using MATLAB (LMS. RLS algorithms).
8. Design and analysis of spectrum estimators (Bartlett, Welch) using MATLAB.
9. BER performance analysis of M-ary digital Modulation Techniques (coherent & Non coherent) in AWGN Environment using MATLAB/SCILAB/LABVIEW.
10. Design and performance analysis of lossless coding techniques - Huffman coding and Lempel Ziv Algorithm using MATLAB/SCILAB/LABVIEW.
11. Noise / Echo cancellation using MATLAB (LMS / RLS algorithms).
12. Study of synchronization (frame, bit, symbol).
13. Wireless channel characterization.

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Generate and detect digital modulation techniques in AWGN channel

CO2: Evaluate the performance of CDMA / OFDM & MIMO systems

CO3: Illustrate the performance of channel equalizers using LMS / RLS algorithms.

CO4: Estimate power spectrum of the given random sequence using non-parametric estimation methods.

CO5: Implement various channel encoder / decoder using MATLAB

21CM106	ADVANCED DIGITAL SIGNAL PROCESSING LABORATORY	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To generate discrete and random time sequences.
- To analyze frequency characteristics of FIR and IIR filters.
- To investigate the spectral estimation methods and Additive white Gaussian Noise (AWGN) channel characterization.
- To implement multirate signal processing.
- To interpret the use of LMS/RLS algorithm in the design of adaptive filters.

LIST OF EXPERIMENTS

1. Generation of standard discrete time sequences (Unit Impulse, Unit step, Unit ramp, Sinusoidal and Exponential signals) and carrying out of arithmetic operations and plot the results.

2. Generation of random sequences satisfying the given probability distributions such as Uniform, Gaussian, Rayleigh and Rician.
3. Design of FIR filters for the given specification and plot the frequency response of the designed filter.
4. Design of IIR filters for the given specification and plot the frequency response of the designed filter.
5. Analysis of finite word length effects of FIR filters coefficients.
6. Estimation of power spectrum of the given random sequence using Nonparametric methods (Bartlett, Welch and Blackman Tukey).
7. Estimation of power spectrum of the given random sequence using parametric methods (AR, MA and ARMA).
8. Up-sampling the discrete time sequence by L times and plot the spectrum of both the given sequence and up-sampled sequence.
9. Down-sampling the discrete time sequence by M times and plot the spectrum of both the given sequence and down-sampled sequence.
10. Design an adaptive filter to extract a desired signal from the given noisy signal by Cancelling the noise using LMS algorithm.
11. Design an adaptive filter to extract a desired signal from the given noisy signal by Cancelling the noise using RLS algorithm.
12. Implementation of digital filter banks for the given specifications.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Generate deterministic/Random sequences using simulation tool.

CO2: Design and analyze the frequency response of FIR/IIR digital filters for the given specifications.

CO3: Estimate power spectrum of the given random sequence using parametric / nonparametric estimation methods.

CO4: Implement adaptive filters using LMS/RLS algorithm.

CO5: Analyze the discrete time systems at various sampling rates.

SEMESTER II

21CM107	MIC AND RF SYSTEM DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn about the fundamentals of microwave integrated circuits.
- To know the concepts of passive microwave components.
- To be familiar with microwave amplifiers and oscillators.
- To design integrated antennas and the relevant measurement techniques.
- To introduce the MMIC inspired systems.

UNIT I	INTRODUCTION TO MICROWAVE INTEGRATED CIRCUITS	9

MMIC technology - advantages and applications- Active device technologies- design approaches- multichip module technology substrates.

UNIT II	PASSIVE COMPONENTS	9

Inductors – Capacitors – Resistors - Micro-strip components - Coplanar circuits - Multilayer techniques –Micro machined passive components , Switches & Attenuators- Filter design.

UNIT III	AMPLIFIERS & OSCILLATORS	9

AMPLIFIERS: Stability & gain analysis - matching techniques - reactively matched amplifier design-LNA. OSCILLATORS: Design principles - active device CAD techniques for large signal oscillators design- phase noise - MMIC VCO - Mixers.

UNIT IV	INTEGRATED ANTENNAS AND MEASUREMENT TECHNIQUES	9

Integrated antenna selection- photonic band gap antennas - micro machined antenna - micro electro mechanical system antennas - test fixture measurements - probe station measurements -thermal and cryogenic measurements- experimental field probing techniques.

UNIT V	SYSTEM DESIGN USING MMIC TECHNOLOGY	9

Analysis of MMIC Technology and design issues in Phased array radar, Satellite transponder -Integrated electronic warfare T/R modules - Avionic systems integration.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Impart the knowledge of microwave integrated circuits for multichip designing.

CO2: Familiarize about passive microwave components and the principles.

CO3: Demonstrate the operation of microwave amplifiers and oscillators.

CO4: Design integrated antennas.

CO5: Analyse the performance of MMIC inspired systems.

REFERENCES:

1. Ravender Goyal, "Monolithic MIC: Technology & Design", 1st Edition, Artech House, 1989.
2. Hoffman R.K, "Handbook of Microwave Integrated Circuits", 1st Edition, Artech House, Boston, 1987.
3. Ulrich L. Rohde and David P.N, "RF / Microwave Circuit Design for Wireless Applications", 2nd Edition, John Wiley, 2012.
4. C. Gentili, "Microwave Amplifiers and Oscillators", 1st Edition, North Oxford Academic, 1987.
5. Samuel. Y. Liao, "Microwave Circuit Analysis and Amplifier Design", 1st Edition, Prentice Hall, Inc., 1987.
6. Matthew N.O. Sadiku, "Numerical Techniques in Electromagnetics", 1st Edition, CRC Press, 2009.

21CM108	OPTICAL NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the working principles of optical system components.
- To be familiar with transmission system engineering.
- To know the development of optical network architectures.
- To study about wavelength division multiplexing.
- To learn about various optical topologies.

UNIT I	OPTICAL NETWORK COMPONENTS	9

Introduction to Optical Networks: Telecommunications Networks Architecture, Services, circuit switching and packet switching, Optical Networks: Multiplexing Techniques, Second generation Optical Networks, Optical Packet Switching, Transmission Basics: Wavelength, frequencies, and channel spacing, Wavelength standards, Optical power and loss, Network Evolution, Nonlinear Effects: Self-phase Modulation, Cross-phase Modulation, Four Wave mixing, Solitons. Components: Couplers, Isolators and Circulators, Multiplexers and Filters, Optical Amplifiers, Transmitters, Detectors, Switches, Wavelength Converters.

UNIT II	TRANSMISSION SYSTEM ENGINEERING	9

Transmission System Engineering: System Model, Power Penalty, Transmitter, Receiver, Optical Amplifiers, Crosstalk, Dispersion, Wavelength Stabilization, Overall Design Considerations. Optical Internets: Migration to IP optical networking, IP and Optical backbone, IP Routing table, MPLS and optical cross connect table, Protocol stack Alternatives, Internetworking SS7 and Legacy Transport, Internet transport network protocol stack.

UNIT III	NETWORK ARCHITECTURE	9

SONET, SDH and Optical Transport Networks (OTNs): SONET and SDH: SONET multiplexing hierarchy, Frame structure, Functional Component, problem detection, concatenation. Architecture of Optical Transport Networks (OTNs): Digital wrapper, in-band and out-ofband control signalling, Importance of Multiplexing and multiplexing hierarchies, SONET multiplexing hierarchies, SDH multiplexing hierarchies, New Optical Transport, OTN layered Model, Generic Framing Procedure (GFP).

UNIT IV	WDM	9

WDM, Network topologies, MPLS and Optical Networks: WDM: WDM operation, Dense Wavelength Division Multiplexing (DWDM), Erbium-doped Fiber (EDF), WDM amplifiers, Add-Drop Multiplexers, Wavelength Continuity Property, Higher dispersion for DWDM, Tunable DWDM Lasers.

UNIT V	TOPOLOGIES	9

Network topologies and protection schemes: Robust networks, Line and path protection switching, Types of topology, Point to point topology, bi-directional line-switched ring (BLSR), meshed topology, Passive optical networks, Metro optical networks , MPLS and Optical Networks: IS label switching, Forwarding equivalence class (FEC), Types of MPLS nodes, Label distribution and binding, label swapping and traffic forwarding, MPLS support of Virtual Private Networks (VPN), MPLS traffic engineering, Multi protocol Lambda switching (MPLS).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain about the optical components used in optical networks.

CO2: Interpret optical network routing algorithms and transmission system.

CO3: Analyze the optical network architecture.

CO4: Illustrate the performance of wavelength division multiplexing.

CO5: Identify and formulate different networking topologies.

REFERENCES:

1. Rajiv Ramaswami and Kumar Sivarajan, "Optical Networks – Practical Perspective", 3rd Edition, Morgan - Kaufmann Publishers, 2008.
2. Uyless Black, "Optical Networks, Third Generation Transport Systems", 2nd Edition, Pearson Ed, 2003.

21CM109	SIGNAL DETECTION AND ESTIMATION THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of detection and estimation.
- To learn the basics of multi-user detection theory.
- To understand the theory behind various estimation techniques.
- To familiarize with Wiener filter and Kalman filter in detail.
- To characterize multipath fading channels.

UNIT I	REVEIW OF PROBABILITY AND STOCHASTIC PROCESS	9

Conditional probability, Bayes' theorem , Random variables, Conditional distributions and densities, moments and distribution of random variables., Stationary Processes, Cyclo stationary processes, Averages and Ergodicity, Autocorrelation function, Power spectral density, Discrete time stochastic processes, Spatial stochastic processes, Random signals, Relationship of power spectral density and autocorrelation function.

UNIT II	SINGLE AND MULTIPLE SAMPLE DETECTION	9

Hypothesis testing and the MAP criterion, Bayes criterion, Minimax criterion, Neyman-Pearson criterion, Sequential detection, Optimum digital detector in additive gaussian noise , Performance of binary receivers in AWGN.

UNIT III	FUNDAMENTALS OF ESTIMATION THEORY	9

Formulation of the general parameter estimation problem, Relationship between detection and estimation theory, Types of estimation problems, Properties of estimators, Bayes estimation, Minimax estimation, Maximum-Likelihood estimation, Comparison of estimators of parameters.

UNIT IV	WIENER AND KALMAN FILTERS	9
Orthogonality principle. Autoregressive techniques. Discrete Wiener filter. Continuous Wiener filter. Generalization of discrete and continuous filter representations . Linear least-squares methods. Minimum-Variance weighted Least-Squares methods. Minimum-variance. Least Squares. Kalman algorithm - Computational considerations. Signal estimation. Continuous Kalman filter. Extended Kalman filter.		
UNIT V	APPLICATIONS	9
Detector structures in non-Gaussian noise . Examples of noise models. Receiver structures, and Error-rate performance. Estimation of non-gaussian noise parameters. Fading-multipath channel models. Receiver structures with known channel parameters. Receiver structures without knowledge of phase. Receiver structures without knowledge of amplitude or phase. receiver structures and performance with no channel knowledge.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of detection and estimation theory to solve communication problems.

CO2: Utilize probability and stochastic process concepts in detection and estimation.

CO3: Illustrate estimation models.

CO4: Interpret Wiener and Kalman filters to solve linear estimation problems.

CO5: Outline Multipath fading channels.

REFERENCES:

1. Harry L. Van Trees. "Detection, Estimation and Modulation Theory", Part I, 1st Edition. John Wiley and Sons, New York, 2004.
2. Ludeman and Lonnie C., "Random processes: filtering, estimation, and detection", 1st Edition, John Wiley & Sons, Inc., 2003.
3. Sergio Verdu, "Multi User Detection" Cambridge University Press, 1998.
4. Steven M. Kay, "Fundamentals of Statistical Processing, Volume I: Estimation Theory", 1st Edition, Prentice Hall Signal Processing Series, Prentice Hall, 1993.
5. Thomas Schonhoff, "Detection and Estimation Theory", 3rd Edition, Prentice Hall, New Jersy, 2007.

21CM110	ADVANCED DIGITAL IMAGE PROCESSING	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To learn about the fundamental image processing methods.
- To know about different mathematical transforms for image enhancement and restoration.
- To be familiar with segmentation and morphological processing.
- To discuss about the need of image classification algorithms.
- To study about the different image registration and visualization methods.

UNIT I	DIGITAL IMAGE PROCESSING FUNDAMENTALS	12

Elements of visual perception, brightness, contrast, hue, saturation, mach band effect, 2D image transforms-DFT, DCT, KLT, SVD. Image enhancement in spatial and frequency domain, Review of Morphological image processing.

UNIT II	IMAGE SEGMENTATION TECHNIQUES	12

Edge detection, Thresholding, Region growing, Fuzzy clustering, Watershed algorithm, Active contour models, Texture feature based segmentation, Graph based segmentation, Wavelet based Segmentation - Applications of image segmentation.

UNIT III	FEATURE EXTRACTION	12

First and second order edge detection operators, Phase congruency, Localized feature extraction - detecting image curvature, shape features, Hough transform, shape skeletonization, Boundary descriptors, Moments, Texture descriptors- Autocorrelation, Co-occurrence features, Run length features, Fractal model based features, Gabor filter, wavelet features.

UNIT IV	REGISTRATION AND IMAGE FUSION	12

Registration - Preprocessing, Feature selection - points, lines, regions and templates Feature correspondence - Point pattern matching, Line matching, Region matching, Template matching. Transformation functions - Similarity transformation and Affine Transformation. Re-sampling – Nearest neighbour and Cubic splines. Image Fusion - Overview of image fusion, pixel fusion, wavelet based fusion -region based fusion.

UNIT V	3D IMAGE VISUALIZATION	12

Sources of 3D Data sets, Slicing the Data set, Arbitrary section planes, The use of color, Volumetric display, Stereo Viewing, Ray tracing, Reflection, Surfaces, Multiple connected surfaces, Image processing in 3D, Measurements on 3D images.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the fundamentals of image processing.

CO2: Analyse various segmentation algorithms.

CO3: Describe various feature extraction techniques for image analysis.

CO4: Discuss the concepts of image registration and fusion.

CO5: Explain 3D image visualization.

REFERENCES:

1. Ardeshir Goshtasby, " 2D and 3D Image registration for Medical, Remote Sensing and Industrial Applications", John Wiley and Sons, 2005.
2. Anil K. Jain, Fundamentals of Digital Image Processing', Pearson Education, Inc., 2002.
3. John C.Russ, "The Image Processing Handbook", CRC Press, 2007.
4. Mark Nixon and Alberto Aguado, "Feature Extraction and Image Processing", Academic Press, 2008.
5. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing', Pearson, Education, Inc., 2nd Edition, 2004.
6. Rick S.Blum and Zheng Liu, "Multisensor image fusion and its Applications", 1st Edition, Taylor & Francis, 2006.

21CM111	PRODUCT DEVELOPMENT LABORATORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To develop their own innovative prototype of ideas.
- To train the students in preparing mini project reports and examination.

Individual student works on a topic approved by the head of the department and develops the prototypes using the available packages and prepares a comprehensive project report after completing the work to the satisfaction. The progress of the project is evaluated based on a minimum of two reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

- Take up their Project Work Phase –I and Phase -II and find solution by formulating proper methodology.

21CM112	TECHNICAL PAPER WRITING AND SEMINAR PRESENTATION	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- To build the concept of advanced engineering developments.
- To introduce literature survey.
- To outline the technical reports presentation.
- To extend presentation and technical skill.
- To make use of various teaching aids such as overhead projectors, power point presentation and demonstrative models.

METHOD OF EVALUATION:

During the seminar session, each student is expected to prepare and present a topic on engineering/ technology, for duration of about 8 to 10 minutes. In a session of three periods per week and all the students are expected to present the seminar. Each student is expected to present at least twice during the semester and the student is evaluated based on that. At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report. A faculty guide is to be allotted and he / she will guide and monitor the progress of the student and maintain attendance also. Evaluation is 100% internal.

TOTAL : 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Extent motivation for any topic of interest and develop a thought process for technical presentation.

CO2: Outline a detailed literature survey and build a document with respect to technical publications.

CO3: Analyze the comprehensive proof-of-concept and related data.

CO4: Develop presentation and technical skill.

CO5: Make use of new and recent technology (e.g. Latex) for creating technical reports.

PROFESSIONAL ELECTIVES

21CMP01	MACHINE LEARNING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic concepts and techniques of Machine Learning.
- To learn about Supervised and Unsupervised Learning Techniques.
- To study the various Probability Based Learning Techniques.
- To understand Dimensionality Reduction and Evolutionary Models.
- To interpret the Graphical Models.

UNIT I	INTRODUCTION	9

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron –Design a Learning System –Perspectives and Issues in Machine Learning – Concept Learning Task–Concept Learning as Search–Finding a Maximally Specific Hypothesis–Version Spaces and the Candidate Elimination Algorithm — Linear Discriminants — Perceptron — Linear Separability—Linear Regression.

UNIT II	LINEAR MODELS	9

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice — Examples of using the MLP — Overview — Deriving Back Propogation— Radial Basis Functions and Splines—Concepts—RBF Network—Curse of Dimensionality–Interpolations and Basis Functions–SupportVectorMachines.

UNIT III	TREE AND PROBABILISTIC MODELS	9

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map

UNIT IV	DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS	9

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic

algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process		
UNIT V	**GRAPHICAL MODELS**	9
Markov Chain- Monte Carlo methods – Sampling – Proposal distribution – Markov Chain- Monte Carlo – Graphical models – Bayesian networks – Markov Random Fields – Hidden Markov models – Tracking methods		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

Upon completion of this course, learners will be able to:

CO1: Utilize the appropriate machine learning strategy for any given problem.

CO2: Identify supervised, unsupervised and semi-supervised learnings.

CO3: Interpret the role of Probabilistic models in learning.

CO4: Develop dimensionality reduction algorithms.

CO5: Illustrate the graph models of machine learning.

REFERENCES:

1. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", 3rd Edition, MIT Press, 2014.
2. Jason Bell, "Machine learning- Hands on for Developers and Technical Professionals", 1stEdition, Wiley, 2014.
3. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", 1stEdition, Cambridge University Press, 2012.
4. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall/ CRC Machine Learning and Pattern Recognition Series, 2014.
5. Tomm Mitchell, "Machine Learning", 1st Edition, McGraw Hill Education, 2013.

21CMP02	WAVELET TRANSFORMS AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce the fundamental concepts of wavelet transforms.
- To study about multi resolution concepts.
- To learn wavelet system design.
- To be familiar with the different wavelet families and applications.
- To interpret the applications of various wavelets.

UNIT I	INTRODUCTION TO WAVELETS	9

Introduction to multi-rate signal processing- Decimation and Interpolation, Quadrature mirror filters, Sub-band coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous wavelet transform, Time frequency representation, Wavelet system and its characteristics, Orthogonal & Orthonormal functions and function space.

UNIT II	MULTI RESOLUTION CONCEPT AND DISCRETE WAVELET TRANSFORM	9

Multi resolution formulation of wavelet systems- signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks-Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

UNIT III	WAVELET SYSTEM DESIGN	9

Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

UNIT IV	WAVELET FAMILIES	9

Continuous Wavelets- Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets- Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.

UNIT V	APPLICATIONS	9

Denoising of Signals and Images, Image enhancement, Edge detection, Image fusion, Image compression, Wavelet based feature extraction, Analysis of phonocardiogram signals, Analysis of EEG signals, Speech enhancement for hearing aids.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Relate the vector concepts and signal concepts.

CO2: Outline multi resolution process.

CO3: Infer knowledge about wavelet systems.

CO4: Experiment with continuous and discrete wavelet transforms.

CO5: Identify the wavelets to specific applications.

REFERENCES:

1. C.Sidney Burrus, Ramesh Gopinath and Haito Guo, "Introduction to wavelets and Wavelet Transform", 16th Edition, Prentice Hall, 1998.
2. G.Strang and T.Nguyen, "Wavelet and filter banks" 1st Edition, Wesley and Cambridge Press, 2008.
3. P.P.Vaidyanathan, "Multi-rate systems and filter banks", 8th Edition, Prentice Hall 1993
4. Raguveer M Rao and Ajith S. Bopardikar, "Wavelet transforms – Introduction to theory and applications", 6th Edition, Addison Wesley, 1998
5. S.Mallet, "A Wavelet tour of Signal Processing", 1st Edition, Academic Press 1998
6. K.P.Soman and KL Ramachandran, "Insight into wavelets from theory to practice", 20th Edition, PHI, 2008

21CMP03	ADVANCED SATELLITE COMMUNICATION AND NAVIGATION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study about the orbital mechanics.
- To learn M2M developments and satellite applications.
- To know about satellite communication in Ipv6 environment.
- To be familiar with various navigational systems.
- To impart knowledge about different deep space missions.

UNIT I	OVERVIEW OF SATELLITE COMMUNICATION	9

Overview of satellite communication and orbital mechanics link budget parameters, Link-budget calculations, Auxiliary equations, Performance calculations.

UNIT II	M2M DEVELOPMENTS AND SATELLITE APPLICATIONS	9
Overview of Internet of Things and M2M- M2M applications, examples and Satellite support- Satellite roles context and applications- Antennas for satellite M2M applications- M2M Market opportunities for satellite operators- Ultra HD Video/TV and satellite implications- High Throughput Satellites (HTS) and Ka/Ku Spot beam technologies- Aeronautical, Maritime and other mobility services.		
UNIT III	SATELLITE COMMUNICATION IN IPV6 ENVIRONMENT	9
Overview of IPv6 and its benefits for Satellite networks - Migration and Coexistence- Implementation scenarios and support- Preparations for IPv6 in Satellite communication- Satellite specific protocol issues in IPv6 – Impact of IPv6 on Satellite network architecture and services-Detailed transitional plan- IPv6 demonstration over satellites - Key results and recommendations.		
UNIT IV	SATELLITE NAVIGATION AND GLOBAL POSITIONING SYSTEM	9
Overview of radio and satellite navigation, GPS principles, Signal model and codes, satellite signal acquisition, Mathematical model of GPS observables, Methods of processing GPS data. GPS receiver operation and Differential GPS. IRNSS, GAGAN, GLONASS and Galileo.		
UNIT V	DEEP SPACE NETWORKS AND INTERPLANETARY MISSIONS	9
Introduction – Functional description - Design procedure and performance criterion-Mars exploration Rover- Mission and space craft summary-Telecommunication subsystem overview-Ground Subsystem-Telecom subsystem and Link performance Telecom subsystem Hardware and software Chandrayaan-1 Mission - Mission and space craft summary-Telecommunication subsystem overview- Ground subsystem-Telecom subsystem and Link performance. Mangalyaan mission - Mission and space craft summary-Telecommunication subsystem overview- Ground Subsystem -Telecom subsystem and Link performance.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain about orbital mechanics and link budget calculations

CO2: Outline the various applications of Satellite

CO3: Explain the concept of IPv6 Protocols in Satellite communication

CO4: Illustrate satellite navigation and principles of global positioning system

CO5: Outline Deep space networks and Inter planetary missions

1. Adimurthy.V, "Concept design and planning of India's first interplanetary mission", Current Science, Vol. 109, No. 6, 2015.
2. Anil K.Maini and Varsha Agrawal, "Satellite Technology: Principles and Applications", 3rd Edition, Wiley, 2014.
3. DanielMinoli "Innovations in Satellite Communication and SatelliteTechnology" ,3rd Edition, Wiley, 2015.
4. Hofmann-Wellenhof B., Lichtenegger H., and Elmar Wasle, "Global Navigational Satellite Systems" 1st Edition, Springer-Verlag, 2008.
5. Jim Taylor, "Deep Space Communications", 2ndEdition, John Wiley & Sons,2016.
6. Louis J. Ippolito, Jr. "Satellite Communications Systems Engineering: Atmospheric Effects, Satellite Link Design and System Performance", 1st Edition, Wiley, 2017.

21CMP04	MIMO OFDM SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamental concepts of wireless channel modeling techniques.
- To study the basic principle of OFDM technique.
- To know about the various MIMO techniques including MIMO channel capacity, Antenna diversity and space-time codes.
- To learn the spatial characteristics of wireless channel using various estimation techniques.
- To interpret the technical background of signal detection technique for spatially multiplexed MIMO systems.

UNIT I	SAMPLED SIGNAL AND MULTIPATH FADING CHANNEL MODELS	9

Physical scattering models- Extended channel models signal model for SISO, SIMO, MISO and MIMO ITU channel models- 3GPPP channel models - Extended ITU models- Spatial channel model SCM extension channel model, WINNER channel model.

UNIT II	CAPACITY ANALYSIS & BIT ERROR RATE ANALYSIS	9
Capacity in frequency flat fading channel, Capacity in frequency selective fading channel - Transmit beam forming - Receiver selection combining- Receiver equal combining- Receiver maximal ratio combining.		
UNIT III	**SPATIAL DIVERSITY AT TRANSMITTER AND RECEIVER**	**9**
Diversity gain- Transmit and receive antenna diversity- Diversity order and performance- Combined space and path diversity- Indirect transmit diversity-space time coding for frequency flat channels- frequency selective channels - Receivers for SISO, SIMO and MIMO.		
UNIT IV	**CHANNEL ESTIMATION AND TIMING & FREQUENCY SYNCHRONIZATION**	**9**
MIMOLS estimation- MMSE estimation- Robust MMSE estimation-coarse time synchronization- Fine time synchronization- Coarse frequency synchronization- Fine frequency synchronization.		
UNIT V	**OFDM AND SPREAD SPECTRUM MODULATION**	**9**
SISO-OFDM- MIMO OFDM- SISO SS modulation- MISO SS modulation, Model, capacity and receiver gain of MIMO MAC, MIMO BC and MIMO MU.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the concepts of MIMO OFDM Wireless communication systems.

CO2: Demonstrate the multiple access extension and PAPR reduction techniques of OFDM.

CO3: Determine the capacity and bit error rate of MIMO OFDM system for a given power delay profile of the MIMO channel.

CO4: Estimate the channel Impulse response coefficients of the SISO, SIMO, MISO and MIMO Systems.

CO5: Detect signals for spatially multiplexed MIMO Systems using various techniques.

REFERENCES:

1. A. Paulraj, R. Nabar and D Gore, "Introduction to Space-Time Wireless Communications", 1st Edition, Cambridge University Press, 2008.
2. D.Tse and P.Viswanath, "Fundamentals of Wireless Communications", 1st Edition, Asian Edition, Cambridge University Press, 2006.

3. Stefania Sesia, Issam Toufik and Matthew Baker, "LTE - The UMTS Long Term Evolution: From Theory to Practice", 2nd Edition, Wiley, 2011.
4. Y.S.Cho, J.Kim,Won Young Yang and Chung G. Kang, " MIMO OFDM Wireless Communications with MATLAB", 1st Edition, John Wiley & sons(Asia) private Ltd, 2010.
5. L. Hanzo, Y.A. Li Wang, M. Jiang, "MIMO-OFDM for LTE, Wi-Fi and WiMAX", 1st Edition, John Wiley & Sons Ltd, 2010.
6. E. Biglieri, R. Calderbank, A. Constantinides, A. Goldsmith and A. Paulraj, "MIMO Wireless Communications", 1st Edition, Cambridge University Press, 2010.

21CMP05	ANALOG AND MIXED SIGNAL VLSI DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the MOS characteristics, large signal model /small signal model and its analysis
- To interpret the submicron circuit, its process flow and delay elements
- To understand the characteristics and architectures of different types of data converters.
- To learn SNR and filters for data converters.
- To study about the switched capacitor amplifier circuits

UNIT I INTRODUCTION AND BASIC MOS DEVICES 9

Challenges in analog design-Mixed signal layout issues- MOSFET structures and characteristics- large signal and small signal model of single stage Amplifier-Source follower- Common gate stage – Cascode stage – large and small signal analysis of differential amplifier with active load, pole-zero estimation, zero value time constant method, frequency response of CS, cascade amplifiers.

UNIT II SUBMICRON CIRCUIT DESIGN 9

Submicron CMOS process flow, Capacitors and Resistors, Current mirrors, Digital circuit design, Delay elements – Adders- Op-amp parameters and design.

UNIT III	DATA CONVERTERS	9
Static and dynamic errors in DAC and ADC – Architectures & Characteristics of Sample and Hold- Digital to Analog Converters- DAC- R-2R, weighted DAC, multiplying DAC, segmented DAC and sigma delta DAC. ADC – Flash ADC, pipelined ADC, successive approximation ADC, sigma delta ADC.		
UNIT IV	SNR IN DATACONVERTERS	9
Overview of SNR of Data converters- Clock Jitters- Improving techniques-averaging – Decimating Filters for ADC- Band pass and High Pass Sinc Filters- Interpolating filters for DAC.		
UNIT V	SWITCHED CAPACITOR CIRCUITS	9
Resistors, First order low pass circuit, Switched capacitor amplifier, Switched capacitor integrator – Design of flip around sample and hold circuit – pipelined ADC.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the characteristics and model of MOS circuits.

CO2: Relate the Submicron circuits and its delay elements.

CO3: Explain the characteristics and architectures of different types of data converters.

CO4: Compare the SNR of data converters.

CO5: Develop switched capacitor circuits.

REFERENCES:

1. J. Jacob Wikner, Mikael Gustavsson and Nianxiong Tan "CMOS Data Converters for Communications", 1st Edition, Springer, 2000.
2. Van de Plassche and Rudy J., "CMOS Integrated Analog-to-Digital and Digital-to-Analog Converters", 2nd Edition, Springer, 2003.

21CMP06	ELECTROMAGNETIC METAMATERIALS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concepts of left handed materials.
- To design metamaterial transmission lines.
- To learn about the structure of metamaterials.
- To design metamaterial antennas.
- To interpret the applications of metamaterials.

UNIT I	LEFT HANDED MATERIALS AND THEIR PROPERTIES	9

Left-Handedness from Maxwell's equations, Entropy conditions in dispersive media, Boundary conditions, Reversal of Doppler effect, Reversal of Snell's law: Negative refraction, Focusing by a "Flat LH Lens", Reversal of Goos-Haenchen effect, Reversal of convergence and divergence in Convex and Concave lenses, Sub-wavelength diffraction, Fresnel coefficients.

UNIT II	METAMATERIAL TRANSMISSION LINES	9

Ideal homogeneous CRLH TLs- equivalent MTM constitutive parameters, Balanced and Unbalanced resonances, LC network implementation: Transmission matrix analysis, Input impedance, Cutoff frequencies, Analytical dispersion relation, Bloch impedance. Experimental transmission characteristics, Conversion from transmission line to constitutive parameters.

UNIT III	METAMATERIAL STRUCTURE ANALYSIS	9

Real distributed 1D CRLH structures: General design guidelines, Microstrip implementation, and parameters extraction, Two-dimensional MTMs: Eigen value problem, Negative Refractive Index (NRI) effects: Negative phase velocity, Negative refraction, Negative focusing, RH-LH interface surface plasmons. Distributed 2D structures: Description of possible structures, Dispersion and Propagation characteristics, Parameter extraction, Distributed implementation of the NRI slab reflectors with unusual properties.

UNIT IV	METAMATERIAL ANTENNAS	9

Fundamental aspects of Leaky-Wave structures, Principle of leakage radiation, Uniform and periodic Leaky-Wave structures, Uniform LW structures, Periodic LW structures, Metamaterial Leaky-Wave structures. Backfire-to Endfire (BE) Leaky-Wave (LW) antenna, Electronically scanned BE LW antenna: Electronic scanning principle, Electronic beamwidth control principle, Analysis of the structure and results, Two-Dimensional structures: Two Dimensional LW radiation, Conical-Beam antenna, Full-Space scanning antenna, Dual-Band CRLH-TL resonating ring antenna, "Meta-Interfaces", Heterodyne phased array, Nonuniform Leaky-Wave radiator.

UNIT V	APPLICATION AND ADVANCES IN METAMATERIALS	9

"Real-Artificial" Materials: Homogenization, Quasi-Optical NRI lenses and devices, Three-dimensional Isotropic LH MTMs, Optical MTMs, 'Magnetless' magnetic MTMs, Terahertz magnetic MTMs, Surface plasmonic MTMs, Antenna radomes and Frequency selective surfaces, Nonlinear MTMs, Active MTMs.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

- CO1: Illustrate the properties of metamaterials.
- CO2: Construct metamaterial transmission lines.
- CO3: Design the metamaterial structures.
- CO4: Demonstrate the metamaterial inspired antennas.
- CO5: Select the metamaterials for advanced applications.

REFERENCES:

1. Christophe Caloz and Tatsuo Itoh, "Electromagnetic Metamaterials: Transmission Line Theory and Microwave Applications", 1st Edition, A John Wiley & Sons, Inc., Publication, 2006
2. Tie Jun Cui, David Smith and Ruopeng Liu, "Metamaterials: Theory, Design, and Applications", 1st Edition, Springer, 2009
3. Douglas H. Werner and Do-Hoon K, "Transformation Electromagnetics and Metamaterials", 1st Edition, Springer-Verlag London, 2014

21CMP07	ADVANCED ANTENNA DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn various types of printed antennas.
- To understand about wearable antennas.
- To gain the knowledge about active integrated antennas.
- To be familiar with the reconfigurability function in antenna design.
- To study about metamaterials and metasurfaces.

UNIT I	PRINTED ANTENNAS	9
Concepts of Printed antennas, Broadband microstrip patch antennas, Circularly polarized planar antennas, Enhanced gain patch antennas, Wideband compact patch antennas, Microstrip slot antennas, Microstrip planar monopole antenna, Patch antennas for multiband applications.		
UNIT II	**WEARABLE ANTENNAS**	**9**
Overview of wearable systems and its characteristics, Antennas for wearable devices, Design requirements, Modeling and Characterization of wearable antennas, WBAN radio channel characterization and Effect of wearable antennas, Domains of operation, Sources on the human body, Compact wearable antenna for healthcare sensors.		
UNIT III	**ACTIVE INTEGRATED ANTENNAS**	**9**
Active wearable antenna modules-Features, Electromagnetic characterization of fabrics and Flexible foam materials, Matrix-Pencil two-line method, Small-Band inverse planar antenna Resonator method, Active antenna modules for wearable textile systems, Substrate integrated waveguide technology.		
UNIT IV	**RECONFIGURABLE ANTENNAS**	**9**
Reconfigurable methodologies, Design considerations for reconfigurable systems, Reconfigurable planar/printed antenna configurations, Active reconfigurable systems.		
UNIT V	**METAMATERIALS AND METASURFACES**	**9**
Double negative properties, Structures, Design of metamaterial antennas, Multi-surface - Metasurface antennas, Metahorns, Metalenses, Analysis of metasurfaces.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Evaluate the performance of different printed antennas.

CO2: Analyse the properties of wearable antennas.

CO3: Apply EM characterization to analyse active integrated antennas.

CO4: Design reconfigurable antennas.

CO5: Develop metamaterials and metasurfaces.

REFERENCES:

1. Debatosh Guha and Yahia M.M. Antar, "Microstrip and Printed Antennas", 1st Edition, John Wiley & Sons, 2011.
2. Taming the Borg, "Moving Wearables into the Mainstream", 1st Edition, Springer,

2008.

3. Eng Hock Lim and Kwok Wa Leung, "Compact Multifunctional Antennas for Wireless Systems", 2nd Edition, John Wiley & Sons, 2012.
4. Zhi Ning Chen, "Antennas for Portable Devices", 3rd Edition, John Wiley & Sons, 2007.
5. Warren L Stutzman and Gary A.Thiele. "Antenna Theory and Design", 3rd Edition, John Wiley & Sons, 2013.

21CMP08	MILLIMETER WAVE COMMUNICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn about the characteristics and applications of millimeter wave.
- To understand the fundamentals of millimeter wave devices and circuits.
- To know the various components of millimeter wave communications system.
- To interpret the concepts of millimeter wave MIMO systems.
- To study about antenna design at millimeter wave frequencies.

UNIT I	INTRODUCTION	9

Millimeter wave characteristics- millimeter wave wireless, implementation challenges, Radio wave propagation for mm wave: Large scale propagation channel effects, small scale channel effects, Outdoor and Indoor channel models, Emerging applications of millimeter wave communications.

UNIT II	MM WAVE DEVICES AND CIRCUITS	9

Millimeter wave generation and amplification: Peniotrons, Ubitrons, Gyrotrons and Free electron lasers. HEMT, models for mm wave Transistors, transistor configurations, Analog mm wave components: Amplifiers, Mixers, VCO, PLL. Metrics for analog mm wave devices, Consumption factor theory, Trends and architectures for mm wave wireless, ADCs and DACs.

UNIT III	MM WAVE COMMUNICATION SYSTEMS	9

Modulations for millimeter wave communications: OOK, PSK, FSK, QAM, OFDM, Millimeter wave link budget, Transceiver architecture, Transceiver without mixer, Receiver without Oscillator, Millimeter wave calibration, production and manufacture, Millimeter wave design considerations.

UNIT IV	MM WAVE MIMO SYSTEMS	9

Massive MIMO communications, Spatial diversity of antenna arrays, Multiple antennas, Multiple transceivers, Noise coupling in MIMO system, Potential benefits for mm wave systems, Spatial, Temporal and Frequency diversity, Dynamic spatial, frequency and modulation allocation.

UNIT V	ANTENNAS FOR MM WAVE SYSTEMS	9

Antenna beamwidth, polarization, advanced beam steering and beam forming, mm wave design consideration, On-chip and In package mm wave antennas, Techniques to improve gain of on-chip antennas, Implementation for mm wave in adaptive antenna arrays, Device to Device communications over 5G systems, Design techniques of 5G mobile.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the characteristics of millimeter wave.

CO2: Infer the properties of millimeter wave devices and circuits.

CO3: Explain about the usage of millimeter wave communication systems.

CO4: Outline the characteristics of millimeter wave MIMO systems.

CO5: Design antenna for millimeter wave frequencies.

REFERENCES:

1. K.C. Huang and Z. Wang, "Millimeter Wave Communication Systems", 2nd Edition, Wiley-IEEE Press, March 2011.
2. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport and Murdock, "Millimeter Wave Wireless Communication", 4th Edition, Prentice Hall, 2014.
3. Xiang, W; Zheng, K and Shen, X.S; "5G Mobile Communications", 2nd Edition, Springer, 2016.

21CMP09	MULTIMEDIA COMPRESSION TECHINIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the basic ideas of compression algorithms related to multimedia components such as text, speech, audio, image and video.
- To know about the principles and standards in text compression.
- To infer the use of image compression in multimedia processing applications.
- To study about audio compression.
- To explore the video compression and its applications.

UNIT I	FUNDAMENTALS OF COMPRESSION	9

Introduction to multimedia – Graphics, Image and Video representations – Fundamental concepts of video, digital audio – Storage requirements of multimedia applications – Need for compression – Taxonomy of compression algorithms - Elements of information theory – Error free compression – Lossy compression.

UNIT II	TEXT COMPRESSION	9

Huffman coding – Adaptive Huffman coding - Arithmetic coding – Shannon-Fano coding Dictionary techniques – LZW family algorithms.

UNIT III	IMAGE COMPRESSION	9

Image compression: Fundamentals – Compression standards – JPEG standard – Sub-band coding – Wavelet based compression – Implementation using Filters – EZW, SPIHT coders – JPEG 2000 standards – JBIG and JBIG2 standards.

UNIT IV	AUDIO COMPRESSION	9

Audio compression techniques – μ law, A-Law companding – Frequency domain and filtering – Basic sub-band coding – Applications to speech coding – G.722 – MPEG audio – Progressive encoding – Silence compression, Speech compression – Formant and CELP vocoders.

UNIT V	VIDEO COMPRESSION	9

Video compression techniques and standards – MPEG video coding: MPEG-1 and MPEG-2 video coding: MPEG-3 and MPEG-4 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – DVI real time compression – Current trends in compression standards.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the requirement of compression in different real time applications.

CO2: Select relevant techniques for text compression.

CO3: Experiment various image compression algorithms.

CO4: Compare the performance of audio compression techniques.

CO5: Illustrate the different standards applicable for video compression.

REFERENCES:

1. David Solomon, "Data Compression – The Complete Reference", 4th Edition, Springer Verlog, New York, 2006.
2. Darrel Hankerson, Greg A Harris and Peter D Johnson, "Introduction to Information Theory and Data Compression", 2nd Edition, Chapman and Hall, CRC Press, 2003.
3. Khalid Sayood, "Introduction to Data Compression", Morgan Kauffman Harcourt India, 3rd Edition, 2010.
4. Mark S. Drew and Ze-Nian Li, "Fundamentals of Multimedia", 1st Edition, PHI, 2009.
5. Peter Symes, "Digital Video Compression", 1st Edition, McGraw Hill Publishers, 2004.
6. Yun Q.Shi and Huifang Sun, "Image and Video Compression for Multimedia Engineering, Algorithms and Fundamentals", CRC Press, 2003.

21CMP10	COGNITIVE RADIO NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To introduce to the concepts of cognitive radio.
- To understand the cognitive radio architecture.
- To learn spectrum sensing and dynamic spectrum access.
- To be familiar with MAC layer and network layer design for cognitive radio.
- To know how cognitive radio relates with internet of things and M2M technologies.

UNIT I	INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO	9

Evolution of software defined radio and cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.

UNIT II	COGNITIVE RADIO ARCHITECTURE	9
Cognitive radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference hierarchy, Architecture maps, Building the cognitive radio architecture on software defined radio, Architecture and Overview of IEEE 802.22 standard for broadband wireless access in TV bands.		
UNIT III	**SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS**	**9**
Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection , Bayesian Approach, Neyman Pearson fusion rule for spectrum sensing, Optimum spectrum sensing –KullbackLeibler divergence and other approaches, Fundamental tradeoffs in spectrum sensing, Spectrum sharing models of dynamic spectrum access - Unlicensed and licensed spectrum sharing, Fundamental limits of cognitive radio.		
UNIT IV	**MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO**	**9**
MAC for cognitive radios – Multichannel MAC - slotted ALOHA – CSMA, Network layer design – routing in cognitive radios, flow control and error control techniques.		
UNIT V	**ADVANCED TOPICS IN COGNITIVE RADIO**	**9**
Cognitive radio for Internet of Things - Features and applications – Enabling technologies and protocols – M2M technologies - Data storage and analysis techniques - Requirement and challenges of IoT – Energy efficiency– MIMO Cognitive radio – Power allocation algorithms.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Summarize the benefits, evolution and implications of software defined radio.

CO2: Explain the techniques and functions of cognitive radio architecture.

CO3: Outline the basics of various spectrum sensing techniques and algorithms.

CO4: Interpret the functions of MAC layer and network layer and its various protocols.

CO5: Outline cognitive radio for internet of things and M2M technologies.

REFERENCES:

1. Alexander M. Wyglinski, Maziar Nekovee and Thomas Hou, "Cognitive Radio Communications and Networks", Academic Press, Elsevier, 2010.
2. Bruce Fette, "Cognitive Radio Technology", Newnes, 2006.

3. Kwang-Cheng Chen and Ramjee Prasad, "Cognitive Radio Networks", 1st Edition, John Wiley and Sons, 2009.
4. Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007.
5. S.Shanmugavel, M.A.Bhagyaveni, R.Kalidoss, "Cognitive Radio-An Enabler for Internet of Things", 1st Edition, River Publishers, 2017.

SEMESTER III

21CMP11	ELECTROMAGNETIC INTERFERENCE AND COMPATIBILITY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of electromagnetic interference and compatibility.
- To study about EMI Coupling Principles.
- To know the methods to mitigate EMI.
- To be familiar with the EMI Standards and Regulations.
- To learn about the EMI testbeds.

UNIT I	BASIC THEORY	9

Introduction to EMI and EMC, Intra and inter system EMI, Elements of Interference, Sources and Victims of EMI, Conducted and Radiated EMI emission and susceptibility, Case histories, Radiation hazards to humans, Various issues of EMC, EMC Testing categories EMC engineering application.

UNIT II	COUPLING MECHANISM	9

Electromagnetic field sources and Coupling paths, Coupling via the supply network, Common mode coupling, Differential mode coupling, Impedance coupling, Inductive and Capacitive coupling, Radioactive coupling, Ground loop coupling, Cable related emissions and coupling, Transient sources, Automotive transients.

UNIT III	EMI MITIGATION TECHINIQUES	9

Working principle of shielding and Murphy's law, LF magnetic shielding, Apertures and shielding effectiveness, Choice of materials for H, E, and free space fields, Gasketting and sealing, PCB level shielding, Principle of grounding, Isolated grounds, Grounding strategies for large systems, Grounding for mixed signal systems, Filter types and operation, Surge protection devices, Transient protection.

UNIT IV	STANDARD AND REGULATION	9

Need for standards, Generic/General standards for residential and industrial environment, Basic standards, Product standards, National and International EMI standardizing organizations; IEC, ANSI, FCC, AS/NZS, CISPR, BSI, CENELEC, ACEC. Electro magnetic emission and susceptibility standards and specifications, MIL461E standards.

UNIT V	EMI TEST METHODS AND INSTRUMENTATION	9

Fundamental considerations, EMI shielding effectiveness tests, Open field test, TEM cell for immunity test, Shielded chamber , Shielded anechoic chamber, EMI test receivers, Spectrum analyzer, EMI test wave simulators, EMI coupling networks, Line impedance stabilization networks, Feed through capacitors, Antennas, Current probes, MIL -STD test methods, Civilian STD test methods.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the basics of Interferences.

CO2: Utilize various EMI coupling principles to achieve compatibility.

CO3: Explain the Electromagnetic compatible PCBs for EMI mitigation techniques.

CO4: Illustrate the EMI standards and regulation.

CO5: Demonstrate various EMI / EMC testbeds.

REFERENCES:

1. Bernhard Keiser, "Principles of Electromagnetic Compatibility", 3rd Edition, Artech House, Norwood, 1986.
2. Clayton Paul, "Introduction to Electromagnetic Compatibility", 1st Edition, Wiley Interscience, , 2006.
3. Daryl Gerke and William Kimmel, "EDN's Designer's Guide to Electromagnetic Compatibility", Elsevier Science & Technology Books, 2002.
4. Henry W. Ott, "Electromagnetic Compatibility Engineering", 3rd Edition, John Wiley & Sons Inc, Newyork, 2009.
5. V Prasad Kodali, "Engineering Electromagnetic Compatibility", IEEE Press, Newyork, 2001.

21CMP12	FREQUENCY SELECTIVE SURFACES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the fundamentals of FSS.
- To be familiarize with the periodic structures.
- To design the layered radomes.
- To analyze the geometries of FSS.
- To explain the operation surface iIntegrated waveguide.

UNIT I	INTRODUCTION TO FSS	9

Periodic structures - Surface waves unique to finite periodic structures - Complementary arrays - passive versus active arrays - dipole versus slot arrays - Applications of periodic structures: Hybrid radomes, Bandstop filters, Dichroic reflectors, Circuit analog absorbers, Meanderline polarizer.

UNIT II	TYPES OF ELEMENTS	9

Center connected or N-Poles: Unloaded tri-pole array, Square spiral element - Loop types: three legged and four-legged loaded element - Solid interior types - combination of elements – Common misconceptions about elements - Comparison of elements - Evaluation of periodic structures.

UNIT III	FSS RADOME MODELING	9

Modeling of an N-layered hybrid radome - Determination of the transmission coefficient for an N - layered hybrid radome - analysis of the hybrid radome – Honeycomb and thick screen radomes - Reflection: image lobes - Luebbers' anomaly - Calculation of scattering from N arrays of dipoles - Matching in the band-pass region.

UNIT IV	ANALYSIS OF FSS	9

Estimating the resonant frequency of a single periodic surface: Effect of dielectric material, Bandwidth - Extension to arrays of wide flat elements - Filter geometries and equivalent circuits - Matrix methods - Derivation of cascading matrix.

UNIT V	SUBSTRATE INTEGRATED WAVEGUIDES	9

Substrate integrated waveguides – Circuits and Components - SIW and FSS - Modeling and design considerations – Applications – Merits and demerits.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Analyze the structure of frequency selective surfaces.

CO2: Explain the characteristics of periodic structures.

CO3: Design layered radomes.

CO4: Develop the equivalent circuits of FSS.

CO5: Illustrate the structure of substrate integrated waveguide.

REFERENCES:

1. Ben A Munk, "Frequency Selective Surfaces-Theory and Design", 1st Edition. John Wiley, 2000.
2. Ben A Munk, "Finite Antenna Arrays and FSS", Wiley-IEEE Press, July 2003
3. Salvatore Celozzi, "Electromagnetic Shielding", 2nd Edition, Wiley Interscience Publication, 2008.
4. E.A.Parker, "The Gentleman's Guide to Frequency Selective Surfaces". 17th Q.M.W. Antenna Symposium, London, April 1991.
5. M. Bozzi, F. Xu, D. Deslandes, and K. Wu, "Modeling and design considerations for substrate integrated waveguide circuits and components," in Int. Telecomm. Modern Satellite, Cable, Broadcast. Serv.Conf., Sep. 2007, pp. 7–16.
6. Benjamin Hooberman, "Everything You Ever Wanted to Know About Frequency-Selective Surface Filters but Were Afraid to Ask", May 2005.

21CMP13	SOFT COMPUTING TECHNIQUES	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To understand Artificial Intelligence and Production Systems.
- To familiarize with architecture and algorithms involved in Neural Networks.
- To gain the knowledge about different types of perceptions.
- To explain Fuzzy Logic, Various fuzzy systems and their functions.
- To learn the s applications and advances of Genetic Algorithms.

UNIT I	INTRODUCTION TO SOFTCOMPUTING	9

Introduction to soft computing, soft computing vs. hard computing, Types of soft computing techniques, Sequential and Parallel Computing. Applications of soft computing: Healthcare, Remote Sensing and Communication Systems.

UNIT II	ARTIFICIAL INTELLIGENCE	9
Introduction, Various types of production systems, characteristics of production systems. Search Techniques: Breadth first search, Depth first search, Hill Climbing, Best first search, A* and AO* Algorithms and control strategies. Knowledge representation issues, Prepositional and predicate logic, monotonic and non monotonic reasoning, forward and backward reasoning, Strong slot and weak slot filler structure.		
UNIT III	NEURAL NETWORKS	9
Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, Difference b/w ANN and human brain, characteristic and applications of ANN, single layer network. Perceptron training algorithm, Linear separability, Widrow & Hebb's learning rule/Delta rule, ADALINE, MADALINE. Introduction of MLP, activation functions, Error calculation, back propagation algorithm, momentum, limitation, characteristics and application of EBPA.		
UNIT IV	FUZZY LOGIC AND FUZZY SYSTEMS	9
Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, features of membership functions. Fuzzy propositions, formation, decomposition & aggregation of fuzzy Rules, fuzzy reasoning, fuzzy inference systems, fuzzy decision making & Applications of fuzzy logic.		
UNIT V	GENETIC ALGORITHM AND APPLICATIONS	9
Fundamental, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, inversion & deletion, mutation operator, Bitwise operator ,Generational Cycle, Convergence of GA, Differences & similarities between GA and other traditional methods, Applications & advances in GA.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course , learners will be able to

CO1: Learn about soft computing techniques and their applications.

CO2: Analyze various neural network architectures.

CO3: Familiarize with perceptrons and counter propagation networks.

CO4: Define the fuzzy systems.

CO5: Analyze the genetic algorithms and their applications.

REFERENCES:

1. S.N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", 2nd Edition, Wiley Publications, 2011.

2. S. Rajasekaran and G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications", 1st Edition, PHI Publication, 2009.
3. N.K.Bose and Ping Liang, "Neural Network fundamental with Graph, Algorithms & Applications", 1st Edition, TMH, 1998.
4. Bart Kosko, "Neural Network & Fuzzy System", 1st Edition, PHI Publication, 2009.
5. Rich E and Knight K, "Artificial Intelligence", 3rd Edition, TMH, 2012.
6. George J Klir and Bo Yuan, "Fuzzy sets & Fuzzy Logic, Theory & Applications", 1st Edition, PHI Publication, 2009.

21CMP14	SPACE TIME WIRELESS COMMUNICATION	L	T	P	C
		4	0	0	3

COURSE OBJECTIVES:

- To understand the concepts and derive the expressions of signals; channel model for various multiple antenna techniques.
- To learn channel capacity and spatial diversity of various multiple antenna systems.
- To study transmit diversity concept under various channel constraints.
- To demonstrate various receiver structure of multiple antenna configuration.
- To understand receiver structures and spread spectrum concepts of multiple antenna systems.

UNIT I	SPACE TIME SIGNAL & CHANNEL MODEL	9

Space time signal model: SISI, SIMO, MISO and MIMO, Space time channel model: SISO, SIMO, MISO and MIMO, Extended channel models: Spatial fading correlation, LOS component, Cross-polarized antennas and Degenerate channels, Statistical properties of channel: Singular value and Squared Frobenius norm.

UNIT II	CAPACITY OF SPACE TIME WIRELESS CHANNELS	9

Frequency flat fading channel with perfect CSIT, Frequency flat fading channel in the absence of CSIT, Frequency selective fading channel with perfect CSIT, Frequency selective fading channel in the absence of CSIT, Random MIMO channel, Correlated MIMO channel.

UNIT III	SPATIAL DIVERSITY	9

Diversity gain: Coding gain vs diversity gain, Spatial diversity vs time/frequency diversity, Transmit antenna diversity: Channel unknown to the transmitter – MISO, Channel known to the transmitter – MISO, Channel unknown to the transmitter – MIMO, Channel known to the transmitter - MIMO, Receive diversity: Selection, Threshold, Equal gain and Maximal ratio combining.

UNIT IV	RECEIVER STRUCTURES	9
Maximum likelihood receiver, Zero forcing receiver, Minimum mean square error, Decision feedback error, D-BLAST and V- BLAST.		
UNIT V	SPACE TIME OFDM & SPREAD SPECTRUM	9
SISO – OFDM, MIMO – OFDM modulation, Signaling and receivers for MIMO – OFDM: Spatial diversity coding for MIMO – OFDM, SM for MIMO – OFDM and Space-frequency coded MIMO – OFDM, SISO – SS modulation: Frequency flat channel, Frequency selective channel, MIMO – SS modulation, Signaling and receivers for MIMO – SS: Spatial diversity coding for MIMO-SS, SM for MIMO-SS.		
		Total Periods: 45

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Obtain signal and channel model for SISO, SIMO, MISO and MIMO systems for specified muti-antenna configuration.

CO2: Determine the capacity of SISO, SIMO, MISO and MIMO systems for the frequency flat and frequency channel models.

CO3: Analyze SIMO and MIMO transmit diversity techniques under the assumptions of known and unknown CSI at the transmitter.

CO4: Analyze MISO and MIMO receiver diversity using various combining techniques.

CO5: Apply zero-forcing, ML, MMSE and DFE techniques to find error probability of space-time receivers.

REFERENCES:

1. D.Tse and P. Viswanath, "Fundamentals of Wireless Communications", 1st Edition, Cambridge University Press, 2005.
2. A.B.Gershman, N.D.Sidiropoulos, "Space Time Processing for MIMO Communications", 4th Edition, John Wiley, 2005.
3. Erik. G. Larsson, "Space Time Block Coding for Wireless Communications", 2nd Edition, Cambridge University Press, 2003.

21CMP15	SYSTEM ON CHIP ARCHITECTURE	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basic processor designing techniques.
- To classify data types.
- To apply hardware system prototyping tools.
- To acquire the knowledge of ARM system control processor.
- To design system in package.

UNIT I	INTRODUCTION TO PROCESSOR DESIGN	9

Abstraction in hardware design, MUO a simple processor, Processor design trade off, Design for low power consumption. ARM Processor as system-on-chip: Acorn RISC Machine –Architecture inheritance – ARM programming model – ARM development tools – 3 and 5 stage pipeline ARM organization – ARM instruction execution and implementation – ARM co-processor interface.

UNIT II	ARM ASSEMBLY LANGUAGE PROGRAMMING	9

ARM instruction types – data transfer, data processing and control flow instructions – ARM instruction set – Co-processor instructions. Architectural support for high level language: Data types – abstraction in software design – Expressions – Loops – Functions and Procedures –Conditional statements – Use of memory.

UNIT III	MEMORY HIERARCHY	9

Memory size and speed – On-chip memory – Caches – Cache design- an example – memory management. Architectural support for system development: Advanced microcontroller bus architecture – ARM memory interface – ARM reference peripheral specification – Hardware system prototyping tools – Armulator –Debug architecture.

UNIT IV	ARCHITECTURAL SUPPORT FOR OPERATING SYSTEM	9

An introduction to operating systems – ARM system control coprocessor – CP15 protection unit registers – ARM protection unit – CP15 MMU registers – ARM MMU architecture – Synchronization – Context switching input and output.

UNIT V	SYSTEM IN PACKAGE DESIGN	9

SoC vs SiC, SiC and board level design; SiP design flow, System planning, Chip-package co-design, System optimization; SiP design layout, simulation, verification, Gaps in SiP design, Power optimization tools, Parasitic extraction tools, Signal integrity. Examples of SiP.

	TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Design system in package.

CO2: Apply hardware system prototyping tools.

CO3: Classify data types.

CO4: Design Arm MMU architecture.

CO5: Model arm system control processor.

REFERENCES:

1. Steve Furber, "ARM System on Chip Architecture", 2nd Edition, Addison Wesley Professional, 2000.
2. Ricardo Reis, "Design of System on a Chip: Devices and Components", 1st Edition, Springer, 2004.
3. Jason Andrews and Newnes, "Co-Verification of Hardware and Software for ARM System on Chip Design (Embedded Technology)",1st Edition, 2005
4. Prakash Rashinkar, Peter Paterson and Leena Singh L ,Kluwer, "System on Chip Verification – Methodologies and Technique"s, Academic Publishers, 1st Edition, 2002.

21CMP16	WEARABLE ELECTRONICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the role of wearable devices.
- To explain the types and application of wearable sensor.
- To study about smart textiles.
- To describe the working of energy harvesting.
- To learn the properties of wearable antennas.

UNIT I	INTRODUCTION TO WEARABLE TECHNOLOGY	9

World of Wearable (WOW), Role of wearable, The emerging concept of big data, The Ecosystem enabling digital life, Smart mobile communication devices, Attributes of wearables, Taxonomy for wearables, Advancements in wearables, Textiles and clothing, Applications of wearables.

UNIT II	WEARABLE BIO AND CHEMICAL SENSORS	9
Introduction, System design, Microneedle technology, Sampling gases, Types of sensors, Challenges in chemical biochemical sensing, Sensor stability, Interface with the body, Textile integration, Power requirements, Applications: Personal health, Sports performance, Safety and Security, Case studies.		
UNIT III	SMART TEXTILE	9
Conductive fibres for electronic textiles: an overview, Types of conductive fibre, Applications of conductive fibres, Bulk conductive polymer yarn, Bulk conductive polymer yarn, Techniques for processing CPYs, Wet-spinning technique, Electro spinning technique, case studies, Hands on project in wearable textile: Solar Backpack, LED Matrix wallet.		
UNIT IV	ENERGY HARVESTING SYSTEMS	9
Introduction, Energy harvesting from Temperature gradient, Thermoelectric generators, DC-DC Converter topologies, DC-DC Converter design for Ultra-Low input voltages, Energy harvesting from Foot motion, AC-DC converters, Wireless energy transmission, Energy harvesting from light, Case studies.		
UNIT V	WEARABLE ANTENNAS	9
Introduction, Background of textile antennas, Design rules for embroidered antennas, Integration of embroidered textile surfaces onto polymer substrates, Characterizations of embroidered conductive, textiles at radio frequencies, RF performance of embroidered textile antennas, Applications of embroidered antennas.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

- CO1: Analyse measurable quantities and working principles of wearable electronic devices.
- CO2: Describe different types of wearable sensors.
- CO3: Determine and interpret the outcome of the smart textiles and solve the design challenges.
- CO4: Analyse and evaluate the energy harvesting systems.
- CO5: Design the customised wearable antennas.

REFERENCES:

1. Edward Sazonov, Michael R., "Wearable Sensors: Fundamentals, Implementation and Applications",1st Edition, Neuman Academic Press, 2014.

2. Tilak Dias, "Electronic Textiles: Smart Fabrics and Wearable Technology", 1st Edition, Woodhead Publishing; ISBN-13: 978-0081002018.
3. Hal Rodriguez and Sahrye Cohen, "Make It, Wear It: Wearable Electronics for Makers, Crafters, and Cosplayers", 1st Edition, McGraw-Hill Education, 2018.
4. Gang Wang, Chengyi Hou, Hongzhi Wang, "Flexible and Wearable Electronics for Smart Clothing: Aimed to Smart Clothing", 1st Edition, Wiley, 2020
5. SenentxuLanceros-Méndez, Carlos MiguelCosta, "Printed Batteries: Materials, Technologies and Applications", 1st Edition, Wiley, 2018.

21CMP17	NETWORK ROUTING ALGORITHMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To expose to the layered architecture for communication networks and the specific functionality of the network layer.
- To study the basic principles of routing and the implementation in conventional networks.
- To understand the evolving routing algorithms based on internetworking requirements, optical backbone and the wireless access part of the network.
- To study the specifications and functionalities of various protocols/standards of mobile networks.
- To be familiarize with Adhoc networks concepts and its routing protocols.

UNIT I	INTRODUCTION	9

ISO OSI Layer Architecture, TCP/IP Layer Architecture, Functions of network layer, General Classification of routing, Routing in telephone networks, Dynamic non hierarchical routing (DNHR), Trunk status map routing (TSMR), real-time network routing (RTNR), Distance vector routing, Link state routing, Hierarchical routing.

UNIT II	INTERNET ROUTING	9

Interior protocol: Routing Information Protocol (RIP), Open Shortest Path First (OSPF), Bellman Ford Distance Vector Routing. Exterior Routing Protocols: Exterior Gateway Protocol (EGP) and Border Gateway Protocol (BGP). Multicast routing: pros and cons of multicast and multiple Unicast routing, Distance vector multicast routing protocol (DVMRP), Multicast Open Shortest Path First (MOSPF), MBONE, Core based tree routing.

UNIT III	ROUTING IN OPTICAL WDM NETWORKS	9
Classification of RWA algorithms, RWA algorithms, Fairness and admission control, Distributed control protocols, Permanent routing and wavelength requirements, Wavelength rerouting- Benefits and issues, Light path migration, Rerouting schemes, algorithms- AG, MWPG.		
UNIT IV	**MOBILE - IP NETWORKS**	**9**
Macro-mobility protocols, Micro-mobility protocol: Tunnel based : Hierarchical mobile IP, Intra domain mobility management, Routing based: Cellular IP, Handoff wireless access internet infrastructure (HAWAII).		
UNIT V	**MOBILE AD -HOC NETWORKS**	**9**
Internet-based mobile ad-hoc networking communication strategies, Routing algorithms – Proactive routing: destination sequenced distance vector routing (DSDV), Reactive routing: Dynamic Source Routing (DSR), Ad hoc On-Demand Distance Vector Routing (AODV), Hybrid Routing: Zone Based Routing (ZRP).		

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

- CO1: Explain the various layers of communication networks and the functionalities of the network layer.
- CO2: Outline the concepts of internet routing and its protocols.
- CO3: Summarize the different routing algorithms for optical WDM networks.
- CO4: Interpret the functionalities of various protocols/standards of mobile IP networks.
- CO5: Infer the different routing protocols for mobile Ad-hoc networks.

REFERENCES:

1. A.T Campbell et al., "Comparison of IP Micromobility Protocols", IEEE Wireless Communications Feb.2002, pp 72-82.
2. C.E Perkins, "Ad Hoc Networking", Addison – Wesley, 2001.
3. M. Steen Strub, "Routing in Communication network", Prentice Hall International, Newyork, 1995.
4. S. Keshav, "An engineering approach to computer networking", 1st Edition, Addison Wesley 1999.
5. William Stallings, "High speed Networks TCP/IP and ATM Design Principles", 4th Edition, Prentice Hall, New York, 1995.

6. William Stallings, "High speed networks and Internets Performance and Quality of Service", 2nd Edition, Pearson Education Asia, Reprint India 2002.

21CMP18	5G TECHNOLOGIES AND ITS APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn fundamentals of 5G wireless propagation channels.
- To understand the transmission and design techniques for 5G deployment.
- To be familiar with D2D and M2M communications.
- To understand the concepts of millimeter wave communications.
- To design smart antennas for 5G communication.

UNIT I	5G WIRELESS PROPAGATION CHANNELS	9

Overview of 5G requirements, Regulations for 5G, Spectrum analysis and sharing for 5G. Channel modeling requirements, propagation scenarios and challenges in 5G modeling, Channel models for mm wave MIMO systems.

UNIT II	TRANSMISSION AND DESIGN TECHNIQUES FOR 5G	9

Modulation techniques – Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC). Multiple access techniques – orthogonal frequency division multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-orthogonal multiple access (NOMA).

UNIT III	DEVICE-TO-DEVICE (D2D) COMMUNICATIONS	9

Device-to-device (D2D) and machine-to-machine (M2M) type communications – Extension of 4G D2D standardization to 5G, radio resource management for mobile broadband D2D, multihop and multi-operator D2D communications. Applications of D2D and M2M communications.

UNIT IV	MILLIMETER WAVE COMMUNICATIONS	9

Millimeter-wave communications – spectrum regulations, deployment scenarios, beam-forming, physical layer techniques, interference and mobility management, Massive MIMO propagation channel models, Channel estimation in massive MIMO, Massive MIMO with imperfect CSI, Multi-cell Massive MIMO, Pilot contamination, Spatial Modulation (SM). Applications of millimeter wave communication.

UNIT V	ANTENNAS FOR 5G COMMUNICATION	9

Smart antenna configurations, fixed side lobe canceling, Retro directive arrays, Diversity techniques, Angle diversity, Maximum ratio combining, Adaptive beamforming, Fixed multiple beams versus adaptive beamforming. Angle of arrival and direction of arrival estimation techniques.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the advancements and benefits of 5G technology and channel modeling constraints.

CO2: Analyse the transmission and design strategies related to 5G communications.

CO3: Implement device to device and machine to machine communication.

CO4: Understand millimeter wave communications and massive MIMO propagation.

CO5: Design smart antennas for 5G communication.

REFERENCES

1. Jonathan Rodriguez, "Fundamentals of 5G Mobile Networks", 1st Edition, John Wiley & Sons.
2. Amitabha Ghosh and Rapeepat Ratasuk, "Essentials of LTE and LTE-A", Cambridge University Press.

21CMP19	ADVANCED WIRELESS NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study about advanced wireless network, LTE, 4G and evolutions from LTE to LTE.
- To learn about wireless IP architecture, packet data protocol and LTE network architecture.
- To discuss about adaptive link layer, hybrid ARQ and graphs routing protocol.
- To study about mobility management, cellular network, and micro cellular networks.
- To understand about the quality of service wireless IP networks.

UNIT I	INTRODUCTION	9

Introduction to 1G/2G/3G/4G terminology. Evolution of public mobile services -Motivation for IP based wireless networks -Requirements and targets for long term evolution (LTE)-Technologies for LTE- 4G advanced features and roadmap evolutions from LTE to LTE-wireless standards. Network model- Network connectivity-Wireless network design with small world properties.

UNIT II	WIRELESS IP NETWORK ARCHITECTURES	9

3GPP packet data networks-Network architecture-Packet Data Protocol(PDP), Context configuring PDP addresses on mobile stations - Accessing IP networks through PS domain LTE network architecture-Roaming architecture-Protocol architecture-Bearer establishment Procedure -Inter-Working with other RATs.

UNIT III	ADAPTIVE LINK ANDNETWORK LAYER	9

Link layer capacity of adaptive air interfaces-Adaptive transmission in AdHoc networks Adaptive hybrid ARQ schemes for wireless links-Stochastic learning link layer protocol, Infrared link access protocol-Graphs and routing protocols-Graph theory-Routing with topology aggregation-Network and aggregation models.

UNIT IV	MOBILITY MANAGEMENT	9

Cellular networks-Cellular systems with prioritized handoff-Cell residing time distribution Mobility prediction in Pico- and micro-cellular networks.

UNIT V	QUALITY OF SERVICE	9

QoS challenges in wireless IP networks - QoS in 3GPP - QoS architecture, Management and classes -QoS attributes - Management of end-to-end IP QoS - EPS bearers and QoS in LTE networks.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

- CO1: Demonstrate their understanding on the latest 4G networks and LTE.
- CO2: Explain the wireless IP and LTE network architectures.
- CO3: Outline the adaptive link layer and network layer graphs and protocols.
- CO4: Demonstrate their comprehension on mobility management and cellular network.
- CO5: Explain the quality of service architecture of wireless IP network and its challenges.

REFERENCES:

1. Ayman ElNashar, Mohamed El-saidny, Mahmoud Sherif, "Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach", 3rd Edition, John Wiley & Sons, 2014.
2. Crosspoint Boulevard, "Wireless and Mobile All-IP Networks", 2nd Edition, Wiley Publication, 2005.
3. Jyh-Cheng Chen and Tao Zhang, "IP-Based Next-Generation Wireless Networks Systems, Architectures, and Protocols", 3rd Edition, John Wiley & Sons, Inc.Publication,2006.
4. SavoGlisic," Advanced Wireless Networks-4G Technologies", 2nd Edition, John Wiley & Sons, Ltd, 2006.
5. StefaniaSesia, IssamToufik and Matthew Baker, "LTE – The UMTS Long Term Evolution from Theory to Practice", 2nd Edition, John Wiley & Sons, Inc. Publication, 2011.

21CMP20	IOT FOR HEALTH CARE APPLICATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the fundamentals of embedded systems and IoT.
- To understand the hardware platforms and sensor interfaces.
- To learn about the web and cloud servers.
- To be familiarize with the real time needs of IOT.
- To study the case specific issues.

UNIT I	INTRODUCTION TO IOT	9

Introduction to embedded systems-an overview, features. Networked embedded system - types and overview, wireless communication standards-zigbee, bluetooth & Wi-Fi. Introduction to smart objects or things. IoT and its applications in health care systems-Patient monitoring & diagnostics, home healthcare, personal care and fitness.

UNIT II	IOT HARDWARE PLATFORM AND SENSOR INTERFACE	9

Introduction to CC3100 Wi-Fi booster pack: overview & features. Introduction to CC3100 SDK: understand the important APIs. Getting started with energia Wi-Fi libraries. Sensor interface: temperature sensor, pressure sensor, light sensor, and IR sensor.

UNIT III	EMBEDDED WEB-SERVER AND IOT CLOUD SERVICES	9
Embedded web server: basic introduction, its importance and role in IoT. Design of a simple embedded web server: HTTP. HTML basics overview of different IoT cloud services.		
UNIT IV	APPLICATION DESIGN	9
Application design: Design of IoT based pulse oximeter, block diagram, concepts of analog front end, signal process and Wi-Fi integration.		
UNIT V	CASE STUDIES	9
Case Study 1: Wireless patient monitor system. Case Study 2: Wearable fitness and activity monitor. Case Study 3: Safety monitoring.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the basic concepts of IoT in healthcare.

CO2: Relate the existing hardware platforms and sensor interfaces for various healthcare based applications.

CO3: Compare the ways of communication between the client and the server in IoT.

CO4: Illustrate the various services available in IoT.

CO5: Build various applications in healthcare using IoT based approach and substantiate the same with appropriate case studies.

REFERENCES:

1. CunoPfister, "Getting Started with Internet of Things", O'Relly, 1st Edition, 2011
2. J. P Vasseur, Adam Dunkels, "Interconnecting Smart Objects with IP", Elsevier, 2010

21CMP21	NUMERICAL TECHNIQUES FOR ELECTROMAGNETIC FIELDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To study the quasistatic field analysis.
- To understand finite difference methods.
- To learn about variational methods.
- To be familiarize with method of moments.
- To formulate finite element methods.

UNIT I	QUASISTATIC FIELD ANALYSIS	9
Introduction to Electro quasi-statics and Magneto-quasi-statics. Laws of Maxwell, Lorentz and Newton. Quasi-static laws. Conditions for fields to be quasi-static. Quasi-static systems. Applications. Quasi-static differential laws in free space.		
UNIT II	FINITE DIFFERENCE METHODS	9
Finite differencing of parabolic PDEs, Finite differencing of hyperbolic PDEs, Finite differencing of elliptic PDEs. Band matrix method. Accuracy and Stability of FD solutions. Practical applications: Guided structures - Transmission lines, Waveguides, Wave scattering analysis using FDTD. Yees finite difference algorithm. Accuracy and Stability, Lattice truncation conditions, Initial fields, Programming aspects. Absorbing boundary conditions for FDTD, Finite differencing for nonrectangular systems, Spherical coordinates, Numerical integration for discrete data - Eulers rule, Trapezoidal rule, Simpson's rule, Newton-Cotes rules, Gaussian rules, Multiple integration.		
UNIT III	VARIATIONAL METHODS	9
Inhomogeneous equations, Operators in linear spaces, Calculus of variations, Construction of functional from PDEs, Rayleigh Ritz method, Weighted residual method, Collocation method, Sub domain method, Least Squares method, Eigen value problems, Practical applications.		
UNIT IV	METHOD OF MOMENTS	9
Integral equations, Connection between differential and integral equations, Greens functions - For free space, For domain with conducting boundaries, Applications –Quasi-static problems, Scattering problems - Scattering by conducting cylinder, Scattering by an Arbitrary array of parallel wires, Radiation problems - Hallens integral equation, Pocklingtons integral equation, EM absorption in the human body, Derivation of integral equations, Transformation to matrix equation discretization, Evaluation of matrix elements, Solution of the matrix equation.		
UNIT V	FINITE ELEMENT METHOD	9
Typical finite elements, Solution of Laplace equation, Element governing equations, Assembling of all elements. Solution of Poisson's equation, Wave equation, Automatic mesh generation - Rectangular domains, Arbitrary domains, Definition of blocks, Subdivision of each block, Connection of individual blocks, Bandwidth reduction, Higher order elements, Pascal triangle, Local coordinates, Shape functions, Three dimensional elements, Finite element methods for exterior problems, Boundary element method.		

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of the numerical methods for various EM problems.

CO2: Identify the solution for any EM problem using finite difference method.

CO3: Select the applications of variational methods to real world problems.

CO4: Illustrate the performance of the antenna or waveguides using method of moments.

CO5: Compare the performance of finite element methods with other methods.

REFERENCES:

1. Matthew N.O.Sadiku, "Numerical Techniques in Electromagnetics with MATLAB", 3rd Edition, CRC Press, 2009.
2. BharathiBhat, and ShibanK.Koul, "Stripline-like Transmission Lines for Microwave Integrated Circuits", 4th Edition, New Age International, 2007.
3. DraganPoljak, "Advanced Modeling in Computational Electromagnetic Compatibility", Wiley, 2007.
4. Jian-Ming Jin, "Theory and Computation of Electromagnetic Fields", 2nd Edition Wiley IEEE Press, 2015.
5. David B. Davidson, "Computational Electromagnetics for RF and Microwave Engineering", 2nd Edition, Cambridge, 2010.
6. Silvester and Ferrari, "Finite Elements for Electrical Engineers", 3rd Edition, Cambridge, 1996.

21CMP22	DEEP LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concept of deep learning and fundamental mathematics required for deep learning.
- To study the modern practical deep networks and their applications.
- To understand the research methods of deep learning.
- To know about the various deep generative models.
- To learn the applications of deep learning networks.

UNIT I	INTRODUCTION AND PREREQUISITE MATHEMATICS	9
Introduction – Historical trends in deep learning - Linear algebra – Scalars – Vectors – Matrices and Tensors – Linear dependence and span - Probability and information theory – The chain rule of conditional probability - Bayes rule – Machine learning basics – Supervised and Unsupervised learning algorithms – Stochastic gradient descent.		
UNIT II	MODERN PRACTICAL DEEP NETWORKS	9
Deep feed forward networks – Gradient based learning – Back propagation and other differentiation algorithms – Regularization for deep learning: Parameter norm penalties – Norm penalties as constrained optimization – Challenges in training deep models – Convolution networks operation – Pooling – Recurrent neural networks – Bidirectional RNNs – Deep recurrent networks – Recursive neural networks.		
UNIT III	DEEP LEARNING RESEARCH	9
Probabilistic PCA and factor analysis - Independent Component Analysis (ICA) –Auto encoders - Representation learning- Greedy layer-Wise unsupervised pretraining - Transfer learning and Domain adaptation - Semi-supervised disentangling of causal factors - Structured probabilistic models for deep learning -The challenge of unstructured modeling - Using graphs to describe model structure - Sampling from graphical models - Learning about dependencies - Inference and approximate inference.		
UNIT IV	DEEP GENERATIVE MODELS	9
Boltzmann machines - Restricted Boltzmann machines - Deep belief networks – Deep boltzmann machines - Boltzmann machines for real valued data - Convolutional Boltzmann machines - Boltzmann machines for structured or sequential outputs - other Boltzmann machines – Back propagation through random operations - Directed generative nets - Drawing samples from auto encoders - Generative stochastic networks -Other generation schemes - Evaluating generative models.		
UNIT V	APPLICATION AND VISUALIZATION	9
Large scale deep learning – Computer vision – Speech recognition – Natural language processing – Other applications - Visualizations - Visual data analysis techniques - Interaction techniques – Social network analysis – Collective inferencing.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Make use of mathematical fundamentals of deep learning algorithms.

CO2: Identify a suitable optimization strategy for deep learning implementation.

CO3: Outline the research modes of deep learning.

CO4: Illustrate suitable deep learning models with suitable justification.

CO5: Choose a suitable visualization technique for the deep learning applications.

REFERENCES:

1. Ian Good fellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.
2. Yusuke Sugomori, "Java Deep Learning Essentials", PACKT, 2016.
3. Timothy Masters, "Deep Belief Nets in C++ and CUDA C: Volume 1: Restricted Boltzmann Machines and Supervised Feed Forward Networks", 2015.
4. Jeff Heaton, Artificial Intelligence for Humans, Volume 3: Deep Learning and Neural Networks, Heaton Research, 2015.
5. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press, 2012

21CMP23	WIRELESS ADHOC AND SENSOR NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the basics of Ad-hoc and sensor networks.
- To learn various fundamental and emerging protocols of all layers.
- To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.
- To know the nature and applications of Ad-hoc and sensor networks.
- To interpret various security practices and protocols of Ad-hoc and sensor networks.

UNIT I	MAC & TCP IN AD HOC NETWORKS	9

Fundamentals of WLANs – IEEE 802.11 Architecture - Self configuration and Auto configuration-Issues in Ad-hoc wireless networks – MAC protocols for Ad-hoc wireless networks – Contention based protocols - TCP over Ad-hoc networks-TCP protocol overview - TCP and MANETs – Solutions for TCP over Ad-hoc networks.

UNIT II	ROUTING IN AD HOC NETWORKS	9
Routing in Ad-hoc networks- Introduction-topology based versus position based approaches- Proactive, Reactive, Hybrid Routing Approach-Principles and Issues – Location services - DREAM – Quorums based location service – Grid – Forwarding strategies – Greedy packet forwarding – Restricted directional flooding- Hierarchical Routing- Issues and Challenges in providing QoS.		
UNIT III	**MAC, ROUTING & QOS IN WIRELESS SENSOR NETWORKS**	**9**
Introduction – Architecture - Single node architecture – Sensor network design considerations – Energy efficient design principles for WSNs – Protocols for WSN – Physical Layer : Transceiver design considerations – MAC layer protocols – IEEE 802.15.4 Zigbee – Link layer and Error control issues - Routing protocols – Mobile nodes and Mobile robots - Data centric and Contention based networking – Transport protocols & QOS – Congestion control issues – Application layer support.		
UNIT IV	**SENSOR MANAGEMENT**	**9**
Sensor management - Topology control protocols and Sensing mode selection protocols - Time synchronization - Localization and positioning – Operating Systems and Sensor Network programming – Sensor network simulators.		
UNIT V	**SECURITY IN AD HOC AND SENSOR NETWORKS**	**9**
Security in Ad-hoc and Sensor networks – Key distribution and management – Software based anti-tamper techniques – watermarking techniques– Defense against routing attacks - Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor network security protocols – SPINS.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

- CO1: Identify different issues in wireless Ad-hoc and sensor networks.
- CO2: Explain protocols developed for Ad-hoc and sensor networks.
- CO3: Identify and address the security threats in Ad-hoc and sensor networks.
- CO4: Build a sensor network environment for different type of applications.
- CO5: Develop security protocols.

REFERENCES:

1. Feng Zhao and Leonidas Guibas, "Wireless Sensor Networks: an information processing approach", Elsevier, 2004.

2. Charles E. Perkins, "Ad Hoc Networking", Addison Wesley, 2000.
3. I.F. Akyildiz, W. Su, Sankara Subramaniam and E. Cayirci, "Wireless sensor networks: a survey", Computer networks, Elsevier, 2002, PP: 394 - 422.

21CMP24	REAL TIME SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To learn the internal architecture and programming of an embedded processor.
- To introduce interfacing I/O devices to the process.
- To introduce the evolution of internet of things (IoT).
- To build a small low-cost embedded and IoT system using arduino/Raspberry Pi/open platform.
- To apply the concept of internet of thing.

UNIT I	8-BIT EMBEDDED PROCESSOR	9

8-bit Microcontroller – Architecture – Instruction set and Programming – Programming parallel ports – Timers and Serial port – Interrupt handling.

UNIT II	EMBEDDED C PROGRAMMING	9

Memory and I/O Devices interfacing – Programming embedded systems in C – Need for RTOS – Multiple tasks and processes – Context switching – Priority based scheduling policies.

UNIT III	IoT AND ARDUINO PROGRAMMING	9

ARM processor – Introduction to the concept of IoT devices – IoT devices versus computers – IoT configurations – Basic components – Introduction to arduino – Types of arduino – arduino toolchain – arduino programming structure – Sketches – Pins – Input/Output from Pins using sketches – Introduction to arduino Shields – Integration of sensors and actuators with arduino.

UNIT IV	IoT COMMUNICATION AND OPEN PLATFORMS	9

IoT Communication models and APIs – IoT communication protocols – Bluetooth – WiFi – ZigBee – GPS –GSM modules – Open platform (like Raspberry Pi) – Architecture – Programming – Interfacing – Accessing GPIO Pins – Sending and Receiving signals using GPIO pins – Connecting to the cloud.

UNIT V	APPLICATIONS DEVELOPMENT	9

Complete design of embedded systems – Development of IoT applications – Home automation – Smart agriculture – Smart cities – Smart healthcare

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the architecture and programming of an embedded processor.

CO2: Summarize the interfacing of I/O devices and programming the embedded systems.

CO3: Explain IoT configurations and arduino programming structure.

CO4: Illustrate the models, communication protocols and open platforms in IoT.

CO5: Build IoT based applications for the benefit of the society.

REFERENCES:

1. Muhammed Ali Mazidi, Janice GillispieMazidi and Rolin D. McKinlay, "The 8051 Microcontroller and Embedded Systems", 2nd Edition, Pearson Education, 2014.
2. Adrian McEwen and Hakim Cassimally, "Designing the Internet of Things", 1st Edition, John Wiley &Sons, 2014.
3. Michael J. Pont, "Embedded C", 3rd Edition, Pearson Education, 2007.
4. Robert Barton, Patrick Grossetete, David Hanes, Jerome Henry and Gonzalo Salgueiro, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", CISCO Press, 2017.
5. Andrew N Sloss, D. Symes and C. Wright, "Arm System Developers Guide", Morgan Kauffman/ Elsevier, 2006.
6. Arshdeep Bahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", VPT, 2014.

21CMP25	TESTING OF VLSI CIRCUITS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To know about the basic testing process.
- To understand the generation of test input.
- To design the testability.
- To know the test patterns.
- To get knowledge about fault diagnosis.

UNIT I	BASICS OF TESTING AND FAULT MODELLING	9
Introduction to testing – Faults in digital circuits – Modeling of faults – Logical fault models – Fault detection – Fault Location – Fault dominance – Logic simulation – Types of simulation – Delay models – Gate level event – Driven simulation.		
UNIT II	**TEST GENERATION FOR COMBINATIONAL AND SEQUENTIAL CIRCUITS**	**9**
Test generation for combinational logic circuits – Testable combinational logic circuit design – Test generation for sequential circuits – Design of testable sequential circuits.		
UNIT III	**DESIGN FOR TESTABILITY**	**9**
Design for testability – Ad-hoc design – generic scan based design – classical scan based design – system level DFT approaches.		
UNIT IV	**SELF TEST AND TEST ALGORITHMS**	**9**
Built-In self Test – test pattern generation for BIST – Circular BIST – BIST architectures – Testable memory design – Test algorithms – Test generation for embedded RAMs.		
UNIT V	**FAULT DIAGNOSIS**	**9**
Logical level diagnosis – Diagnosis by UUT reduction – Fault diagnosis for Combinational circuits – Self checking design – System level diagnosis.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Understand the basic testing process and faults in digital circuits.

CO2: Identify the test generation techniques for combinational and sequential circuits.

CO3: Explain the design for testability.

CO4: Build the testing algorithms.

CO5: Infer the fault diagnosis for combinational circuits.

REFERENCES:

1. M.Abramovici, M.A.Breuer and A.D. Friedman, "Digital systems and Testable Design", Jaico Publishing House, 1st Edition, 2002.
2. P.K. Lala, "Digital Circuit Testing and Testability", Academic Press, 1st Edition, 2002.
3. M.L.Bushnell and V.D.Agrawal, "Essentials of Electronic Testing for Digital,
4. Memory and Mixed-Signal VLSI Circuits", Kluwer Academic Publishers, 1st Edition, 2002.

5. A.L.Crouch, "Design Test for Digital IC's and Embedded Core Systems", Prentice Hall International, 1st Edition, 2002.

21CM201	PROJECT WORK PHASE I	L	T	P	C
		0	0	12	6

COURSE OBJECTIVES:

- To improve the skills in literature survey and to extract the relevant information by vast reading.
- To obtain necessary exposure on the latest developments in the relevant field and to use the current field of work in the research work.
- To develop the abilities for identifying and defining correct problem formulation in their chosen field.
- To acquire required knowledge for analysis and solving the given problem independently.
- To enhance the presentation and documentation skills in order to disseminate solution to the real world challenges.

METHOD OF EVALUATION:

Student should work on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is to be sumbitted at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Solve any challenging practical problems and find solution by formulating proper methodology.

CO2: Demonstrate a sound technical knowledge of their selected project topic.

CO3: Examine problem identification, formulation and solution.

CO4: Design engineering solutions to complex problems utilizing a systems approach.

CO5: Interpret with engineers and the community at large in written and oral forms.

SEMESTER IV

21CM202	PROJECT WORK PHASE II	L	T	P	C
		0	0	24	12

COURSE OBJECTIVES:

- To improve the skills in literature survey and to extract the relevant information by vast reading.
- To obtain necessary exposure on the latest developments in the relevant field and to use the current field of work in the research work.
- To develop the abilities for identifying and defining correct problem formulation in their chosen field.
- To acquire required knowledge for analysis and solving the given problem independently.
- To enhance the presentation and documentation skills in order to disseminate solution to the real world challenges.

METHOD OF EVALUATION:

Student should work on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 600 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Solve any challenging practical problems and find solution by formulating proper methodology.

CO2: Demonstrate a sound technical knowledge of their selected project topic.

CO3: Examine problem identification, formulation and solution.

CO4: Design engineering solutions to complex problems utilising a systems approach.

CO5: Interpret with engineers and the community at large in written an oral forms.

AUDIT COURSES

21AC101	ENGLISH FOR RESEARCH PAPER WRITING *(Common to all PG Programmes)*	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To explain writing skills and level of readability.
- To outline content writing in each section.
- To summarize the skills needed for framing a title.
- To demonstrate the skills needed for writing the conclusion.
- To compare the quality of paper with plagiarism report.

UNIT I	INTRODUCTION TO RESEARCH PAPER WRITING	6
Planning and Preparation. Word Order. Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.		
UNIT II	**PRESENTATION SKILLS**	**6**
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.		
UNIT III	**TITLE WRITING SKILLS**	**6**
Key skills –Title, Abstract, Introduction, Review of the Literature, Methods, Results, Discussion and Conclusions.		
UNIT IV	**RESULT WRITING SKILLS**	**6**
Skills -Methods, Results, Discussion and Conclusions.		
UNIT V	**VERIFICATION SKILLS**	**6**
Useful phrases, checking Plagiarism, ensuring quality paper submission.		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Explain the writing skills and level of readability

CO2: Outline the contents of research paper in each section

CO3:Classify the skills needed for writing a title

CO4: Summarize the content for presenting research conclusion note.

CO5: Illustrate the quality of paper by checking plagiarism.

REFERENCES:

1. Adrian Wallwork , "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011
2. Day R ,"How to Write and Publish a Scientific Paper", Cambridge University Press, 2006.
3. Goldbort R , "Writing for Science", Yale University Press ,2006
4. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM Highman's book 1998.
5. Stephen Howe and Kristina Henriksson, "Phrase Book for Writing Papers and Research in English", 4th Edition, Create Space Independent Publishing Platform, 2007.
6. Adrian Wallwork ,"English for Research: Usage, Style, and Grammar", Springer,2012.
7. Wendy Laura Belcher, Writing Your Journal Article in Twelve Weeks: A Guide to Academic Publishing Success, 1stEdition, SAGE Publications, Inc., 2009

21AC102	**CONSTITUTION OF INDIA** *(Common to all PG Programmes)*	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nationhood in the early years of Indian nationalism
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.
- To understand the importance of local body administration
- To know the role and function of election commission

UNIT I	HISTORY AND PHILOSOPHY OF THE INDIAN CONSTITUTION	6

History - Drafting Committee - (Composition & Working)- Philosophy - Preamble, Salient Features

UNIT II	CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES	6

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT III	ORGANS OF GOVERNANCE	6
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions		
UNIT IV	**LOCAL ADMINISTRATION**	**6**
District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.		
UNIT V	**ELECTION COMMISSION**	**6**
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.		
		TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3: Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4: Discuss the passage of the Hindu Code Bill of 1956.

CO5: Understand the basic Structure and functions of Election Commission.

REFERENCES:

1. Dr. S. N. Busi, "Dr. B. R. Ambedkar, Framing of Indian Constitution", 1st Edition, Ava Publishers, 2016.
2. M.P. Jain, "Indian Constitution Law", 7th Edition, Lexis Nexis, 2014.
3. D.D. Basu, "Introduction to the Constitution of India", 26th Edition, Lexis Nexis, 2022.

VELAMMAL COLLEGE OF ENGINEERING AND TECHNOLOGY
MADURAI – 625 009.
(Autonomous)

M.E. MANUFACTURING ENGINEERING
CHOICE BASED CREDIT SYSTEM
REGULATIONS 2021
I TO IV SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

S. No.	Course Code	Course Name	Category	L	T	P	Credits
Theory							
1	21MA121	Applied Probability and Statistics for Manufacturing Engineering	FC	3	2	0	4
2	21MF101	Modern Manufacturing Processes	PC	3	0	0	3
3	21MF102	Materials Technology	PC	3	0	0	3
4	21MF103	Computer Aided Manufacturing	PC	3	0	0	3
5	21RM102	Research Methodology and IPR	RM	3	0	0	3
6	21MFXXX	Professional Elective – I	PE	3	0	0	3
7	21ACXXX	Audit Course – I*	AC	2	0	0	0
Practical							
8	21MF104	CAD/CAM Laboratory	PC	0	0	4	2
9	21MF105	Technical Seminar	EE	0	0	2	1
						Total	**22**

SEMESTER II

S. No.	Course Code	Course Name	Category	L	T	P	Credits
Theory							
1	21MF106	Optimization Techniques in Manufacturing	PC	3	2	0	4
2	21MF107	Metal Cutting Theory and Practice	PC	3	0	0	3
3	21MF108	Additive Manufacturing	PC	3	0	0	3
4	21MF109	Fluid Power Automation	PC	3	0	0	3
5	21MFXXX	Professional Elective – II	PE	3	0	0	3
6	21MFXXX	Professional Elective – III	PE	3	0	0	3
7		Audit Course – II*	AC	2	0	0	0
Practical							
8	21MF110	Advanced Manufacturing Processes Laboratory	PC	0	0	4	2
9	21MF111	Contemporary manufacturing Research practices	PC	0	0	4	2
						Total	**23**

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SEMESTER III

S. No.	Course Code	Course Name	Category	L	T	P	Credits
Theory							
1	21MFXXX	Professional Elective – IV	PE	3	0	0	3
2	21MFXXX	Professional Elective – V	PE	3	0	0	3
3	21MFXXX	Professional Elective – VI	PE	3	0	0	3
4	21MFXXX	Professional Elective – VII	PE	3	0	0	3
Practical							
5	21MF112	Project Phase – I	EE	0	0	12	6
						Total	**18**

SEMESTER IV

S. No.	Course Code	Course Name	Category	L	T	P	Credits
Practical							
1	21MF113	Project Phase – II	EE	0	0	24	12
						Total	**12**

*Audit Courses I & II is optional to the students.

TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 75

SUMMARY

Category	I	II	III	IV	Total
FC	4	-	-	-	**4**
PC	11	17	-	-	**28**
RM	3	-	-	-	**3**
PE	3	6	12	-	**21**
EE	1	-	6	12	**19**
Total	**22**	**23**	**18**	**12**	**75**

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PROFESSIONAL ELECTIVES FOR M.E. MANUFACTURING ENGINEERING

SEMESTER I, ELECTIVE – I

S. No.	Course Code	Course Name	Category	L	T	P	Credits
1	21MFP01	Material Testing and Characterization Techniques	PE	3	0	0	3
2	21MFP02	Design for Manufacture and Assembly	PE	3	0	0	3
3	21MFP03	Micro Manufacturing	PE	3	0	0	3
4	21MFP04	Manufacturing Process Planning and Cost Estimation	PE	3	0	0	3
5	21MFP05	Materials Management	PE	3	0	0	3

SEMESTER II, ELECTIVE – II & III

S. No.	Course Code	Course Name	Category	L	T	P	Credits
1	21MFP06	Industrial Ergonomics	PE	3	0	0	3
2	21MFP07	Non-Destructive Evaluation	PE	3	0	0	3
3	21MFP08	Quality and Reliability Engineering	PE	3	0	0	3
4	21MFP09	Lean Manufacturing	PE	3	0	0	3
5	21MFP10	Flexible Manufacturing System	PE	3	0	0	3
6	21MFP11	MEMS and Nanotechnology	PE	3	0	0	3
7	21MFP12	Sustainable Manufacturing	PE	3	0	0	3
8	21MFP13	Composite Materials	PE	3	0	0	3

SEMESTER III, ELECTIVE – IV, V, VI & VII

S. No.	Course Code	Course Name	Category	L	T	P	Credits
1	21MFP14	Computer Aided Product Design	PE	3	0	0	3
2	21MFP15	Manufacturing Management	PE	3	0	0	3
3	21MFP16	Nanotechnology	PE	3	0	0	3
4	21MFP17	Finite Element Methods for Manufacturing Engineering	PE	3	0	0	3
5	21MFP18	Robot Design and Programming	PE	3	0	0	3
6	21MFP19	Mechatronics	PE	3	0	0	3
7	21MFP20	Manufacturing System Simulation	PE	3	0	0	3
8	21MFP21	Product Lifecycle Management	PE	3	0	0	3
9	21MFP22	Product Design and Development	PE	3	0	0	3
10	21MFP23	Entrepreneurship Development And Management	PE	3	0	0	3
11	21MFP24	Industrial Safety	PE	3	0	0	3
12	21MFP25	Advances in Materials	PE	3	0	0	3

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13	21MFP26	Smart Manufacturing and Industry 4.0	PE	3	0	0	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

S. No.	Course Code	Course Name	Cate gory	L	T	P	Credits
1	21AC101	English for Research Paper Writing	AC	2	0	0	0
2	21AC102	Disaster Management	AC	2	0	0	0
3	21AC103	Constitution of India	AC	2	0	0	0
4	21AC104	Natramil Ilakkiyam	AC	2	0	0	0

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21MA121	APPLIED PROBABILITY AND STATISTICS FOR MANUFACTURING ENGINEERING	L	T	P	C
		3	2	0	4

PRE-REQUISITE:

- Probability, Distributions, Random variables, Sampling Technique.

OBJECTIVES

- This course is aimed at developing the basic mathematical skills of engineering students

UNIT I	PROBABILITY AND RANDOM VARIABLES	12

Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT II	TWO DIMENSIONAL RANDOM VARIABLE	12

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT III	TESTING OF HYPOTHESIS	12

Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit

UNIT IV	ESTIMATION THEORY	12

Interval estimation for population mean - Standard deviation - Difference in means, proportion ratio of standard deviations and variances.

UNIT V	DESIGN OF EXPERIMENTS	12

Completely randomized design – Randomized block design – Latin square design – 2^2 Factorial design

TOTAL PERIODS	60

OUTCOMES

At the end of the course, the learners will be able to

CO1: analyze the performance in terms of probabilities and distributions achieved by the determined solutions

CO2: demonstrate the properties of two dimensional random variables and compute the correlation and regression.

CO3: apply the concept of testing of hypothesis for small and large samples by using various tests like t-test, F-test, z-test and chi-square test.

CO4: demonstrate knowledge of applicable large sample theory of estimators and tests.

CO5: obtain a better understanding of the importance of the methods in modern industrial processes.

REFERENCES

1. Devore, J. L., "Probability and Statistics for Engineering and Sciences", 8th Edition, Cengage Learning, 2014.
2. Gupta S.C. and KapoorV.K.," Fundamentals of Mathematical Statistics", 12th Edition, Sultan and Sons, New Delhi, 2020.
3. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for

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Engineers", 9th Edition, Pearson Education, Asia, 2016.
4. Rice, J. A., "Mathematical Statistics and Data Analysis", 3rd Edition, Cengage Learning, 2015.
5. Ross, S. M., "Introduction to Probability and Statistics for Engineers and Scientists", 5th Edition, Elsevier, 2014

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21MF101	MODERN MANUFACTURING PROCESSES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To create awareness on Abrasive aided machining
- To understand electrical and electrochemical machining processes.
- To analyse the principles of high energy aided machining.
- To study the surface and bulk machining processes of silicon wafer.
- To introduce students to the major manufacture steps in electronic circuit boards.

UNIT I	ABRASIVE AIDED MACHINING PROCESSES	9

Abrasive machining – water jet machining - ultrasonic machining –Abrasive flow machining- Magnetorheological Abrasive flow machining- construction working principle – steps - types – process parameters – derivations – problems, merits, demerits and applications.

UNIT II	ELECTRICAL AND CHEMICAL AIDED MACHINING PROCESSES	9

Wire cut EDM - Electric discharge machining – Electrochemical machining – chemical machining – Maskants - Electrochemical grinding - construction – principle – types – control - circuits – tool design – merits, demerits and applications. Hybrid Machining.

UNIT III	HIGH ENERGY AIDED MACHINING PROCESSES	9

Laser beam machining – Electron beam machining – Plasma arc machining – Ion beam machining – construction working principle types – process parameter – derivations – problems, merits, demerits and applications.

UNIT IV	FABRICATION OF MICRO DEVICES	9

Semiconductors – Si wafer - planarization – Oxidation - diffusion – ion implantation – etching – metallization – bonding – surface and bulk machining – LIGA Process.

UNIT V	MICROFABRICATION TECHNOLOGY	9

Moulding – PCB board hybrid and MCM technology – programmable devices and ASIC – electronic material and processing– stereolithography – Solid free form fabrication -SAW devices, Surface Mount Technology.

TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Understand and grasp the significance of modern machining process and its applications.

CO2: Identify the selection of machining process and its parameters.

CO3: Express and appreciate the cutting edge technologies and apply the same for research purposes.

CO4: Measure the stages involved in fabrication of micro devices.

CO5: Create new devices involved in micro fabrication and recent technology.

REFERENCES

6. Brahem T. Smith, “Advanced Machining” I.F.S. UK 2016.

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7. Jaeger R.C., "Introduction to Microelectronic Fabrication" Addison Wesley, 2nd Edition, 1998.
8. Jain V K, "Micromanufacturing Processes", CRC Press, 2012.
9. Julian W. Gardner, Vijay K Varadan and Osama O Awadelkarim, Microsensors "MEMS and Smart devices", John Willey, 2013.
10. Pandey P.C. and Shan HS "Modern Machining Processes", Standard Publishing Co., 1stEdition,1980.
11. Serope Kalpakjian and Steven R. Schmid- "Manufacturing Process for Engineering Material" – Pearson Education, 6thEdition, 2018

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21MF102	MATERIALS TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To understand the elastic and plastic behaviour of materials.
- To impart knowledge on fracture analysis.
- To familiarize on modern metallic materials.
- To review on polymeric and ceramics materials and their applications.
- To enable student to select material for specific applications.

UNIT I	ELASTIC AND PLASTIC BEHAVIOR	10

Elasticity in metals and polymers Anelastic and visco-elastic behaviour – Mechanism of plastic deformation shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre, dispersion and texture strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity – Deformation of polymeric, ceramic and non-crystalline materials.

UNIT II	FRACTURE BEHAVIOUR	10

Griffith's theory, stress intensity factor, J-Integral and fracture toughness – Toughening mechanisms – Ductile, brittle transition in steel – High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism maps – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law. Effect of surface and metallurgical parameters on fatigue – Fracture in ceramics and polymers – Failure analysis, sources of failure, procedure of failure analysis.

UNIT III	MODERN METALLIC MATERIALS	8

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel, Super alloys –Intermetallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and nano crystalline materials.

UNIT IV	NON METALLIC MATERIALS	7

Polymeric materials – Formation of polymer structure – Production techniques of fibres, foams, adhesives and coating – structure, properties and applications of Commodity and engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al2O3, SiC, Si3N4 CBN and diamond – properties, applications as abrasives and cutting tool- Properties and applications of CNT – Graphene based Material.

UNIT V	SELECTION OF MATERIALS	10

Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for Atmospheric, water, Soil and chemical, corrosion Selection for adhesive and abrasive wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery, chemical and nuclear applications

	TOTAL PERIODS	45

OUTCOMES

At the end of the course, the learners will be able to

CO1: Develop the knowledge of mechanism of failure of materials and methods.

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CO2: Apply the material property to suit the specific requirements.

CO3: Select the existing materials and development of upcoming new materials.

CO4: Select the various non-metallic materials to suit required applications.

CO5: Identify and select suitable material for relevant application.

REFERENCES

1. W. Bolton – “Engineering Materials Technology” - Butterworth-Heinemann Ltd; 3rd Edition 2015
2. George E.Dieter, “Mechanical Metallurgy”, 3rd Edition,McGraw Hill, 2014.
3. Ashby M.F., “Material Selection in Mechanical Design”, 5thEdition, Butter Worth 2017.
4. ASM Hand book, Vol.11, “Failure Analysis and Prevention”, 10thEdition, ASM, 2002.
5. Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., “Selection and use of engineering materials”, 3rd edition, Butterworth-Heiremann, 2001.
6. Thomas H. Courtney, “Mechanical Behaviour of Materials”, 2ndedition, McGraw Hill, 2000.
7. Marc Andre, Meyers and Krishan Kumar Chawla, “Mechanical Behaviour of Materials”, 2nd Edition, Cambridge University Press, 2009.

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21MF103	COMPUTER AIDED MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the evolution of CAD, CAM, CIM, engineering product specification and interpreting geometric specifications.
- To train the candidates on the integration of Computer Aided Design and Computer Aided Manufacturing.
- To impart knowledge on manual part program and generation of CNC part program using Computer Aided Manufacturing packages.
- To introduce with the implementation of CAD and CAM in manufacturing process.
- To introduce the importance of Internet of Things in Computer Aided Manufacturing.

UNIT I	INTRODUCTION TO CAM	9

Introduction CAD, CAM, CAE, CIM, system configuration for CAM including hardware and software, evolution of product realization, historical development, engineering product specification. Geometric Tolerancing - ASME standard, interpreting geometric specifications, multiple part features and datum.

UNIT II	CAD AND CAM INTEGRATION	9

Introduction - Networking - Techniques, components, interface cards, network standards, Graphics standards - Graphical kernel system, Data exchange format - IGES and STEP.

Process planning, Computer Aided Process Planning (CAPP), Product life cycle management (PLM), Enterprise resource planning (ERP).

UNIT III	PROGRAMMING OF CNC MACHINES	9

Structure of CNC program, Coordinate system, G & M codes, cutter radius compensation, tool nose radius compensation, tool wear compensation, canned cycles, mirroring features, Manual part programming for CNC turning, machining center, wire electric discharge machining, abrasive water jet cutting machine, bulk and sheet metal forming, generation of CNC program using CAM softwares.

UNIT IV	CAD AND CAM FOR MANUFACTURING PROCESSES	9

Classification of Manufacturing process, construction and operations, Integration of CAD and CAM in CNC turning center, machining center, electric discharge machining, wire electric discharge machining, abrasive water jet cutting machine, bulk forming, sheet metal forming.

UNIT V	IOT IN CAM	9

Introduction, overview of IOT enabled manufacturing system, Real-time and multi-source manufacturing information sensing system, IOT enabled smart assembly station, cloud computing based manufacturing resources configuration method, Real-time key production performances analysis method, Real-time information driven production scheduling system.

TOTAL PERIODS	**45**

OUTCOMES

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At the end of the course, the learners will be able to **CO1:** Recognize the importance of CAD, CAM, CIM, Engineering product specification and interpreting geometric specifications. **CO2:** Improve knowledge on the integration of CAD and CAM. **CO3:** Exhibit competency in manual part program and generation of CNC part program using CAM packages. **CO4:** Describe the implementation of CAD and CAM in manufacturing processes. **CO5:** Explain applications of IOT in computer aided manufacturing.
REFERENCES
1. Chang T.C., Wysk, R.A. and Wang.H.P., "Computer Aided Manufacturing", Pearson Prentice Hall, India ,2009, ISBN: 978-0131429192. 2. HMT,"Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2017. 3. Rao P.N., "CAD/CAM", 3rd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, India, 2012, ISBN-13: 978-0070681934. 4. Radhakrishnan P., "Computer Numerical Control ", New Central Book Agency, India,2013. 5. Nee Y.C., Soh K. Ong, Yun G. Wang., "Computer Applications in Near Net-Shape Operations", Springer, United Kingdom, 2012.

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21RM102	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

OBJECTIVES

- To impart knowledge of collecting data for carrying out research work effectively.
- To enable the students to use optimization technique for problem solving.
- To impart decision making skills using statistical tool.
- To gain exposure to write research reports.
- To impart knowledge about the procedure for filing patents and protecting intellectual property rights.

UNIT I	FUNDAMENTALS AND DATA COLLECTION	9

Research methodology - definition, objectives, mathematical tools for analysis, Research design. Types of research, exploratory research, conclusive research, modelling research, algorithmic research, Research process- steps. Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design.

UNIT II	HYPOTHESES TESTING AND ANALYSIS	9

Hypotheses testing – Testing of hypotheses concerning means, concerning variance – one tailed Chi-square test. Introduction to Discriminant analysis, Factor analysis, cluster analysis, multidimensional scaling, conjoint analysis.

UNIT III	REPORT WRITING AND PRESENTATION	9

Report writing- Types of report, guidelines to review report, report format, typing instructions, oral presentation, power point presentation, Data analysis using excel sheet, Proposal submission for funding agencies. Plagiarism, tools to avoid plagiarism, research ethics.

Case study: (Use software) report format, Prepare review paper, Reference formation end note, Grammar verification, Sample plagiarism report using Urkund/ Turnitin.

UNIT IV	PATENT RIGHTS	9

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.

UNIT V	NATURE OF INTELLECTUAL PROPERTY	9

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

TOTAL PERIOD	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Understand the fundamental search concepts and data collection methods for conducting research work.

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CO2:	Experiment the test hypothesis and analyze the outcome.
CO3:	Report the research work and write research proposals for various funding agencies.
CO4:	Analyze the procedure for filing patent rights, licensing and transfer of technology.

REFERENCES

1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010.
2. Ranjith Kumar, "Research Methodology", SAGE publication, 2018.
3. Robert Coe, Michael Waring, Larry V Hadges, James Aruthur, "Research Method and Methodology in Education", SAGE Publication, 2017.
4. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.
5. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008.

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21MF104	CAD / CAM LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES

- To introduce components and assemblies used in machines and use of 3D parametric CAD, CAM software for mechanical design.
- To provide an experiential learning environment using projects done by student groups, while applying CAD, CAE software tools to design mechanisms and structures for mechanical design evaluation, optimization of mass properties, static-stresses, deformations, etc. with experimental validation of simulation models.
- To do some exercises in tool pre-setting and work piece referencing on CNC machine tools, manual part programming for CNC turning and milling centres, Use of software for simulation of turned and milled parts and simple surfaces, Automatic Cutter location data generation from CAD Models in APT format and post-processing for machining on CNC machines using standard CAD/CAM software.

LIST OF EXPERIMENTS

CAM LABORATORY

1. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving canned cycle
2. Exercise on CNC Milling Machine: Profile Milling, Mirroring, Scaling & canned cycle. Study of Sensors, Transducers & PLC: Hall-effect sensor, Pressure sensors, Strain gauge, PLC, LVDT, Load cell, Angular potentiometer, Torque, Temperature & Optical Transducers.
3. Standards, types, applications and working of following components and assemblies, Machine Components: Screw fasteners, Riveted joints, Keys, Cotters and joints, Shaft couplings, Pipe joints and fittings. Assemblies: Bearings, Hangers and brackets, Steam and IC engine parts, Valves, Some important machine assemblies.
4. Mechanical Drawing: Machining and surface finish symbols and tolerances in dimensioning.
5. CAD: Introduction to CAD, CAM, software in product life cycle.
6. Geometric Modelling: Parametric sketching and modelling, constrained model dimensioning, Relating dimensions and parameters. Feature and sequence of feature editing. Material addition and removal for extrude, revolve, blend, helical sweep, swept blend, variable section sweep. References and construction features of points, axis, curves, planes, surfaces. Cosmetic features, representation of welded joints, Draft and ribs features, chamfers, rounds, standard holes. Assembly modelling. Automatic production drawing creation and detailing for dimensions, BOM, Ballooning, sectioned views etc.
7. Productivity Enhancement Tools in CAD Software: Feature patterns, duplication, grouping, suppression. Top-down vs. bottom-up design

CAD LABORATORY

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1. 2D modelling and 3D modelling of components such as
2. Bearing
3. Couplings
4. Gears
5. Sheet metal components
6. Jigs, Fixtures and Die assemblies.

TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Interpret mechanical drawings for components, assemblies and use parametric 3D CAD software tools in the correct manner for creating their geometric part models, assemblies and automated drawings.

CO2: Apply the concepts of machining for the purpose of selection of appropriate machining centres, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set- up, program, and operate CNC milling and turning equipment.

CO3: Create and validate NC part program data using manual data input (MDI) and automatically using standard commercial CAM package for manufacturing of required component using CNC milling or turning applications.

CO4: Produce an industrial component by interpreting 3D part model/ part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools.

CO5: Create and demonstrate the technical documentation for design/ selection of suitable drive technologies, precision components and an overall CNC machine tool system for automation of machining operations using appropriate multi-axis CNC technology.

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<table>
<tr><td rowspan="2">21MF105</td><td rowspan="2">TECHNICAL SEMINAR</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td></tr>
<tr><td colspan="6">OBJECTIVES</td></tr>
<tr><td colspan="6">• To enrich the communication skills of the student through presentation of topics in recent advances in engineering/technology.</td></tr>
<tr><td colspan="6">• A group of 2 students have to choose a problem and carry out scientific systematic investigation experimentally / theoretically in suggesting a viable solution. At the end of the semester, each group of students have to submit a report for evaluation.

• Depth of understanding, coverage, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.</td></tr>
<tr><td colspan="5" align="right">TOTAL PERIODS</td><td>30</td></tr>
<tr><td colspan="6">OUTCOMES</td></tr>
<tr><td colspan="6">At the end of the course, the learners will be able to
CO1: To develop skills to search, read, write, comprehend and present research papers in the areas of manufacturing engineering.</td></tr>
</table>

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SEMESTER II

21MF106	OPTIMIZATION TECHNIQUES IN MANUFACTURING	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES

- To make use of the above techniques while modeling and solving the engineering problems of different fields.

UNIT I	INTRODUCTION	12

Optimization – Historical Development – Engineering applications of optimization – Statement of an Optimization problem – classification of optimization problems.

UNIT II	CLASSIC OPTIMIZATION TECHNIQUES	12

Linear programming - Graphical method – simplex method – dual simplex method – revised simplex method – duality in LP – Parametric Linear programming – Goal Programming.

UNIT III	NON-LINEAR PROGRAMMING	12

Introduction – Lagrangian Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming.

UNIT IV	INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES	12

Integer programming - Cutting plane algorithm, Branch and bound technique, Zero-one implicit enumeration – Dynamic Programming – Formulation, Various applications using Dynamic Programming. Network Techniques – Shortest Path Model – Minimum Spanning Tree Problem –Maximal flow problem.

UNIT V	ADVANCES IN SIMULATION	12

Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems

TOTAL PERIODS	60

OUTCOMES

At the end of the course, the learners will be able to

CO1: To know the basic concepts of optimization problem.
CO2: To know about the simple optimization techniques in Linear Programming.
CO3: To know the various Non-Linear Programming techniques
CO4: To solve the Integer and Dynamic programming techniques.
CO5: To know the simulation techniques.

REFERENCES

1. P.K. Guptha and Man-Mohan, "Problems in Operations Research" – Sultan chand & Sons, 1994
2. R. Panneerselvam, "Operations Research", Prentice Hall of India Private Limited, New Delhi 1 –2005
3. Ravindran, Philips and Solberg, "Operations Research Principles and Practice", John Wiley & Sons, Singapore, 1992
4. Hamdy A. Taha, "Operations Research – An Introduction", Prentice Hall of India, 1997

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21MF107	METAL CUTTING THEORY AND PRACTICE	L	T	P	C
		3	0	0	3

OBJECTIVES

- To recognize the various principles of metal cutting, cutting tool materials and its wear mechanisms during the machining operation.
- To obtain advanced information about the metal cutting theory and to enlarge knowledge in metal cutting theory

UNIT I	INTRODUCTION	9

Need for rational approach to the problem of cutting materials-observation made in the cutting of metals-basic mechanism of chip formation-thin and thick zone modes-types of chips-chip breaker-orthogonal Vs oblique cutting-force velocity relationship for shear plane angle in orthogonal cutting-energy consideration in machining-review of Merchant, Lee and Shafter theories-critical comparison.

UNIT II	TOOL NOMENCLATURE AND THERMAL ASPECTS	9

Nomenclature of single point cutting tool-System of tool nomenclature and conversion of rake angles-Oblique Cutting - nomenclature of multi point tools like drills, milling-conventional Vs climb milling, mean cross sectional area of chip in milling-specific cutting pressure. Heat distributions in machining - Experimental determination and Analytical calculation of cutting tool temperature - Cutting fluids - Effects of cutting fluid - Functions - Requirements - Types and Selection of Cutting Fluids.

UNIT III	TOOL MATERIALS, TOOL LIFE AND TOOL WEAR	9

Essential requirements of tool materials-development in tool materials-ISO specification for inserts and tool holders-tool life-conventional and accelerated tool life tests-concept of mach inability index-economics of machining.

UNIT IV	WEAR MECHANISMS AND CHATTER IN MACHINING	9

Processing and Machining – Measuring Techniques – Reasons for failure of cutting tools and forms of wear-mechanisms of wear-chatter in machining-factors effecting chatter in machining-types of chatter-mechanism of chatter.

UNIT V	DESIGN OF CUTTING TOOLS	9

Design considerations of Single point and Multi point cutting tools - Design of Turning tool, Drills and Milling cutters.

TOTAL PERIODS	45

OUTCOMES

At the end of the course, the learners will be able to

CO1: To acquire advanced information about the metal cutting theory and to enlarge knowledge in metal cutting theory.

CO2: Select tool materials and cutting fluids for machinability and economics.

CO3: Design the cutting tools for metal removal process.

REFERENCES

1. Boothroid D.G. & Knight W.A., "Fundamentals of machining and machine tools", 3rd Edition, CRC Press, 2005.

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2. Bhattacharyya A., "Metal Cutting Theory and Practice", Central Book Publishers, Calcutta, 1984
3. HajraChouldhary S.K and Hajra Choudhury. AK., "Elements of workshop Technology", volume II, Media promoters 2014.
4. Juneja B L., Sekhon G. S., "Fundamentals of Metal Cutting and Machine Tools", New Age International (P) Limited, 1995
5. Shaw M C., "Metal Cutting Principles", Oxford Press, 1984
6. Armarego E.J.A., Brown R.H., "The Machining of Metals", Prentice Hall Inc., 1969
7. Rodin P., "Design and Production of Cutting Tools", MIR Publishers, 1968

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21MF108	ADDITIVE MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To instruct students with fundamental and advanced knowledge in the field of Additive manufacturing technology
- To learn the concepts of rapid product development, apply acquired knowledge to meet global challenges

UNIT I	INTRODUCTION TO ADDITIVIE MANUFACTURING	8

Importance - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM - Rapid Product Development (RPD) –Product Development Cycle – Detail design– Prototype and tooling - Emerging trends

UNIT II	REVERSE ENGINEERING AND CAD MODELING	9

Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

UNIT III	LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS	10

Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications.

Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

UNIT IV	POWDER BASED ADDITIVE MANUFACTURING SYSTEMS	9

Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

UNIT V	OTHER ADDITIVE MANUFACTURING SYSTEMS	9

Three dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

TOTAL PERIOD	**45**

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OUTCOMES
At the end of the course, the learners will be able to **CO1:** Comprehend the basic concepts of additive manufacturing **CO2:** Apply the concepts of CAD for additive manufacturing **CO3:** Appreciate the various liquid and solid based additive manufacturing techniques **CO4:** Appreciate the various powder based additive manufacturing techniques **CO5:** Contrast the different additive manufacturing systems and their capabilities
REFERENCES
1. C K Chua, K F Leong, C S Lim, "Rapid Prototyping Principles and Applications", World Scientific, New Delhi, 2010. 2. Frank W.Liou, "Rapid Prototyping and Engineering Applications", CRC Press, UK, 2011. 3. Terry wohlers, Wohlers Report 2000, Wohlers Associates, USA, 2000. 4. Chua Chee Kai and Leong Kah Fai, 1997, "Rapid Prototyping: Principles and Applications inManufacturing", John Wiley and Sons 5. Paul F. Jacobs, 1996, "Stereo-lithography and Other RP AND M Technologies": from Rapid Prototyping to Rapid Tooling, SME/ASME 6. D. Faux and M. J. Pratt, 1979, "Computational Geometry for design and manufacture", John Wiley and Sons 7. Pham, D.T. and Dimov.S.S.,"Rapid Manufacturing", Springer-Verlag, London, 2001. 8. Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications, 2003.

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21MF109	FLUID POWER AUTOMATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
- To train the students in designing the hydraulic and pneumatic circuits using various design procedures.

UNIT I	INTRODUCTION	9

Need for Automation, Hydraulic & Pneumatic Comparison – ISO symbols for fluid power elements, Hydraulic, pneumatics – Selection criteria.

UNIT II	FLUID POWER GENERATING/UTILIZING ELEMENTS	9

Hydraulic pumps and motor gears, vane, piston pumps-motors-selection and specification-Drive characteristics – Linear actuator – Types, mounting details, cushioning – power packs – construction. Reservoir capacity, heat dissipation, accumulators – standard circuit symbols, circuit (flow) analysis.

UNIT III	CONTROL AND REGULATION ELEMENTS	9

Typical industrial hydraulic circuits-Design methodology – Ladder diagram-cascade, method-truth table-Karnaugh map method-sequencing circuits-combinational and logic circuit.

UNIT IV	CIRCUIT DESIGN	9

Typical industrial hydraulic circuits-Design methodology – Ladder diagram-cascade, method-truth table-Karnaugh map method-sequencing circuits-combinational and logic circuit.

UNIT V	ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS	9

Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

TOTAL PERIODS	45

OUTCOMES

At the end of the course, the learners will be able to

CO1: To know the basic concepts of Hydraulics and Pneumatics
CO2: To know the concepts of Fluid power generating components.
CO3: To know about the controlling and regulating components.
CO4: To design the hydraulic circuits and its various methodologies.
CO5: To design the electro-pneumatics circuits and electronic controlling methods for hydraulic and pneumatic circuits.

REFERENCES

1. Antony Esposito, “Fluid Power Systems and control” Prentice-Hall, 1988
2. Dudbey. A. Peace, “Basic Fluid Power”, Prentice Hall Inc, 1967.
3. E.C.Fitch and J.B.Suryaatmadyn. “Introduction to fluid logic”, McGraw Hill, 1978
4. Herbert R. Merritt, “Hydraulic control systems”, John Wiley & Sons, Newyork, 1967
5. Peter Rohner, “Fluid Power Logic Circuit Design”, Mcmelan Prem, 1994.
6. Peter Rohner,“Fluid Power logic circuit design”. The Macmillan Press Ltd.,London, 1979

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<table>
<tr><td rowspan="2">21MF110</td><td rowspan="2">ADVANCED MANUFACTURING PROCESSES LABORATORY</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
</table>

OBJECTIVES

- To understand of the various Mechanical, Chemical, Thermal and Electrical based modern machining processes through practical skill set.
- To analyze and observe the principles and its importance.
- To study the major application in manufacture of micro and macro devices.

LIST OF EXPERIMENTS

1. Plate cutting in abrasive water jet machine
2. Micro hole drilling in ECM
3. Model fabrication in simple CNC router
4. 3D model fabrication using RPT
5. Profile cutting using WEDM
6. Ultrasonic welding
7. Ultrasonic machining
8. Ultrasonic cavitations –Stir Casting
9. Squeeze Casting
10. Incremental forming
11. Robot aided Welding

(Any 10 for Conduct of end semester examination)

TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Understand and grasp the significance of modern machining process and its applications through hands-on experience.

CO2: Identify the selection of machining processes and its process parameters.

CO3: Express and perform project related works.

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<table>
<tr><td rowspan="2">21MF111</td><td rowspan="2">CONTEMPORARY MANUFACTURING RESEARCH PRACTICES</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>0</td><td>0</td><td>4</td><td>2</td></tr>
<tr><td colspan="6">OBJECTIVES</td></tr>
<tr><td colspan="6">• To give broad expertise on various research field in mechanical engineering.</td></tr>
<tr><td colspan="6">LIST OF EXPERIMENTS</td></tr>
<tr><td colspan="6">1. Regression Modelling using Minitab
2. ANOVA and Hypothesis testing using Minitab
3. Optimization using Genetic Algorithm in MATLAB
4. Grey Relational Analysis
5. Simulation of Friction Stir/Stud Welding
6. Investigation of Thermal performance in solar power plant
7. Simulation analysis of conduction and convection heat transfer using Computation Fluid Dynamics
8. Case study on health care sector using smart PLS
9. Case study on higher studies in India using smart PLS</td></tr>
<tr><td colspan="4">TOTAL PERIODS</td><td colspan="2">45</td></tr>
<tr><td colspan="6">OUTCOMES</td></tr>
<tr><td colspan="6">At the end of the course, the learners will be able to
CO1: Exhibit knowledge in emerging research fields of mechanical engineering.</td></tr>
</table>

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PROFESSIONAL ELECTIVES FOR M.E. MANUFACTURING ENGINEERING
SEMESTER I, ELECTIVE – I

21MFP01	MATERIAL TESTING AND CHARACTERIZATION TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES

- To provide understanding of techniques of microstructure and crystal structure evaluation of materials
- To introduce tools for analysis of microstructure and surface topography of materials.
- To understand the techniques of chemical and thermal analysis of materials.
- To gain knowledge in various static mechanical testing methods.
- To gain knowledge in various dynamic mechanical testing methods.

UNIT I	MICRO AND CRYSTAL STRUCTURE ANALYSIS	9

Principles of Optical Microscopy – Specimen Preparation Techniques – Polishing and Etching – Polarization Techniques – Quantitative Metallography – Estimation of grain size – ASTM grain size numbers – Microstructure of Engineering Materials - Elements of Crystallography – X- ray Diffraction – Bragg‘s law – Techniques of X-ray Crystallography – Debye – Scherer camera – Geiger Diffractometer – analysis of Diffraction patterns – Inter planer spacing – Identification of Crystal Structure, Elements of Electron Diffraction – Estimation of residual stress and grain size.

UNIT II	ELECTRON MICROSCOPY	9

Interaction of Electron Beam with Materials – Transmission Electron Microscopy – Specimen Preparation – Imaging Techniques – BF and DF – SAD – Electron Probe Microanalysis – Scanning Electron Microscopy – Construction and working of SEM and FESEM Back scattered and Secondary Electron Imaging Techniques – Applications- Atomic Force Microscopy- Construction and working of AFM - Contact and Non-Contact modes Applications.

UNIT III	CHEMICAL AND THERMAL ANALYSIS	9

Basic Principles, Practice and Applications of X-Ray Spectrometry, Energy dispersive and Wave Dispersive X-Ray Spectrometry, Auger Spectroscopy, Secondary Ion Mass Spectroscopy, Fourier Transform Infra-Red Spectroscopy (FTIR)- Proton Induced X-Ray Emission Spectroscopy, Differential Thermal Analysis, Differential Scanning Calorimetry (DSC) And Thermo Gravity metric Analysis (TGA) - Dynamic Mechanical Analysis (DMA)

UNIT IV	MECHANICAL TESTING – STATIC TESTS	9

Hardness – Brinell, Vickers, Rockwell and Micro Hardness Test, Rebound hardness and Indendation – Tensile Test – Stress – Strain plot – Proof Stress – Torsion Test - Ductility Measurement – Impact Test – Charpy and Izod – DWTT - Fracture Toughness Test, Codes and standards for testing metallic and composite materials.

UNIT V	MECHANICAL TESTING – DYNAMIC TESTS	9

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Fatigue – Low and High Cycle Fatigues – Rotating Beam and Plate Bending HCF tests – S-N curve – LCF tests – Crack Growth studies – Creep Tests – LM parameters – AE Tests-modal analysis - Applications of Dynamic Tests – Fatigue life estimation.

TOTAL PERIODS | **45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Identify the techniques for analysis of microstructure and crystal structure.

CO2: Recognize the fundamentals of electron microscopy in material testing and characterization.

CO3: Understand the procedures in chemical and thermal analysis of materials.

CO4: Summarize the various static mechanical testing techniques.

CO5: Summarize the various dynamic mechanical testing techniques.

REFERENCES

1. Angelo P C, "Material characterization", Cengage Learning India, 2016.
2. Bhargava A.K, "Mechanical Behaviour and Testing of Materials", 2011
3. Cullity B.D., Stock S.R and Stock S., "Elements of X ray Diffraction", 3rd Edition. Prentice Hall, 2018.
4. Skoog, Holler and Nieman, "Principles of Instrumental Analysis", 7th edition, Cengage Learning, 2017.
5. Suryanarayana A. V. K., "Testing of metallic materialism's", 2nd Edition, 2007.
6. Suryanarayana C, "Experimental Techniques in materials and Mechanics", CRC Press, 1stEdition,2011.
7. Yang Leng, Materials Characterization: "Introduction to Microscopic and Spectroscopic Methods", Hong Kong University Of Science And Technology, John Wiley and Sons (Asia) Pte Ltd., 2ndEdition, 2013.

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21MFP02	DESIGN FOR MANUFACTURE AND ASSEMBLY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To make the students learn about tolerance analysis, allocation and geometrical tolerances.
- Guidelines for design for manufacturing and assembly with examples.

UNIT I	**TOLERANCE ANALYSIS**	**9**

Introduction – Concepts, definitions and relationships of tolerancing – Matching design tolerances with appropriate manufacturing process – manufacturing process capability metrics – Worst care, statistical tolerance Analysis – Linear and Non-Linear Analysis – Sensitivity Analysis – Taguchi's Approach to tolerance design.

UNIT II	**TOLERANCE ALLOCATION**	**9**

Tolerance synthesis – Computer Aided tolerancing – Traditional cost based analysis – Taguchi's quality loss function – Application of the Quadratic loss function to Tolerancing – Principles of selective Assembly – Problems.

UNIT III	**GD&T**	**9**

Fundamentals of geometric dimensioning and tolerancing – Rules and concepts of GD&T – Form controls – Datum systems – Orientation controls – Tolerance of position – Concentricity and symmetry controls – Run out controls – Profile controls.

UNIT IV	**TOLERANCE CHARTING**	**9**

Nature of the tolerance buildup – structure and setup of the tolerance chart – piece part sketches for tolerance charts – Arithmetic ground rules for tolerance charts – Determination of Required balance dimensions – Determination of Mean working Dimensions – Automatic tolerance charting – Tolerance charting of Angular surfaces.

UNIT V	**MANUFACTURING GUIDELINES**	**9**

DFM guidelines for casting, weldment design – Formed metal components – Turned parts – Milled, Drilled parts – Non metallic parts – Computer Aided DFM software – Boothroyd and Dewhurst method of DFMA – DCS – Vis/VSA – 3D Dimensional control – Statistical tolerance Analysis Software – Applications.

	TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: To impart the knowledge about the significance of design for manufacturing and assembly.

REFERENCES

1. Alex Krulikowski, "Fundamentals GD&T", Delmar Thomson Learning, 1997
2. C.M. Creveling, "Tolerance Design – A handbook for Developing Optimal Specifications", Addison – Wesley, 1997.
3. James D. Meadows, 'Geometric Dimensioning and Tolerancing", Marcel Dekker Inc., 1995.

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21MFP03	MICRO MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- The objective of the course is to acquaint the students with the principles, basic machine tools, and developments in the micro manufacturing process and research trends in the area of micro manufacturing process.

UNIT I	MICRO MACHINING I	10

Mechanical Micro machining – Ultra Sonic Micro Machining – Abrasive Jet Micro Machining – Water Jet Micro Machining – Abrasive Water Jet Micro Machining – Micro turning – Chemical and Electro Chemical Micro Machining – Electric discharge micro machining.

UNIT II	MICRO MACHINING II	10

Beam Energy based micro machining – Electron Beam Micro Machining – Laser Beam Micro Machining – Electric Discharge Micro Machining – Ion Beam Micro Machining –Plasma Beam Micro Machining – Hybrid Micro machining – Electro Discharge Grinding – Electro Chemical spark micro machining – Electrolytic in process Dressing.

UNIT III	NANO POLISHING	9

Abrasive Flow finishing – Magnetic Abrasive Finishing – Magneto rheological finishing – Magneto Rheological abrasive flow finishing - Magnetic Float polishing – Elastic Emission Machining – chemomechanical Polishing.

UNIT IV	MICRO FORMING AND WELDING	9

Micro extrusion – Micro and Nano structured surface development by Nano plastic forming and Roller Imprinting – Micro bending with LASER – LASER micro welding – Electron beam for micro welding.

UNIT V	RECENT TRENDS AND APPLICATIONS	7

Metrology for micro machined components – Ductile regime machining– AE based tool wear compensation– Machining of Micro gear, micro nozzle, micro pins – Applications.

TOTAL PERIODS	45

OUTCOMES

At the end of the course, the learners will be able to

CO1: Describe the various mechanical Micro machining Process.
CO2: Describe the various Energy based Micro machining Process.
CO3: Identify the importance of Nano Polishing Process.
CO4: Explain the Micro forming and welding Process.
CO5: Describe the recent trends and applications in Micro manufacturing.

REFERENCES

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2. Bharat Bhushan, “Handbook of nanotechnology”, springer, Germany, 2010.
3. Jain V.K., ‘Introduction to Micro machining’ Narosa Publishing House, 2011.
4. Jain V.K., “Advanced Machining Processes”, Allied Publishers, Delhi, 2002
5. Jain V. K., “Micro Manufacturing Processes”, CRC Press, Taylor & Francis Group, 2012
6. Janocha H., Actuators – “Basics and applications”, Springer publishers – 2012

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BoS Chairman

21MFP04	MANUFACTURING PROCESS PLANNING AND COST ESTIMATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concepts of manufacturing process planning.
- To familiarize the idea of cost accounting and information.
- To develop estimation skills in estimating material and labour cost.
- To introduce concepts of depreciation and different methods of depreciation.
- To develop estimation skills in estimating cost of manufactured product such as casting,
- welding, forging, machining.

UNIT I	PROCESS PLANNING	9

Process planning– Aims– Information required– Techniques of process planning – Questionnaire method– Key functional analysis– preparation of processor planning operation sheets– Routing– Process selection– Break even analysis.

UNIT II	COST ESTIMATION AND ACCOUNTING	9

Cost estimation- aims and objectives - cost accounting - aims and accounting - Difference between estimation and accounting - Realistic estimation - Estimation procedure - Elements of cost – Material cost - labour cost-expenses overheads - Factory overheads - Administrative overheads – selling and distribution overheads – components of cost.

UNIT III	ESTIMATION OF MATERIAL AND LABOR COST	9

Material cost estimation – Procedure – Mensuration formulae – Estimation of material cost for different jobs of varying geometries such as casting, forging., Estimation of labour cost –set up time – Tear down time – operation time – Machining time – Time allowances – Relaxation allowances – Personnel allowances – Allowances specific

UNIT IV	DEPRECIATION	9

Depreciation – Definition – causes of depreciation – Methods of depreciation – Straight line Method – Declining balance method – sum of the years digit method – sinking fund method- Annuity method – Repair provision method.

UNIT V	ESTIMATION OF COST FOR MANUFACTURING PROCESS	9

Estimation of cost for forging, welding - Estimation of cost for foundry – Estimation of machining time for various machining operations such as Turning , Drilling, Reaming, Milling, Grinding, Boring, Shaping, Planning operations etc.,

TOTAL PERIODS 45

OUTCOMES

At the end of the course, the learners will be able to

CO1: Design a suitable manufacturing planning sheet for a manufactured product.
CO2: Arrive at cost of manufactured product in stages.
CO3: Estimate material and labour cost.
CO4: Identify a suitable method for depreciation.
CO5: Estimate cost or manufactured product such as casting, welding, forging, machined

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component.
REFERENCES
1. Kesavan R, Elanchezhiyan and C, Vijayaramnath B, "Process planning and cost estimation" New age International, Delhi-2009 2. Narang GBS, "Production and Costing" – Khanna publications – 1991 3. Adithan M, "Process planning and cost estimations", New age, 2007. 4. Charles T, Honegran, Srikant M Dater, Madhav V Rajan, "Cost Accounting", Pearson, 2015. 5. Pannerselvam R, Sivasankaran P, "Process planning and cost estimation", PHI-2016. 6. Peter Scales, "Process Planning", Butterworth, 2003.

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BoS Chairman

21MFP05	MATERIALS MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce to the students the various concepts of materials management

UNIT I	**INTRODUCTION**	**9**
Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.		
UNIT II	**MANAGEMENT OF PURCHASE**	**9**
Purchasing policies and procedures – Selection of sources of supply – Vendor development – Vendor evaluation and rating – Methods of purchasing – Imports – Buyer – Seller relationship – Negotiations.		
UNIT III	**MANAGEMENT OF STORES AND LOGISTICS**	**9**
Stores function – Location – Layout – Stock taking – Materials handling – Transportation – Insurance – Codification – Inventory pricing – stores management – safety – warehousing – Distribution linear programming – Traveling Salesman problems – Network analysis – Logistics Management.		
UNIT IV	**MATERIALS PLANNING**	**9**
Forecasting – Materials requirements planning – Quantity – Periodic – Deterministic models – Finite production.		
UNIT V	**INVENTORY MANAGEMENT**	**9**
ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.		
	TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Familiarized with the various concepts and functions of material management, so that the students will be in a position to manage the materials management department Independently.

REFERENCES

1. Dr. R. Kesavan, C.Elanchezian and T.SundarSelwyn, “Engineering Management”, – Eswar Press – 2005.
2. Dr.R. Kesavan, C.Elanchezian and B.Vijaya Ramnath, “Production Planning and Control”, Anuratha Publications, Chennai, 2008.
3. G. Reghuram, N. Rangaraj, “Logistics and supply chain management – cases and concepts”, Macmillan India Ltd., 2006.
4. Gopalakrishnan.P, “Handbook of Materials Management”, Prentice Hall of India, 2005.
5. Guptha P.K. and Heera, “Operations Research”, Suttan Chand & Sons, 2007.
6. Lamer Lee and Donald W.Dobler, “Purchasing and Material Management”, Text and cases, Tata McGraw Hill, 2006.

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21MFP06	INDUSTRIAL ERGONOMICS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the concepts of Ergonomics and to indicate the areas of Applications.

UNIT I	**INTRODUCTION**	**9**

Concepts of human factors engineering and ergonomics – Man – machine system and design philosophy – Physical work – Heat stress – manual lifting – work posture – repetitive motion

UNIT II	**ANTHROPOMETRY**	**9**

Physical dimensions of the human body as a working machine – Motion size relationships – Static and dynamic anthropometry – Anthropometric aids – Design principles – Using anthropometric Measures for industrial design – Procedure for anthropometric design.

UNIT III	**DESIGN OF SYSTEMS**	**9**

Displays – Controls – Workplace – Seating – Work process – Duration and rest periods – Hand tool Design – Design of visual displays – Design for shift work.

UNIT IV	**ENVIRONMENTAL FACTORS IN DESIGN**	**10**

Temperature – Humidity – Noise – Illumination –Vibration – Measurement of illumination and contrast – use of photometers – Recommended illumination levels. The ageing eye – Use of indirect (reflected) lighting – cost efficiency of illumination – special purpose lighting for inspection and quality control – Measurement of sound – Noise exposure and hearing loss – Hearing protectors – analysis and reduction of noise – Effects of Noise on performance – annoyance of noise and interference with communication – sources of vibration discomfort

UNIT V	**WORK PHYSIOLOGY**	**8**

Provision of energy for muscular work – Role of oxygen physical exertion – Measurement of energy expenditure Respiration – Pulse rate and blood pressure during physical work – Physical work capacity and its evaluation

TOTAL PERIOD	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Develop the knowledge of mechanism of failure of materials and methods.
CO2: Apply the material property to suit the specific requirements.
CO3: Select the existing materials and development of upcoming new materials.
CO4: Select the various non-metallic materials to suit required applications.
CO5: Identify and select suitable material for relevant application.

REFERENCES

1. Khan M. I, “Industrial Ergonomics”, Prentice Hall India Learning Private Limited, 2021.
2. E.J. McCormic & Mark S. Sangers, “Human factors in engineering design”, McGraw Hill 2018
3. Martin Helander, “A guide to the ergonomics of manufacturing”, East West press, 2017
4. R.S. Bridger “Introduction to Ergonomics”, McGraw Hill, 2014

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21MFP07	NON DESTRUCTIVE EVALUATION	L	T	P	C
		3	0	0	3

OBJECTIVES:

The general objectives of the course are to enable the students to,

- To study and understand the various Non-Destructive Evaluation and Testing methods, theory and their industrial applications.

UNIT I	OVERVIEW OF NDT	7

NDT Versus Mechanical testing, Overview of the Non Destructive Testing Methods for the detection of manufacturing defects as well as material characterization. Relative merits and limitations, various physical characteristics of materials and their applications in NDT. Visual inspection – Unaided and aided.

UNIT II	SURFACE NDE METHODS	8

Liquid Penetrant Testing - Principles, types and properties of liquid penetrants, developers, advantages and limitations of various methods, Testing Procedure, Interpretation of results. Magnetic Particle Testing- Theory of magnetism, inspection materials Magnetization methods, Interpretation and evaluation of test indications, Principles and methods of demagnetization, Residual magnetism.

UNIT III	THERMOGRAPHY AND EDDY CURRENT TESTING (ET)	10

Thermography- Principles, Contact and non-contact inspection methods, Techniques for applying liquid crystals, Advantages and limitation - infrared radiation and infrared detectors, Instrumentations and methods, applications. Eddy Current Testing-Generation of eddy currents, Properties of eddy currents, Eddy current sensing elements, Probes, Instrumentation, Types of arrangement, Applications, advantages, Limitations, Interpretation/Evaluation.

UNIT IV	ULTRASONIC TESTING (UT) AND ACOUSTIC EMISSION (AE)	10

Ultrasonic Testing-Principle, Transducers, transmission and pulse-echo method, straight beam and angle beam, instrumentation, data representation, A/Scan, B-scan, C-scan. Phased Array Ultrasound, Time of Flight Diffraction. Acoustic Emission Technique –Principle, AE parameters, Applications

UNIT V	RADIOGRAPHY (RT)	10

Principle, interaction of X-Ray with matter, imaging, film and film less techniques, types and use of filters and screens, geometric factors, Inverse square, law, characteristics of films - graininess, density, speed, contrast, characteristic curves, Penetrometers, Exposure charts, Radiographic equivalence. Fluoroscopy- Xero-Radiography, Computed Radiography, Computed Tomography

TOTAL PERIOD	45

OUTCOMES

At the end of the course, the learners will be able to

CO1: Demonstrate the Visual Inspection methods

CO2: Demonstrate the Surface nondestructive Testing methods

CO3: Explain the Thermography and Eddy Current Testing methods

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CO4:	Explain the Ultrasonic testing and Acoustic Emission methods
CO5:	Demonstrate the Radiography testing methods

REFERENCES

1. Baldev Raj, T. Jayakumar, M. Thavasimuthu "Practical Non-Destructive Testing", Narosa Publishing House, 2009.
2. Ravi Prakash, "Non-Destructive Testing Techniques", 1st revised edition, New Age International Publishers, 2010
3. ASM Metals Handbook, "Non-Destructive Evaluation and Quality Control", American Society of Metals, Metals Park, Ohio, USA, 200, Volume-17.
4. Paul E Mix, "Introduction to Non-destructive testing: a training guide", Wiley, 2nd Edition New Jersey, 2005
5. Charles, J. Hellier, "Handbook of Nondestructive evaluation", McGraw Hill, New York 2001.
6. ASNT, "American Society for Non Destructive Testing", Columbus, Ohio, NDT Handbook, Vol. 1, Leak Testing, Vol. 2, Liquid Penetrant Testing, Vol. 3, Infrared and Thermal Testing Vol. 4, Radiographic Testing, Vol. 5, Electromagnetic Testing, Vol. 6, Acoustic Emission Testing, Vol. 7, Ultrasonic Testing

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21MFP08	QUALITY AND RELIABILITY ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the approaches and techniques to assess quality by statistical process control.
- To study the methodology to assess and sampling of parameters.
- To introduce to experimental design and Taguchi method.
- To illustrate the students the concepts of reliability engineering tools.
- To train students the design for reliability and maintainability.

UNIT I	**QUALITY AND STATISTICAL PROCESS CONTROL**	**8**

Quality – Definition – Quality Assurance – Variation in process – Factors – process capability – control charts – variables X, R and X, - Attributes P, C and U-Chart tolerance design. Establishing and interpreting control charts – charts for variables – Quality rating – Short run SPC.

UNIT II	**ACCEPTANCE SAMPLING**	**8**

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer‘s risk and consumer‘s risk. AQL, LTPD, AOQL, Concepts – standard sampling plans for AQL and LTPD – use of standard sampling plans.

UNIT III	**EXPERIMENTAL DESIGN AND TAGUCHI METHOD**	**9**

Fundamentals – factorial experiments – random design, Latin square design – Taguchi method – Loss function – experiments – S/N ratio and performance measure – Orthogonal array.

UNIT IV	**CONCEPT OF RELIABILITY AND DESIGN**	**9**

Definition – reliability vs quality, reliability function – MTBF, MTTR, availability, bathtub curve – time dependent failure models – distributions – normal, Weibull, lognormal – Reliability of system and models – serial, parallel and combined configuration – Markove analysis, load sharing systems, standby systems, covariant models, static models, dynamic models

UNIT V	**DESIGN FOR RELIABILITY AND MAINTAINABILITY**	**11**

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.

TOTAL PERIODS	**45**

OUTCOMES

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At the end of the course, the learners will be able to
CO1: Understand the basic techniques of quality improvement, fundamental knowledge of statistics and probability and use control charts. **CO2:** Describe different sampling plans. **CO3:** Solve problems by various design methods. **CO4:** Acquire basic knowledge of reliability. **CO5:** Implement the concepts of reliability and maintainability.
REFERENCES
1. Amitava Mitra, Fundamentals of Quality Control and Improvement, 4th Edition, Pearson Education, 2016. 2. Charles E Ebling, "An Introduction to Reliability and Maintainability Engineering", Tata-McGraw Hill, 2018 3. David J Smith, Reliability, Maintainability and Risk: Practical Methods for Engineers, Butterworth 2010. 4. Dhillon, Engineering Maintainability – "How to design for reliability and easy maintenance", PHI, 2008. 5. Kesavan R, Elanchezlian C, Vijayaramanath B, "Total quality Management" – I.K. Industrial publication, Delhi – 2013. 6. Patrick D T O'Connor, "Practical Reliability Engineering", 4th Edition, John-Wiley and Sons Inc, 2012.

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21MFP09	LEAN MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the various tools for lean manufacturing (LM).
- To apply the above tools to implement LM system in an organization.

UNIT I	INTRODUCTION TO LEAN MANUFACTURING	9

Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT II	CELLULAR MANUFACTURING, JIT, TPM	9

Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT III	SET UP TIME REDUCTION, TQM, 5S, VSM	9

Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

UNIT IV	SIX SIGMA	9

Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation.

UNIT V	CASE STUDIES	9

Various case studies of implementation of lean manufacturing at industries.

TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Outline the various Lean Manufacturing tools and its applications.
CO2: Explain the lean tools for productivity improvements.
CO3: Illustrate the concepts to reduce the process time.
CO4: Describe the implementation process of Six Sigma.
CO5: Recommend and justify suitable Lean Tools for the identified cases.

REFERENCES

1. "Design and Analysis of Lean Production Systems", Ronald G. Askin & Jeffrey B. Goldberg, John Wiley & Sons, 2003.
2. Mikell P. Groover (2002) _ "Automation, Production Systems and CIM".
3. Rother M. and Shook J, 1999 "Learning to See: Value Stream Mapping to Add Value and Eliminate Muda", Lean Enterprise Institute, Brookline, MA.

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21MFP10	FLEXIBLE MANUFACTURING SYSTEM	L	T	P	C
		3	0	0	3

OBJECTIVES

- Ability to perform Planning, Scheduling and control of Flexible Manufacturing systems.
- Perform simulation on software's use of group technology to product classification.

UNIT I	PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS	9

Introduction to FMS– development of manufacturing systems – benefits – major elements – types of flexibility – FMS application and flexibility – single product, single batch, n – batch scheduling problem – knowledge based scheduling system.

UNIT II	COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS	9

Introduction – composition of FMS – hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – trends.

UNIT III	FMS SIMULATION AND DATA BASE	9

Application of simulation–model of FMS–simulation software – limitation – manufacturing data systems – data flow – FMS database systems–planning for FMS database.

UNIT IV	GROUP TECHNOLOGY AND JUSTIFICATION OF FMS	9

Introduction – matrix formulation – mathematical programming formulation – graph formulation – knowledge based system for group technology – economic justification of FMS - application of possibility distributions in FMS systems justification.

UNIT V	APPLICATIONS OF FMS AND FACTORY OF THE FUTURE	9

FMS application in machining, sheet metal fabrication, prismatic component production – aerospace application – FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics for future.

TOTAL PERIODS 45

OUTCOMES

At the end of the course, the learners will be able to

CO1: Demonstrate Planning, Scheduling and Control of FMS.
CO2: Explain about the Computer Control and Software for FMS.
CO3: Examine FMS Simulation and Database.
CO4: Apply the concepts of Group Technology and Justification of FMS.
CO5: Explain the applications of FMS and Factory of the Future.

REFERENCES

1. Radhakrishnan P. and Subramanyan S., "CAD/CAM/CIM", Wiley Eastern Ltd.,New Age International Ltd., 1994.
2. Raouf, A. and Ben-Daya, M., Editors, "Flexible manufacturing systems: recent development", Elsevier Science, 1995.

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3. Groover M.P., “Automation, production systems and computer integrated manufacturing”, Prentice Hall of India Pvt., New Delhi, 1996.
4. Kalpakjian, “Manufacturing engineering and technology”, Addison-Wesley Publishing Co., 1995.
5. Taiichi Ohno, “Toyota production system: beyond large-scale production”, Productivity Press (India) Pvt. Ltd. 1992.
6. Jha, N.K. “Handbook of flexible manufacturing systems”, Academic Press Inc.,1991.

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BoS Chairman

21MFP11	MEMS AND NANOTECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To inspire the students to expect to the trends in manufacturing of micro components and measuring systems to nano scale.

UNIT I	OVER VIEW OF MEMS AND MICROSYSTEMS	9

Definition – historical development – properties, design and fabrication micro-system, microelectronics, working principle ,applications and advantages of micro system. Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds - silicon piezo resistors, Galium arsenide, quartz, polymers for MEMS, conductive polymers.

UNIT II	FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING	9

Photolithography, photo resist applications, light sources, ion implantation, diffusion–Oxidation - thermal oxidation, silicon dioxide, chemical vapour deposition, sputtering - deposition by epitaxy – etching – bulk and surface machining – LIGA process – LASER, Electron beam ,Ion beam processes – Mask less lithography. Micro system packaging –packaging design– levels of micro system packaging -die level, device level and system level – interfaces in packaging – packaging technologies- Assembly of Microsystems

UNIT III	MICRO DEVICES	9

Sensors – classification – signal conversion ideal characterization of sensors micro actuators, mechanical sensors – measurands - displacement sensors, pressure sensor, flow sensors, Accelerometer , chemical and bio sensor - sensitivity, reliability and response of micro-sensor - micro actuators – applications.

UNIT IV	SCIENCE AND SYNTHESIS OF NANO MATERIALS	9

Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source-based production techniques – Gaseous carbon source-based production techniques – Diamond like carbon coating. Top down and bottom-up processes.

UNIT V	CHARACTERIZATION OF NANO MATERIALS	9

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

TOTAL PERIODS	**45**

OUTCOMES

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At the end of the course, the learners will be able to

CO1: Describe the concepts of MEMS and microsystems.

CO2: Explain the various fabrication processes and microsystem packaging.

CO3: Classify the micro devices.

CO4: Explain the science and synthesis of nanomaterials.

CO5: Discuss characterization of nanomaterials.

REFERENCES

1. Charles P Poole, Frank J Owens, "Introduction to Nano technology", John Wiley and Sons, 2003
2. Julian W. Hardner "Micro Sensors, Principles and Applications", CRC Press 1993.
3. Mohamed Gad-el-Hak, "MEMS Handbook", CRC press, 2006, ISBN : 8493-9138-5
4. Norio Taniguchi, Nano Technology, Oxford University Press, New York, 2003
5. Sami Franssila, "Introduction to Micro fabrication", John Wiley & sons Ltd, 2004. ISBN:470-85106-6
6. Tai – Ran Hsu, "MEMS and Microsystems Design and Manufacture", Tata-McGraw Hill, New Delhi, 2002.
7. Waqar Ahmed and Mark J. Jackson, "Emerging Nanotechnologies for Manufacturing", Elsevier Inc.,2013,ISBN : 978-93-82291-39-8

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BoS Chairman

21MFP12	SUSTAINABLE MANUFACTURING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concept of Green Manufacturing to the students

UNIT I	AIR POLLUTION SAMPLING AND MEASUREMENT	5

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants-solution to the atmosphere dispersion equation-the Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dixide, carbon monoxide, oxidants and ozone.

UNIT II	NOISE POLLUTION & CONTROL	10

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise-Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects.

UNIT III	WATER DEMAND, WATER QUALITY	10

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues.

UNIT IV	FIRE SAFETY	10

Basic Elements, Causes, Industrial Fires, Explosions, Effects on Environmental, Property & Human Loss, Prevention technique, Building Design, Fire Protection System, contingency plan, Emergency preparedness, Evacuation.

UNIT V	SAFETY RADIATION PROTECTION	10

Radiation fundamentals-Types of radiation lonizing and Non-lonizing radiation, their uses and biological effects. Radioactive waste disposal radioactive soil, water and air and their fate. Treatment and disposal Liquid and solid Radioactive wastes

TOTAL PERIODS	45

OUTCOMES

At the end of the course, the learners will be able to

CO1: It will create the awareness of air and noise pollution and methods of measurements and control

CO2: It will impart the knowledge of fire safety and its protection

REFERENCES

1. Dornfield David, "Green Manufacturing", Springer, 2012
2. Davim. J.Pauls, "Green Manufacturing Processes and Systems", Springer, 2013
3. Cairncrss and Francis – "Costing the earth" – Harvard Business School Press – 2009.

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21MFP13	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I	INTRODUCTION	9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II	REINFORCEMENTS	9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III	MANUFACTURING OF METAL MATRIX COMPOSITES	9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV	MANUFACTURING OF POLYMER MATRIX COMPOSITES	9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V	STRENGTH	9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Describe the characteristics of composite materials and effect of reinforcement in composite materials.
CO2: Identify the various reinforcements used in composite materials.
CO3: Understand the manufacturing processes of metal matrix composites.
CO4: Understand the manufacturing processes of polymer matrix composites.
CO5: Analyze the strength of composite materials.

REFERENCES

1. Cahn R.W. – “Material Science and Technology” – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., “Materials Science and Engineering, An introduction”, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., “Composite Materials”, 2013.

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21MFP14	COMPUTER AIDED PRODUCT DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the computer aided modeling and various concepts of product design.

UNIT I	INTRODUCTION	8

Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware & Peripherals – software packages for design and drafting.

UNIT II	COMPUTER GRAPHICS FUNDAMENTALS AND GEOMETRIC MODEL	8

Computer graphics – applications – principals of interactive computer graphics – 2D 3D transformations – projections – curves - Geometric Modeling – types – Wire frame surface and solid modeling – Boundary Representation, constructive solid geometry – Graphics standards – assembly modeling – use of software packages.

UNIT III	PRODUCT DESIGN CONCEPTS AND PRODUCT DATA MANAGEMENT	10

Understanding customer needs – Product function modeling – Function trees and function structures – Product tear down methods – Bench marking – Product port folio – concept generation and selection – Product Data Management – concepts – Collaborative product design– manufacturing planning factor – Customization factor – Product life cycle management.

UNIT IV	PRODUCT DESIGN TOOLS & TECHNIQUES	10

Product modeling – types of product models; product development process tools – TRIZ – Altshuller's inventive principles – Modeling of product metrics – Design for reliability – design for manufacturability – machining, casting, and metal forming – design for assembly and disassembly - Design for environment.

UNIT V	PRODUCT DESIGN TECHNIQUES	9

FMEA – QFD – Poka Yoke - DOE – Taguchi method of DOE – Quality loss functions – Design for product life cycle.

	TOTAL PERIODS	45

OUTCOMES

At the end of the course, the learners will be able to

CO1: Understand and appreciate use of computer in product development.
CO2: Analyze geometric transformations.
CO3: use a PDM/PLM system for product design.
CO4: Understand the methods DFM (Design for Manufacturing) and DFE (Design for the Environment) in product development.
CO5: Analyze the software packages for product life cycle management.

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3. David F.Rogers.J, Alan Adams, “Mathematical Elements for Computer Graphics”, McGraw Hill, 1990
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21MFP15	MANUFACTURING MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To introduce the concepts of manufacturing management and various manufacturing management functions to the students.

UNIT I	PLANT ENGINEERING	9

Plant location – Factors affecting plant location – Techniques – Plant layout - principles - Types – Comparison of layouts – Materials handling – Principles – Factors affecting selection of Materials handling system – Types of materials handling systems – Techniques.

UNIT II	WORK STUDY	9

Method study – Principles of motion economy – steps in method study – Tool and Techniques – Work measurement – Purpose – stop watch time study – Production studies – work sampling – Ergonomics – Value analysis

UNIT III	PROCESS PLANNING AND FORECASTING	9

Process planning – Aims of process planning – steps to prepare the detailed work sheets for manufacturing a given component – Break even analysis – Forecasting – Purpose of forecasting – Methods of forecasting – Time series – Regression and Correlation – Exponential smoothing.

UNIT IV	SCHEDULING AND PROJECT MANAGEMENT	9

Scheduling – Priority rules for scheduling – sequencing – Johnson's algorithm for job sequencing – n job M machine problems – Project Network analysis – PERT/CPM – Critical path –Floats – Resource leveling – Queuing analysis.

UNIT V	PERSONNEL AND MARKETING MANAGEMENT	9

Principles of Management – Functions of personnel management – Recruitment – Training – Motivation – Communication – conflicts – Industrial relations – Trade Union – Functions of marketing – Sales promotion methods – Advertising – Product packaging – Distribution channels – Market research and techniques.

	TOTAL PERIODS	45

OUTCOMES

At the end of the course, the learners will be able to

CO1: Choosing the plant layout and material handling systems.
CO2: Execute work study and time study for manufacturing activities.
CO3: Preparing process planning and forecast analysis.
CO4: Sketch the scheduling and sequencing the work activities.
CO5: Integrating personnel management, Industrial relations and marketing.

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2. Dr. R. Kesavan, C.Elanchezian and B.Vijayaramnath, "Production Planning and Control", Anuratha Publications, Chennai – 2008
3. Dr. R. Kesavan,C. Elanchezian and T.Sundar Selwyn, "Engineering Management" – Eswar Press, Chennai – 2005
4. Martand T. Telsang, "Production Management", S.Chand & Co., 2007

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21MFP16	NANO TECHNOLOGY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To expose the students to the evolution of Nano systems, to the various fabrication techniques.
- Also to impart knowledge to the students about Nano materials and various Nano measurements techniques.

UNIT I	OVER VIEW OF NANOTECHNOLOGY	6

Definition – historical development – properties, design and fabrication Nano systems, working principle, applications and advantages of nano system. Nanomaterial – ordered oxides – Nano arrays – potential health effects.

UNIT II	NANODEFECTS, NANO PARTILES AND NANOLAYERS	8

Nanodefects in crystals – applications – Nuclear Track nano defects. Fabrication of nano particles – LASER ablation – sol gels – precipitation of quantum dots. Nano layers – PVD, CVD, Epitaxy and ion implantation – formation of Silicon oxide- chemical composition – doping properties – optical properties.

UNIT III	NANOSTRUCTURING	8

Nano photolithography – introduction – techniques – optical – electron beam – ion beam – X-ray and Synchrotron – nanolithography for microelectronic industry – nanopolishign of Diamond – Etching of Nano structures – Nano imprinting technology – Focused ion beams - LASER interference Lithography Nano arrays –Near-Field Optics - case studies and Trends.

UNIT IV	SCIENCE AND SYNTHESIS OF NANO MATERIALS	12

Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture Nanoparticles, Sol-Gel Synthesis, Inert Gas Condensation, High energy Ball Milling, Plasma Synthesis, Electro deposition and other techniques. Synthesis of Carbon nanotubes – Solid carbon source based production techniques – Gaseous carbon source based production techniques – Diamond like carbon coating. Top down and bottom up processes.

UNIT V	CHARACTERIZATION OF NANO MATERIALS	11

Nano-processing systems – Nano measuring systems – characterization – analytical imaging techniques – microscopy techniques, electron microscopy scanning electron microscopy, confocal LASER scanning microscopy - transmission electron microscopy, transmission electron microscopy, scanning tunneling microscopy, atomic force microscopy, diffraction techniques – spectroscopy techniques – Raman spectroscopy, 3D surface analysis – Mechanical, Magnetic and thermal properties – Nano positioning systems.

TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

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CO1:	Summarize the concept of fabrication of nano systems
CO2:	Discuss about the nano defects and various doping methods.
CO3:	Demonstrate the principles in nanolithography techniques.
CO4:	Categorize the various synthesis process of Nano materials.
CO5:	Recognize the fundamentals of different characterization techniques in Nanomaterial.

REFERENCES

1. Charles P Poole, Frank J Owens, “Introduction to Nano technology”, John Wiley and Sons, 2003
2. Fahrner W.R., “Nanotechnology and Nanoelectronics”, Springer (India) Private Ltd., 2011.
3. Julian W. Hardner Micro Sensors, “Principles and Applications”, CRC Press 1993.
4. Mark Madou, “Fundamentals of Micro fabrication”, CRC Press, New York, 1997.
5. Mohamed Gad-el-Hak, “MEMS Handbook”, CRC press, 2006, ISBN : 8493-9138-5
6. Norio Taniguchi, “Nano Technology”, Oxford University Press, New York, 2003
7. Sami Franssila, “Introduction to Micro fabrication”, John Wiley & sons Ltd, 2004. ISBN: 470-85106-6.
8. Tai – Ran Hsu, “MEMS and Microsystems Design and Manufacture”, Tata-McGraw Hill, New Delhi, 2002.
9. Waqar Ahmed and Mark J. Jackson, “Emerging Nanotechnologies for Manufacturing”, Elsevier Inc.,2013,ISBN : 978-93-82291-39-8

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21MFP17	FINITE ELEMENT METHODS FOR MANUFACTURING ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To study the fundamentals of one dimensional and two dimensional problems using FEA in manufacturing.

UNIT I	INTRODUCTION	6

Fundamentals – Initial, boundary and Eigen value problems – weighted residual, Galerkin's and Rayleigh Ritz methods - Integration by parts – Basics of variational formulation – Polynomial and Nodal approximation.

UNIT II	ONE DIMENSIONAL ANALYSIS	10

Steps in FEM – Discretization. Interpolation, derivation of elements characteristic matrix, shape function, assembly and imposition of boundary conditions-solution and post processing – One dimensional analysis in solid mechanics and heat transfer.

UNIT III	TWO DIMENSIONAL ANALYSIS AND HIGHER ORDER FORMULATIONS	10

Shape functions for one and two dimensional elements- Three noded triangular and four nodded quadrilateral element Global and natural co-ordinates – Non-linear analysis – Isoparametric elements – Jacobian matrices and transformations – Basics of two dimensional, plane stress, plane strain and axisymmetric analysis.

UNIT IV	COMPUTER IMPLEMENTATION	9

Pre Processing, mesh generation, elements connecting, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages – Development of code for one dimensional analysis and validation.

UNIT V	FINITE ELEMENT ANALYSIS OF PRODUCTION PROCESSES	10

FE analysis of metal casting – special considerations, latent heat incorporation, gap element – Time stepping procedures – Crank – Nicholson algorithm – Prediction of grain structure – Basic concepts of plasticity and fracture – Solid and flow formulation – small incremental deformation formulation – Fracture criteria – FE analysis of metal cutting, chip separation criteria, incorporation of strain rate dependency – FE analysis of welding.

	TOTAL PERIODS	45

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OUTCOMES

At the end of the course, the learners will be able to

CO1: Understand the concept of finite element method for solving manufacturing engineering problems.

CO2: Formulate and solve manually problems in 1-D solid mechanics and heat transfer problems.

CO3: Develop 2-D FE formulations involving triangular, quadrilateral elements and higher order elements.

CO4: Apply the commercial FE analysis packages for solving simple practical problems.

CO5: Analyze various manufacturing processes with the application of finite element techniques.

REFERENCES

1. Reddy, J.N., "Finite Element Method in Engineering", Tata McGraw Hill, 2007.
2. Robert D. Cook, David S. Malkus, Michael E. Plesha, Robert J. Witt, "Concepts and Applications of Finite Element Analysis", John Wiley & Sons, Incl.2002.
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21MFP18	ROBOT DESIGN AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES

- To gain knowledge on growth of robots since origin based on the application.
- To study the kinematics of robot.
- To study the dynamics of robot.
- To expose the students in the various programming techniques in robot and illuminate the curiosity over recent AI techniques.
- To familiarize the sensors and actuators involved in the robot based the application.

UNIT I	INTRODUCTION	9

Definition, Need Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors – types, selection applications.

UNIT II	ROBOT KINEMATICS	9

Introduction – Matrix representation Homogeneous transformation, forward and inverse – Kinematic equations, Denavit–Hartenberg parameters representations – Inverse Kinematic relations. Fundamental problems with D-H representation, differential motion and velocity of frames – Jacobian, Differential Charges between frames:

UNIT III	ROBOT DYNAMICS AND TRAJECTORY PLANNING	9

Lagrangian mechanics, dynamic equations for single, double and multiple DOF robots – static force analysis of robots, Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning

UNIT IV	ROBOT PROGRAMMING & AI TECHNIQUES	9

Types of Programming – Teach Pendant programming – Basic concepts in AI techniques – Concept of knowledge representations – Expert system and its components.

UNIT V	ROBOT SENSORS AND ACTUATORS	9

Design of Robots – characteristics of actuating systems, comparison, microprocessors control of electric motors, magnetostrictive actuators, shape memory type metals, sensors, position, velocity,force, temperature, pressure sensors – Contact and non-contact sensors, infrared sensors, RCC, Vision sensors.

TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Describe the various types of Industrial Robots and their architecture.
CO2: Compute the forward and inverse kinematics for robot motion.
CO3: Compute the trajectory of robot in joint space and Cartesian space.
CO4: Explain about the robot programming principles and Modern AI Techniques.
CO5: Identify the appropriate robot sensors and actuators based on the application.

REFERENCES

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5. Saeed.B.Niku, “Introduction to Robotics, Analysis, system, Applications”, Pearson educations, 2010.
6. Wesley E Snyder R, “Industrial Robots, Computer Interfacing and Control”, Prentice Hall International Edition, 2013.

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21MFP19	MECHATRONICS	L	T	P	C
		3	0	0	3

OBJECTIVES

- To create knowledge in Mechatronics systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives the frame work of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

UNIT I	INTRODUCTION	6

Introduction to Mechatronics-systems – Mechatronics approach to modern engineering and design – Need of Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics – Mechatronics elements

UNIT II	SENSORS AND TRANSDUCER	12

Introduction – Performance Terminology – Potentiometers – Strain gauges – LVDT – Eddy current sensor – Hall effect sensor – Capacitance sensors – Digital transducers – Temperature sensors – Optical sensors – Piezo electric sensor-ultrasonic sensors – Proximity sensors – Signal processing techniques.

UNIT III	MICROPROCESSORS AND MICROCONTROLLERS	12

Introduction – Architectures of 8 – bit microcontrollers (8051) series, PIC Microcontrollers (16f xxx) series – Assembly language programming instruction format, addressing modes, instruction sets, Basic program examples interface of keypads, leds, leds, A/D and D/A Converters, RS 232 serial communication interface, classification of memories.

UNIT IV	ACTUATORS	8

Switching Devices, Classification of actuators – Electrical actuators – Solid state relays, solenoids, D.C. motors, Servo motors, Stepper motors – Interfacing with microcontroller through H-bridge Circuits – Piezoelectric actuators.

UNIT V	MECHATRONIC SYSTEM	7

Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies – Engine management system, Automatic camera, Automatic wishing machine, Pick and place robots.

TOTAL PERIODS 45

OUTCOMES

At the end of the course, the learners will be able to

CO1: Identify key elements of mechatronics and its representation by block diagram.
CO2: Understand the concept of sensors and use of interfacing systems.
CO3: Understand the concept of Microprocessor & Microcontroller.
CO4: Understand the concept and applications of different actuators.
CO5: Illustrate various applications of mechatronic systems.

REFERENCES

1. Devadas shetty, Richard A. Kolk, “Mechatronics System Design”, PWS Publishing Company, 2001.

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4. W.Bolton, “MECHATRONICS” Pearson Education Limited, 2004

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21MFP20	MANUFACTURING SYSTEM SIMULATION	L	T	P	C
		3	0	0	3

OBJECTIVES

- Introduce computer simulation technologies and techniques
- Introduce concepts of modeling layers of society's critical infrastructure networks
- Build tools to view and control simulations and their results

UNIT I	INTRODUCTION	9

Systems and modeling – statistical models in simulation –discrete and continuous system – Monte Carlo Simulation. Simulation of Single Server Queuing System. Simulation of manufacturing shop Simulation of Inventory System.

UNIT II	RANDOM NUMBERS	9

Random number generation –Properties of Random Numbers –Generation of Pseudo Random Numbers – Techniques –Tests for Random Numbers

UNIT III	RANDOM VARIATES	9

Random variate generation-Inverse Transform Technique –Direct Transform Techniques Convolution Method Acceptance Rejection Technique– Routines for Random Variate Generation, Testing –Analysis of simulation data.

UNIT IV	ANALYSIS OF SIMULATION DATA	9

Input modeling-Fitness tests – verification and validation of simulation models – output analysis for a single model, Comparison and evaluation of alternate system design, Optimization using simulation.

UNIT V	SIMULATION LANGUAGES	9

Simulation languages and packages-Case studies in WITNESS; FLEXSIM, ARENA, SIMQUICK- Simulation based optimization-Modelling and Simulation with Petrinets – Case studies in manufacturing and material handling system.

TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Develop Manufacturing Models of Discrete event systems
CO2: Generation of Uncertainty using Random numbers and Random Variates
CO3: Input, Output Analysis: Verification & Valediction of Models and Optimization

REFERENCES

1. Geoffrey Gordon, "System Simulation", 2nd Edition, Prentice Hall, India, 2002.
2. Jerry Banks & John S.Carson, Barry L Nelson, "Discrete event system simulation", Prentice Hall
3. Law A.M, "Simulation Modelling and Analysis", Tata Mc Graw Hill
4. NarsinghDeo, "System Simulation with Digital Computer", Prentice Hall
5. Pidd, M, "Computer Simulation in Management Science", John Wiley & Sons, Inc.

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21MFP21	PRODUCT LIFE CYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- Use ENOVIA Engineering BOM Management
- Create parts and specifications
- Create Change Orders

UNIT I	INTRODUCTION	9

Product life cycle – Introduction, growth, maturity & decline, Product Lifecycle Management- Definition & Overview, Background for PLM-corporate challenges, Need of PLM, Components/Elements of PLM, Emergence of PLM, Significance of PLM - life cycle problems to be resolved, product development problems to be resolved, Customer Involvement.

UNIT II	ENOVIA, EBOM AND ECM	9

Working with Parts, Creating & Attaching Specifications, Releasing parts using Enterprise Change Management, Reports

UNIT III	COLLABORATIVE LIFE CYCLE MANAGEMENT	9

Different phases of product lifecycle and corresponding technologies, Foundation technologies and standards e.g. visualization, collaboration and enterprise application integration, Core functions e.g., data vaults, document and content management, workflow and program management, Functional applications e.g., configuration management. Human resources in product lifecycle. Creating a Product Structure, Managing the Structure

UNIT IV	PRODUCT LIFE CYCLE MANAGEMENT SYSTEM	9

Product life cycle management system- system architecture, Information models and product structure, Information model, the product information data model, the product model, functioning of the system.

UNIT V	3D TOLERANCING & ANNOTATION	9

Product life cycle management system- system architecture, Information models and product structure, Information model, the product information data model, the product model, functioning of the system. Reasons for the deployment of PLM systems

TOTAL PERIODS	45

OUTCOMES

At the end of the course, the learners will be able to

CO1: Illustrate the concepts of PLM in product life cycle
CO2: Categorize Change Requests for the parts and specifications
CO3: Analyze the life cycle management for new developed product.
CO4: Develop and interpret the data model
CO5: Apply 3d tolerance and annotation concepts to product

REFERENCE

1. Grieves Michael, "Product Lifecycle Management- Driving the Next Generation of Lean Thinking", McGraw-Hill, 2006.
2. Stark, John. "Product Lifecycle Management: 21st Century Paradigm for Product

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21MFP22	PRODUCT DESIGN AND DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

At the end of this course

- Students are expected to design and develop various products

COURSE

CO1: To acquire advanced information about the metal cutting theory and to enlarge knowledge in metal cutting theory.
CO2: Select tool materials and cutting fluids for machinability and economics.
CO3: Design the cutting tools for metal removal process.

UNIT I	PRODUCT DEVELOPMENT AND CONCEPT SELECTION	9

Product development process – Product development organizations- Identifying the customer needs – Establishing the product specifications – concept generation – Concept selection.

UNIT II	PRODUCT ARCHITECTURE	9

Product architecture – Implication of the architecture – Establishing the architecture – Related system level design issues.

UNIT III	INDUSTRIAL AND MANUFACTURING DESIGN	9

Need for industrial design – Impact of industrial design – Industrial design process. Assessing the quality of industrial design- Human Engineering consideration - Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors

UNIT IV	PROTOTYPING AND ECONOMIC ANALYSIS	9

Principles of prototyping – Planning for prototypes - Elements of economic analysis – Base case financial model – Sensitivity analysis – Influence of the quantitative factors

UNIT V	MANAGING PRODUCT DEVELOPMENT PROJECTS	9

Sequential, parallel and coupled tasks - Baseline project planning – Project Budget Project execution – Project evaluation- patents- patent search-patent laws International code for patents.

TOTAL PERIODS 45

OUTCOMES

At the end of the course, the learners will be able to

CO1: To acquire advanced information about the metal cutting theory and to enlarge knowledge in metal cutting theory.
CO2: Select tool materials and cutting fluids for machinability and economics.
CO3: Design the cutting tools for metal removal process.

REFERENCES

1. Charles Gevirtz, “Developing New products with TQM”, McGraw – Hill International editions, 1994
2. Karal .T. Ulrich, Steven D.Eppinger, “Product Design and Development”, McGRAW-HILL International Editions.2003.
3. S.Rosenthal, “Effective product design and development”, Irwin 1992.

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21MFP23	ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES

- To develop and strengthen entrepreneurial quality and motivation in students. To impart basic entrepreneurial skills and understandings to run a business efficiently and effectively.

UNIT I	ENTREPRENEURAL COMPETENCE	6

Entrepreneurship concept – Entrepreneurship as a Career – Entrepreneurial Personality - Characteristics of Successful, Entrepreneur – Knowledge and Skills of Entrepreneur.

UNIT II	ENTREPRENEURAL ENVIRONMENT	12

Business Environment - Role of Family and Society - Entrepreneurship Development Training and Other Support. Organizational Services - Central and State Government Industrial Policies and Regulations - International Business.

UNIT III	BUSINESS PLAN PREPARATION	12

Sources of Product for Business - Prefeasibility Study - Criteria for Selection of Product - Ownership - Capital - Budgeting Project Profile Preparation - Matching Entrepreneur with the Project - Feasibility Report Preparation and Evaluation Criteria.

UNIT IV	LAUNCHING OF SMALL BUSINESS	10

Finance and Human Resource Mobilization Operations Planning - Market and Channel Selection - Growth Strategies - Product Launching – Incubation, Venture capital, IT startups.

UNIT V	MANAGEMENT OF SMALL BUSINESS	5

Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Outline the basic concept of Entrepreneurship competence.
CO2: Summarize the role of various entrepreneurial environment
CO3: Identify suitable business opportunities for their enterprise based on their capacity to invest in and manage a business venture.
CO4: Analyze the opportunities for launching start-ups and expansion
CO5: Analyze the various facts for effective management of business.

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1. Hisrich, “Entrepreneurship”, Edition 9, Tata McGraw Hill, New Delhi, 2014
2. S.S.Khanka, “Entrepreneurial Development”, S.Chand and Company Limited, New Delhi, (Revised Edition) 2013.
3. Mathew Manimala, “Entrepreneurship Theory at the Crossroads, Paradigms & Praxis, Biztrantra”, 2nd Edition ,2005
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21MFP24	INDUSTRIAL SAFETY	L	T	P	C
		3	0	0	3

OBJECTIVES

- To develop and strengthen the safety ideas and motivate the students to impart basic safety skills and understandings to run an industry efficiently and effectively

UNIT I	OPERATIONAL SAFETY	9

Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation – electroplating – hot bending pipes – safety in welding and cutting, Cold – metal operation – safety in machine shop – cold bending and chamfering of pipes metal cutting – shot blasting, grinding, painting – power press and other machines. Management of toxic gases and chemicals – industrial fires and prevention – road safety – highway and urban safety – safety of sewage disposal and cleaning – control of environmental pollution – managing emergencies in industries – planning security and risk assessments, on – site and off site. Control of major industrial hazards.

UNIT II	SAFETY APPRAISAL AND ANALYSIS	9

Human side of safety – personal protective equipment – causes and cost of accidents. Accidents prevention program – specific hazard control strategies – HAZOP training and development of employees – first aid – fire fight devices – accident reporting, investigation. Measurement of safety performance, accident reporting and investigation – plant safety inspection, job safety analysis – safety permit procedures. Product safety – plant safety rules and procedures – safety sampling – safety inventory systems. Determining the cost effectiveness of safety measurement.

UNIT III	OCCUPATIONAL HEALTH	9

Concept and spectrum of health functional units and activities of operational health service – occupational and related disease – levels of prevention of diseases – notifiable occupational diseases Toxicology Lead – Nickel, chromium and manganese toxicity – gas poisoning (such as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet radiation and infrared radiation on human system.

UNIT IV	SAFETY AND HEALTH REGULATIONS	9

Safety and health standards – industrial hygiene – occupational diseases prevention welfare facilities. The object of factories act 1948 with special reference to safety provisions, model rules 123a, history of legislations related to safety – pressure vessel act – Indian boiler act – the environmental protection act – electricity act – explosive act.

UNIT V	SAFETY MANAGEMENT	9

Evaluation of modern safety concepts – safety management functions – safety organization, safety department- safety committee, safety audit – performance measurements and motivation – employee participation in safety - safety and productivity.

	TOTAL PERIODS	45

OUTCOMES

At the end of the course, the learners will be able to

CO1: Intergrade operational safety in industrial process.
CO2: Executing safety appraisal by implementing HAZOP.
CO3: Determining the occupational health hazards presents in the workplace.
CO4: Integrating the safety and health regulations in workplace.

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CO5:	Articulate to run an industry with utmost safety precautions.

REFERENCES

1. John V Grimaldi, "Safety Management". AITB publishers, 2003.
2. Krishnan N.V, "Safety in Industry", Jaico Publisher House, 1996.
3. John.V .Grimaldi and Rollin. H Simonds, "Safety Managenent", All India traveler book seller, New Delhi – 1989.
4. Singh, U.K and Dewan, J.M., "Sagety, Security And Risk Management", APH publishing company, New Delhi, 1996.
5. Deshmukh L M , "Industrial Safety Management" McGraw Hill Education India, 2000

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21MFP25	ADVANCES IN MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

The general objectives of the course are to enable the students to,

- To study and understand the various advances in materials and their industrial applications

UNIT I	MODERN METALLIC MATERIALS	9

Dual phase steels, High strength low alloy (HSLA) steel, Transformation induced plasticity (TRIP) Steel, Maraging steel, Nitrogen steel – Inter-metallics, Ni and Ti aluminides – smart materials, shape memory alloys – Metallic glass and Nano crystalline materials. Functionally graded materials.

UNIT II	NON METALLIC MATERIALS	9

Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al_2O_3, SiC, Si_3N_4, CBN and diamond – properties, processing and applications.

UNIT III	PROCESSING OF POLYMER MATRIX COMPOSITES	9

Open mould process, bag moulding, compression moulding with BMC and SMC filament winding – pultrusion – centrifugal casting – injection moulding – structure, properties and application of PMC's – Carbon Matrix Composites - Interfaces – Properties – recycling of PMC.

UNIT IV	PROCESSING OF METAL AND CERAMIC MATRIX COMPOSITES	9

Solid state fabrication techniques – diffusion bonding – powder metallurgy techniques plasma spray, chemical and physical vapour deposition of matrix on fibres Chemical vapour infiltration – Sol gel – liquid state fabrication methods – infiltration – squeeze, casting – rheo casting – compocasting - Interfaces properties– application of MMC and ceramic matrix composites.

UNIT IV	SELECTION OF MATERIALS	9

Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

TOTAL PERIOD	**45**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Comprehend the novelty in metallic materials

CO2: Contrast the various non-metallic materials and their applications

CO3: Summarize the processing of polymer matrix composites

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CO4:	Summarize the processing of metal and ceramic matrix composites
CO5:	Examine the selection of materials for industrial applications

REFERENCES

1. Kenneth G. Budinski, Michael K. Budinski, M. Thavasimuthu "Engineering Materials: Properties and Selection", 9th Edition", Pearson 2010
2. Gandhi, M.V., Thompson, B.S., "Smart Materials and Structures", Chapman and Hall 1992
3. Bhushan, B., Nano Technology (ed), Springer.

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<table>
<tr><td rowspan="2">21MFP26</td><td rowspan="2">SMART MANUFACTURING AND INDUSTRY 4.0</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
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OBJECTIVES

- To present a problem oriented in depth knowledge of Smart Manufacturing.
- The objective of this course is to learn the statistics and optimization methodologies in smart manufacturing systems.
- The students will know how to apply artificial intelligence (AI) and data mining (DM) techniques to solve the real problems in shop-floor level or capacity planning problems.
- Evaluation criteria and industry benchmarks for determining where and how smart manufacturing processes can benefit your organization.
- Detailed understanding of how sensors, automation and data science are transforming individual processes and improving operational performance throughout the manufacturing enterprise

UNIT I	**INTRODUCTION**	**9**

Basic concepts of smart manufacturing-Smart Manufacturing Processes- Three Dimensions: Demand Driven and Integrated Supply Chains, Dynamically Optimized Manufacturing Enterprises (plant + enterprise operations) , Real Time, Sustainable Resource Management (intelligent energy demand management, production energy optimization and reduction of GHG)

UNIT II	**SMART DESIGN & FABRICATION.**	**9**

Smart Design & Fabrication: Digital Tools, Product Representation and Exchange Technologies and Standards, Agile (Additive) Manufacturing Systems and Standards. Mass Customization, Smart Machine Tools, Robotics and Automation (perception, manipulation, mobility, autonomy), Smart Perception – Sensor networks and Devices.

Smart Applications: Online Predictive Modeling, Monitoring and Intelligent Control of Machining/Manufacturing and Logistics/Supply Chain Processes; Smart Energy Management of manufacturing processes and facilities

UNIT III	**MACHINE LEARNING**	**9**

Machine Learning - Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks-Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

UNIT IV	**AUTOMATED PROCESS PLANNING**	**9**

Variant Approach, Generative Approach, Expert Systems for Process Planning, Feature Recognition, Phases of Process planning. Knowledge Based System for Equipment Selection (KBSES) - Manufacturing system design. Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KRSES.

UNIT V	**GROUP TECHNOLOGY**	**9**

Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

TOTAL PERIODS	**45**

OUTCOMES

At the end of the course, the learners will be able to

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CO1: The student can identify different areas of Smart Manufacturing. **CO2:** Students should be able to understand basic Components of Knowledge Based Systems. **CO3:** Understand the Concept of Artificial Intelligence. **CO4:** Students should be able to understand Automated Process Planning. **CO5:** Students should be able to understand about grouping the parts.	
REFERENCES	

1. "Intelligent Manufacturing Systems" Andrew Kusiak/Prentice Hall.
2. "Artificial Neural Networks" Yagna Narayana/PHI/2006
3. "Automation, Production Systems and CIM" Groover M.P./PHI/2007
4. McEwen and H. Cassimally, "Designing the Internet of Things", 1st edition,Wiley, 2013, ISBN-10: 111843062X.
5. Vengurlekar and P. Bagal, "Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management", 1st edition, McGraw-Hill Education.
6. "Neural networks: A comprehensive foundation" Simon Hhaykin/ PHI.
7. "Artificial neural networks" B.Vegnanarayana/PHI
8. "Neural networks in Computer intelligence" Li Min Fu/ TMH/2003
9. "Neural networks" James A Freeman David M S kapura/ Pearson education/2004
10. "Introduction to Artificial Neural Systems" Jacek M. Zurada/JAICO Publishing House Ed.2006.
11. Kuniavsky, "Smart Things: Ubiquitous Computing User Experience Design", 1st edition, Morgan Kaufmann, 2010, ISBN-10: 0123748992.

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AUDIT COURSES (AC)

Registration for any of these courses is optional to students

21AC101	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I	INTRODUCTION TO RESEARCH PAPER WRITING	6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II	PRESENTATION SKILLS	6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT III	TITLE WRITING SKILLS	6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT IV	RESULT WRITING SKILLS	6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V	VERIFICATION SKILLS	6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL PERIOD 30

OUTCOMES

At the end of the course, the learners will be able to

CO1: Understand that how to improve your writing skills and level of readability

CO2: Learn about what to write in each section.

CO3: Understand the skills needed when writing a Title

CO4: Understand the skills needed when writing the Conclusion

CO5: Ensure the good quality of paper at very first-time submission.

REFERENCES

1. Adrian Wallwork , "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011
2. Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
3. Goldbort R "Writing for Science", Yale University Press (available on Google Books) 2006
4. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM. Highman's book 1998

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21AC102	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Ability to develop the strengths and weaknesses of disaster management approaches

UNIT I	INTRODUCTION	6
Disaster: Definition, Factors and Significance; Difference between Hazard And Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude		
UNIT II	**REPERCUSSIONS OF DISASTERS AND HAZARDS**	**6**
Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts		
UNIT III	**DISASTER PRONE AREAS IN INDIA**	**6**
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics.		
UNIT IV	**DISASTER PREPAREDNESS AND MANAGEMENT**	**6**
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.		
UNIT V	**RISK ASSESSMENT**	**6**
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival		
	TOTAL PERIOD	**30**

OUTCOMES

At the end of the course, the learners will be able to

CO1: Ability to summarize basics of disaster

CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.

CO3: Understand the skills needed when writing a Title

CO4: Understand the skills needed when writing the Conclusion

CO5: Ensure the good quality of paper at very first-time submission.

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REFERENCES

1. Goel S. L., “Disaster Administration And Management Text And Case Studies”, Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, “Disaster Management in India: Perspectives, issues and strategies” New Royal book Company,2007.
3. Sahni, PardeepEt.Al. , “Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi, 2001.

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21AC103	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I	HISTORY AND PHILOSOPHY OF THE INDIAN CONSTITUTION	6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT II	CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES	6

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check

UNIT III	ORGANS OF GOVERNANCE	6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT IV	LOCAL ADMINISTRATION	6

District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila Pachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT V	ELECTION COMMISSION	6

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women

TOTAL PERIOD	30

OUTCOMES

At the end of the course, the learners will be able to

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

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CO3:	Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution
CO4:	Discuss the passage of the Hindu Code Bill of 1956.
CO5:	Understand the basic Structure and functions of Election Commission.

REFERENCES

1. "The Constitution of India", 1950 (Bare Act),Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar "Framing of Indian Constitution",1st Edition, 2015.
3. "Day R How to Write and Publish a Scientific Paper", Cambridge University Press 2006
4. M.P. Jain, "Indian Constitution Law", 7th Edn., Lexis Nexis,2014
5. D.D. Basu, "Introduction to the Constitution of India", Lexis Nexis, 2015

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21AC104	நற்றமிழ் இலக்கியம்	L	T	P	C
		2	0	0	0

UNIT I	**சங்க இலக்கியம்**	6

1. தமிழின் துவக்க நூல் தொல்கொப்பியம் – எழுத்து, சொல், பொருள்
2. அகநானூறு (82) - இயற்கை இன்னிசை அரங்கம்
3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி
4. புறநானூறு (95, 195) - போரை நிறுத்திய ஔவையார்

UNIT II	**அறநெறித் தமிழ்**	6

1. அறநெறி வகுத்த திருவள்ளுவர்- அறம் வலியுறுத்தல், அன்புடைமை ஒப்புரவு அறிதல், ஈகை, புகழ்
2. பிற அறநூல்கள் - இலக்கிய மருந்து
   - ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மை வலியுறுத்தும் நூல்)

UNIT III	**இரட்டை காப்பியங்கள்**	6

1. கண்ணகியின் புரட்சி - சிலப்பதிகார வழக்குரை கதை
2. சமூகசேவை இலக்கியம் மணிமேகலை
   -சிறைக்கோட்டம் அறக்கோட்டமாகிய கதை

UNIT IV	**அருள் நெறித்தமிழ்**	6

1. சிறுபாணாற்றுப்படை
   - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் அவ்வைக்கு நெல்லிக்காய் கொடுத்தது, அரசர் பண்புகள்
2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இமயம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
   - சிறுவனே வள்ளலானான்

UNIT V	**நவீன தமிழ் இலக்கியம்**	6

1. உரைநடைத்தமிழ்
   - தமிழன் முதல் புதினம்
   - தமிழன் முதல் சிறுகதை
   - கட்டுரை இலக்கியம்

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- பயண இலக்கியம் - நாடகம்	
TOTAL PERIOD	**30**

REFERENCES

1. (Tamil Virtual University) - www.tamilvu.org
2. (Tamil Wikipedia) -https://ta.wikipedia.org

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VELAMMAL

COLLEGE OF ENGINEERING & TECHNOLOGY, MADURAI – 625 009

(Autonomous)

(Accredited by NAAC with 'A' Grade and by NBA for 5 UG Programmes)

(Approved by AICTE and affiliated to Anna University, Chennai)

DEPARTMENT

OF

ELECTRICAL AND ELECTRONICS ENGINEERING

M.E. POWER SYSTEMS ENGINEERING (FULL TIME)

Curriculum and Syllabus I to IV Semesters

VELAMMAL COLLEGE OF ENGINEERING & TECHNOLOGY, MADURAI – 625 009

(Autonomous)

REGULATIONS 2021

M.E. POWER SYSTEMS ENGINEERING (CBCS)

Curriculum and Syllabus

I to IV Semesters

SEMESTER I

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1.	21MA123	Applied Mathematics for Power System Engineers	FC	3	2	0	4
2.	21PS101	Advanced Power System Analysis	PC	3	0	0	3
3.	21PS102	Analysis and Design of Power Converters	PC	3	0	0	3
4.	21PS103	Advanced Digital Signal Processing	PC	3	2	0	4
5.	21PS104	System Theory	PC	3	0	0	3
6.	21PSPXX	Professional Elective I	PE	3	0	0	3
7.	21AC101	Audit Course I* *(Common to all PG Programmes)*	AC	2	0	0	0
		PRACTICAL					
8.	21PS105	Power System Simulation Laboratory-I	PC	0	0	4	2
9.	21PS106	Power Converters Laboratory	PC	0	0	4	2
		Total Credits					**24**

SEMESTER II

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1.	21PS107	Restructured Power System	PC	3	0	0	3
2.	21PS108	Digital Protection For Power System	PC	3	0	0	3
3.	21PS109	Smart grid	PC	3	0	0	3
4.	21PS110	Power System Operation and control	PC	3	0	0	3
5.	21PSPXX	Professional Elective II	PE	3	0	0	3
6.	21PSPXX	Professional Elective III	PE	3	0	0	3
7.	21AC102	Audit Course II* *(Common to all PG Programmes)*	AC	2	0	0	0
		PRACTICAL					
8.	21PS111	Power System Simulation Laboratory-II	PC	0	0	4	2
9.	21PS112	Technical Seminar	EE	0	0	2	1
		Total Credits					**21**

SEMESTER III

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1.	21RM102	Research Methodology and IPR *Common to M.E (Computer Science Engineering), M.E. (Power Systems) and M.E (Manufacturing Engineering)*	RM	3	0	0	3
2.	21PSPXX	Professional Elective IV	PE	3	0	0	3
3.	21PSPXX	Professional Elective V	PE	3	0	0	3

4.	21PSPXX	Professional Elective VI	PE	3	0	0	3
		PRACTICAL					
5.	21PS113	Project Work Phase I	EE	0	0	12	6
		Total Credits					**18**

SEMESTER IV

S.No.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1.	21PS114	Project Work Phase II	EE	0	0	24	12
		Total Credits					**12**

*** Audit course I and II is optional**

PROFESSIONAL ELECTIVES (PE)

PROFESSIONAL ELECTIVE-I

S.No.	Course Code	COURSE TITLE	CATEGORY	L	T	P	C
1.	21PSP35	Analysis of Electrical Machines	PE	3	0	0	3
2.	21PSP36	Soft Computing Techniques	PE	3	0	0	3
3.	21PSP37	Industrial Power System Analysis and Design	PE	3	0	0	3

PROFESSIONAL ELECTIVE-II

S.No.	Course Code	COURSE TITLE	CATEGORY	L	T	P	C
1.	21PSP38	Solar and Energy Storage Systems	PE	3	0	0	3
2.	21PSP39	HVDC Transmission	PE	3	0	0	3
3.	21PSP40	FACTS	PE	3	0	0	3

PROFESSIONAL ELECTIVE-III

S.No.	Course Code	COURSE TITLE	CATEGORY	L	T	P	C
1.	21PSP41	Waste to Energy	PE	3	0	0	3

2.	21PSP42	Distributed Generation and Microgrid	PE	3	0	0	3
3.	21PSP43	Energy Efficiency in Electrical Utilities	PE	3	0	0	3

PROFESSIONAL ELECTIVE-IV

S.No.	Course Code	COURSE TITLE	CATEGORY	L	T	P	C
1.	21PSP44	Electrical Distribution System	PE	3	0	0	3
2.	21PSP45	Controllers for power converters	PE	3	0	0	3
3.	21PSP46	Energy Efficiency in Thermal Utilities	PE	3	0	0	3

PROFESSIONAL ELECTIVE-V

S.No.	Course Code	COURSE TITLE	CATEGORY	L	T	P	C
1.	21PSP47	Energy Management and Auditing	PE	3	0	0	3
2.	21PSP48	Electric Vehicles and Power Management	PE	3	0	0	3
3.	21PSP49	Design of Substations	PE	3	0	0	3

PROFESSIONAL ELECTIVE-VI

S.No.	Course Code	COURSE TITLE	CATEGORY	L	T	P	C
1.	21PSP50	Wind Energy Conversion Systems	PE	3	0	0	3
2.	21PSP51	Power System Dynamics	PE	3	0	0	3
3.	21PSP52	Machine Learning	PE	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EE)

S.No.	Course Code	COURSE TITLE	CATEGORY	L	T	P	C
1.	21PS112	Technical Seminar	EE	0	0	2	1
2.	21PS113	Project Work Phase I	EE	0	0	12	6
3.	21PS114	Project Work Phase II	EE	0	0	24	12

RESEARCH METHODOLOGY AND IPR COURSES (RM)

S.No.	Course Code	COURSE TITLE	CATEGORY	L	T	P	C
1.	21RM102	Research Methodology and IPR *Common to M.E (Manufacturing Engineering), M.E (Computer Science Engineering), M.E (Power Systems Engineering)*	RM	3	0	0	3

AUDIT COURSES (AC)

S.No.	Course Code	COURSE TITLE	CATEGORY	L	T	P	C
1.	21AC101	English for Research Paper Writing	AC	2	0	0	0
2.	21AC102	Constitution of India	AC	2	0	0	0

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A. K.
BoS Chairman

SEMESTERWISE CREDIT DISTRIBUTION

	I	II	III	IV	Total Credits
FC	4	-	-	-	**4**
PC	17	14	-	-	**31**
PE	~~3~~	6	~~9~~ 12	-	**18**
EE	-	1	6	12	**19**
RM	3 ~~-~~	-	~~3~~	-	**3**
Total	24	21	18	12	**75**

S.No.	Topic
1	Fundamental Course (FC)
2	Professional Core Courses (PC)
3	Professional Elective Courses(PE)
4	Project work, Seminar and Internship in Industry - Employability Enhancement Courses (EE)
5	Research Methodology Courses (RM)

SEMESTER-I

21MA123	APPLIED MATHEMATICS FOR POWER SYSTEM ENGINEERS	L	T	P	C
		3	2	0	4

COURSE OBJECTIVES:

- To develop the ability to apply the concepts of matrix theory in Electrical Engineering problems.
- To familiarize the students in the field of differential equations to solve boundary value problems associated with Engineering applications.
- To acquire skills in solving problems using Fourier series associated with Engineering applications.
- To impart deep knowledge and concepts to solve complicated problems using linear programming.
- To encourage students to develop the capability of solving problems using non - linear programming techniques.

UNIT I	MATRIX THEORY	12
The Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Singular value decomposition - Pseudo inverses - Least square approximation		
UNIT II	**LAPLACE TRANSFORMS TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS**	**12**
Definitions - Properties - Transform error function - Bessel's function - Dirac Delta function - Unit step function - Convolution theorem - Inverse Laplace transform - Complex inversion formula - Solutions to partial differential equations: Heat and Wave equations.		
UNIT III	**FOURIER SERIES**	**12**
Fourier Trigonometric series : Periodic function as power signals - Convergence of series - Even and odd functions : Cosine and sine series - Non periodic function - Extension to other intervals – Power signals : Exponential Fourier series - Parseval's theorem and power spectrum – Eigenvalue problems and orthogonal functions - Regular Sturm –Liouville systems - Generalized Fourier series		
UNIT IV	**LINEAR PROGRAMMING**	**12**
Formulation - Graphical solution - Simplex method - Big M method - Two phase method - Transportation and Assignment models.		
UNIT V	**NON – LINEAR PROGRAMMING**	**12**
Lagrange multipliers – Equality constraints – Inequality constraints – Kuhn – Tucker Conditions – Quadratic programming.		
	TOTAL: 60 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Apply the concepts of matrix theory in Electrical Engineering problems.

A.P. Srolpalai
BoS Chairman

CO2: Make use of the concept of Laplace transform to find the solution of partial differential equations.
CO3: Solve problems using Fourier series associated with engineering applications.
CO4: Predict an optimal solution of an optimization problem using linear Programming concept
CO5: Identify a suitable non – linear programming techniques to solve an optimization problems.

REFERENCES:

1. Richard Bronson , "Matrix Operation , Schaum's outline series", 2nd Edition, McGraw Hill, New Delhi, 2011.
2. Sankara Rao. K, "Introduction to Partial Differential Equations", 3rd Edition, Prentice Hall of India Pvt . Ltd, New Delhi, 1997.
3. Andrews .L.C, and Phillips. R.L, "Mathematical Techniques for Engineers and Scientists",
   Prentice Hall, New Delhi , 2005.
4. Taha .H.A , "Operations Research - An Introduction" , 10th Edition, Pearson Education, New Delhi, 2010.

21PS101	ADVANCED POWER SYSTEM ANALYSIS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain different techniques of dealing with sparse matrix for large scale power systems
- To illustrate different methods of power flow solutions.
- To interpret optimal power flow solutions in detail.
- To relate short circuit fault analysis of different type of faults.
- To summarize different numerical integration methods and factors influencing transient stability

UNIT I SOLUTION TECHNIQUES **9**

Sparse Matrix techniques for large scale power systems: Optimal ordering schemes for preserving sparsity. Flexible packed storage scheme for storing matrix as compact arrays – Factorization by Bifactorization and Gauss elimination methods; Repeat solution using Left and Right factors and L and U matrices.

UNIT II POWER FLOW ANALYSIS **9**

Power flow equation in real and polar forms; Review of Newton's method for solution; Adjustment of P-V buses; Power-Flow Studies in System Design and Operation; Review of Fast Decoupled Power Flow method; Sensitivity factors for P-V bus adjustment.

UNIT III OPTIMAL POWER FLOW **9**

Problem statement; Solution of Optimal Power Flow (OPF) – The gradient method, Newton's method, Linear Sensitivity Analysis; LP methods – With real power variables only – LP method with AC power flow variables and detailed cost functions; Security constrained Optimal Power Flow; Interior point algorithm; Bus Incremental costs.

UNIT IV	SHORT CIRCUIT ANALYSIS	9
Formation of bus impedance matrix with mutual coupling (single phase basis and three phase basis) - Computer method for fault analysis using ZBUS and sequence components. Derivation of equations for bus voltages, fault current and line currents, both in sequence and phase – symmetrical and unsymmetrical faults.		
UNIT V	TRANSIENT STABILITY ANALYSIS	9
Introduction, Numerical Integration Methods: Euler and Fourth Order Runge-Kutta methods, Algorithm for simulation of SMIB and multi-machine system with classical synchronous machine model; Factors influencing transient stability, Numerical stability and implicit Integration methods.		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Outline the concepts of sparse matrix for large scale power system analysis.

CO2:Illustrate power system studies that needed for the transmission system planning

CO3:Solve for power optimal flow analysis in power systems

CO4:Summarize the different types of faults in power systems and its solution techniques

CO5:Explain the transient stability analysis in power system

TEXT BOOKS:

1. A.J.Wood and B.F.Wollenberg, "Power Generation Operation and Control", 3rd Edition, John Wiley and Sons 2013.
2. P.Kundur, "Power System Stability and Control", 3rd Edition, McGraw Hill, 2006.
3. John J Griainger& William D. Stevenson, "Power System Analysis", 2nd Edition ,McGraw Hill, 2017.
4. D P Kothari & I J Nagrath, "Power System Engineering", 3rd Edition, McGraw Hill, 2019.

REFERENCES

1. M.A.Pai," Computer Techniques in Power System Analysis",2nd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2006.
2. G W Stagg , A.H El. Abiad, "Computer Methods in Power System Analysis", 1st Edition ,McGraw Hill, ,1968.
3. Abhijit Chakrabarti , SunitaHalder, "Power System Analysis:Operation and Control", 3rd Edition , Prentice Hall India, 2017
4. HadiSaadat, "Power System Analysis", 3rd Edition, McGraw Hill, 2006

21PS102	ANALYSIS AND DESIGN OF POWER CONVERTERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the operation and characteristics of controlled rectifiers.
- To apply switching techniques and basic topologies of DC-DC switching regulators.
- To outline the design of power converter components.
- To illustrate the depth knowledge about resonant converters.
- To summarize the concepts of AC-AC power converters and their applications.

UNIT I	SINGLE PHASE & THREE PHASE CONVERTERS	9

Principle of phase-controlled converter operation – single-phase full converter and semi converter (RL,RLE load)- single phase dual converter – Three phase operation full converter and semi-converter (R,RL,RLE load) – reactive power – power factor improvement techniques –PWM rectifiers.

UNIT II	DC-DC CONVERTERS	9

Limitations of linear power supplies, switched mode power conversion, Non-isolated DC- DC converters: operation and analysis of Buck, Boost, Buck-Boost, Cuk& SEPIC – under continuous and discontinuous operation – Isolated converters: basic operation of Fly back, Forward and Push-pull topologies.

UNIT III	DESIGN OF POWER CONVERTER COMPONENTS	9

Introduction to magnetic materials- hard and soft magnetic materials –types of cores, copper windings – Design of transformer –Inductor design equations –Examples of inductor design for buck/fly back converter-selection of output filter capacitors – selection of ratings for devices – input filter design.

UNIT IV	RESONANT DC-DC CONVERTERS	9

Switching loss, hard switching, and basic principles of soft switching- classification of resonant converters- load resonant converters – series and parallel – resonant switch converters – operation and analysis of ZVS, ZCS converters comparison of ZCS/ZVS Introduction to ZVT/ZCT PWM converters.

UNIT V	AC-AC CONVERTERS	9

Principle of on-off and phase angle control – single phase ac voltage controller – analysis with R & RL load – Three phase ac voltage controller – principle of operation of cyclo converter – single phase and three phase cyclo converters – Introduction to matrix converters.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Illustrate the performance of semi and full converters for different load setup

CO2: Explain the different configurations of DC – DC converters

CO3: Apply various power converter components

CO4: Outline Resonant DC-DC Converters

CO5: Summarize the different types of AC – AC converters and its applications

TEXT BOOKS:

1. Ned Mohan,T.M Undeland and W.P Robbin, "Power Electronics: converters, Application and design", Wiley India Edition, John Wiley and sons, 2006
2. Rashid M.H., "Power Electronics Circuits, Devices and Applications ", 3rd Edition, Prentice Hall India, 2004.
3. P.C. Sen, "Modern Power Electronics", 1st Edition, Wheeler Publishing and Co, 1998.
4. P.S.Bimbra, "Power Electronics", 11th Edition, Khanna Publishers, 2003
5. Simon Ang, Alejandro Oliva, "Power-Switching Converters, 2nd Edition, CRC Press, Taylor & Francis Group, 2010

REFERENCES

1. V.Ramanarayanan, "Course material on Switched mode power conversion", 3rd Edition, 2007
2. Alex Van den Bossche and Vencislav Cekov Valchev, "Inductors and Transformers for Power Electronics", 1st Edition, CRC Press, Taylor & Francis Group, 2005
3. W. G. Hurley and W. H.Wolfle, "Transformers and Inductors for Power Electronics Theory, Design and Applications", 1st Edition, John Wiley & Sons Ltd, 2013
4. Marian.K.Kazimierczuk and Dariusz Czarkowski, "Resonant Power Converters", 2nd Edition, John Wiley & Sons limited, 2011.

		L	T	P	C
21PS103	**ADVANCED DIGITAL SIGNAL PROCESSING**	3	2	0	4

COURSE OBJECTIVES:

- To explain the fundamentals of digital signal processing in time-frequency domain & its application
- To analyze the discrete time system.
- To summarize about filters and their design for digital implementation.
- To compare Architectures & features of Programmable digital signal processors & develop logical functions of digital signal processors.
- To illustrate about the application development with commercial family of digital signal processors.

UNIT I	**FUNDAMENTALS OF DSP**	**12**

Frequency interpretation, sampling theorem, aliasing, discrete-time systems, constant-coefficient difference equation. Digital filters: FIR filter design – rectangular, Hamming, Hanning windowing technique. IIR filter design – Butterworth filter, bilinear transformation method, frequency transformation. Fundamentals of multirate processing – decimation and interpolation.

UNIT II	TRANSFORMS AND PROPERTIES	
Discrete Fourier transform (DFT): - properties, Fast Fourier transform (FFT), DIT-FFT, and DIF-FFT. Wavelet transforms: Introduction, wavelet coefficients – Ortho normal wavelets and their relationship to filter banks, multi-resolution analysis, and Haar and Daubechies wavelet.		12
UNIT III	ADAPTIVE FILTERS	
Wiener filters – an introduction. Adaptive filters: Fundamentals of adaptive filters, FIR adaptive filter – steepest descent algorithm, LMS algorithm, NLMS, applications – channel equalization. Adaptive recursive filters – exponentially weighted RLS algorithm.		12
UNIT IV	ARCHITECTURE OF COMMERCIAL DIGITAL SIGNAL PROCESSORS	12
Introduction to commercial digital signal processors, Categorization of DSP processor – Fixed point and floating point, Architecture and instruction set of the TI TMS 320 C54xx and TMS 320 C6xxx DSP processors, On-chip and On-board peripherals – memory (Cache, Flash, SDRAM), codec, Multichannel Buffered I/O Serial Ports (McBSPs), interrupts, direct memory access (DMA), timers and general purpose I/Os.		
UNIT V	INTERFACING I/O PERIPHERALS FOR DSP BASED APPLICATIONS	12
Introduction, External Bus Interfacing Signals, Memory Interface, I/O Interface, Programmed I/O, Interrupts, Design of Filter, FFT Algorithm, ,Application for Serial Interfacing, DSP based Power Meter, Position control , CODEC Interface .		
		TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

- CO1:Solve various types of practical problems in Digital Signal Processing.
- CO2:Illustrate the concept of DFTs and FFTs for digital filters.
- CO3:Explain the different types of adaptive filters
- CO4:Summarize the conceptual aspects of Signal processing Transforms.
- CO5:Compare the commercial available DS Processors for interfacing.

TEXT BOOKS :

1. John. G. Proakis, Dimitris G. Manolakis, "Digital signal processing", 4th Edition, Pearson Education, 2002
2. Robert J.Schilling,Sandra L.Harris, "Introduction To Digital Signal Processing with Matlab", 3rd Edition,Cengage, 2014.
3. Ifeachor E. C., Jervis B. W ,"Digital Signal Processing: A practical approach", 2nd Edition, Pearson Education PHI ,2002
4. Shaila D. Apte, " Digital Signal Processing", 2nd Edition, Wiley, 2016.

REFERENCES :

1. Rulph Chassaing and Donald Reay, "Digital Signal Processing and Applications with

the MS320C6713 and TMS320C6416 DSK", 1st Edition , John Wiley & Sons, Inc., Hoboken, New Jersey, 2008.

2. B Venkataramani and M Bhaskar "Digital Signal Processors", 2nd Edition, TMH,2010

3. Taan S.Elali,"Discrete Systems and Digital Signal Processing with Matlab", 2nd Edition, CRC Press, 2009.

4. Avatar Sing, S. Srinivasan, "Digital Signal Processing- Implementation using DSP Microprocessors with Examples from TMS320C54xx", 2nd Edition, Thomson India, 2004.

21PS104	SYSTEM THEORY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To summarize the fundamentals of physical systems in terms of its linear and nonlinear models.
- To explain about systems representation in state variable form
- To interpret the linear and non-linear state equations
- To outline the properties of linear systems such as controllability and observability
- To illustrate the stability analysis of systems using Lyapunov's theory.

UNIT I	STATE VARIABLE REPRESENTATION	9
Introduction-Concept of State-State equations for Dynamic Systems -Time invariance and linearity- Non uniqueness of state model- Physical Systems and State Assignment – free and forced responses- State Diagrams.		
UNIT II	**SOLUTION OF STATE EQUATIONS**	**9**
Existence and uniqueness of solutions to Continuous-time state equations - Solution of Nonlinear and Linear Time Varying State equations - State transition matrix and its properties – Evaluation of matrix exponential- System modes- Role of Eigen values and Eigen vectors.		
UNIT III	**STABILITY ANALYSIS OF LINEAR SYSTEMS**	**9**
Controllability and Observability definitions and Kalman rank conditions -Stabilizability and Detectability-Test for Continuous time Systems- Time varying and Time invariant case-Output Controllability-Reducibility- System Realizations.		
UNIT IV	**STATE FEEDBACK CONTROL AND STATE ESTIMATOR**	**9**
Introduction-Controllable and Observable Companion Forms-SISO and MIMO Systems- The Effect of State Feedback on Controllability and Observability-Pole Placement by State Feedback for both SISO and MIMO Systems-Full Order and Reduced Order Observers.		
UNIT V	**LYAPUNOV STABILTY ANALYSIS**	**9**
Introduction-Equilibrium Points- BIBO Stability-Stability of LTI Systems- Stability in the		

A.SSS
BoS Chairman

sense of Lyapunov - Equilibrium Stability of Nonlinear Continuous-Time Autonomous Systems-The Direct Method of Lyapunov and the Linear Continuous-Time Autonomous Systems-Finding Lyapunov Functions for Nonlinear Continuous-Time Autonomous Systems – Krasovskil's and Variable-Gradiant Method.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Explain the time-invariant systems in state space form as well as analyze, whether the system is stabilizable, controllable, observable and detectable.

CO2:Summarize state feedback controller and state observers

CO3:Classify singular points and construct phase trajectory using delta and isocline methods.

CO4:Apply the techniques such as describing function, Lyapunov Stability, Popov's Stability Criterion Circle Criterion and assess the stability of certain class of non-linear system.

CO5:Illustrate non-linear behaviors such as Limit cycles, input multiplicity and output multiplicity, Bifurcation and Chaos.

TEXT BOOKS:

1. M. Gopal, "Modern Control System Theory", 3rd Edition New Age International, 2014.
2. K. Ogatta, "Modern Control Engineering", 4th Edition, PHI, 2002.
3. John S. Bay, "Fundamentals of Linear State Space Systems", 1st Edition, McGraw-Hill, 1999.
4. D. Roy Choudhury, "Modern Control Systems", 4th Edition, New Age International, 2005.

REFERENCES :

1. John J. D'Azzo, C. H. Houpis and S. N. Sheldon, "Linear Control System Analysis and Design with MATLAB", 5th Edition, Taylor Francis, 2003.
2. Z. Bubnicki, "Modern Control Theory", 1st Edition, Springer, 2005.
3. C.T. Chen, "Linear Systems Theory and Design'' 3rd Edition, Oxford University Press, 1999.
4. M. Vidyasagar, "Nonlinear Systems Analysis', 2nd Edition, Prentice Hall, Englewood Cliffs, New Jersey,2002.

		L	T	P	C
21PS105	**POWER SYSTEM SIMULATION LABORATORY-I**	0	0	4	2

COURSE OBJECTIVES:

- To apply various power flow algorithms in power system parameters estimation.
- To analyze the transient response of single machine infinite bus system.

- To demonstrate the contingency states in power system using simulation software.
- To experiment with the different schemes of economic dispatch in power system using simulation software.
- To plan a unit commitment method for generation scheduling using simulation software.

LIST OF EXPERIMENTS

1. Power flow analysis by Newton-Raphson method
2. Power flow analysis Fast decoupled method
3. Transient stability analysis of single machine-infinite bus system
4. Contingency analysis for estimation of generator shift factors
5. Economic dispatch using lambda-iteration method without losses
6. Economic dispatch using lambda-iteration method with losses
7. Unit commitment with Priority-list method
8. Dynamic programming method for unit commitment
9. Simulation of Voltage Source Inverter
10. Contingency analysis for identifying line outage distribution factors
11. Power system state estimation using Weighted Least Square (WLS) method
12. Analysis of switching surge using MATLAB/SIMULINK/ EMTP

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Analyze the power flow using Newton-Raphson method and Fast decoupled method.

CO2: Apply different simulation methods for transient stability analysis.

CO3: Identify the economic dispatch methods for power system operation.

CO4:Solve the different unit commitment methods for power system operation.

CO5: Identify line outage factors through contingency analysis.

21PS106	POWER CONVERTERS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To analyze the basic understanding of the dynamic behavior of the power electronic switches.
- To develop the power electronic circuits and implementing the same using simulation tools.
- To solve mathematical modeling of power electronic system and ability to implement the same using simulation.
- To apply the simulate various topologies of inverters and analyze their harmonic spectrum.
- To build fabricate the gate drive power converter circuits.

LIST OF EXPERIMENTS

1. Study of switching characteristics of Power MOSFET & IGBT.
2. Circuit Simulation of Three-phase semi-converter with R,RL& RLE load.
3. Circuit Simulation of Three-phase fully controlled converter with R, RL & RLE load.
4. Circuit Simulation of Three-phase Voltage Source Inverter in 180 and 120 degree mode of conduction
5. Circuit simulation of Three-phase PWM inverter and study of spectrum analysis for various modulation indices.
6. Simulation of Four quadrant operation of DC Chopper.
7. Simulation of a single-phase Z-source inverter with R load.
8. Simulation of three-phase AC voltage Controller with R load.
9. Simulation of a five-level cascaded multilevel inverter with R load.
10. Simulation of a Fly back DC-DC converter

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the gate drive power converter circuits and analyze the three phase controlled rectifiers and isolated DC-DC converters for designing the power supplies

CO2:Analyze the simulate various topologies of inverters and analyze their harmonic spectrum

CO3:Build fabricate the gate drive power converter circuits.

CO4:Solve mathematical modeling of power electronic system and ability to implement the same using simulation tools

CO5:Summarize the various power electronic applications

SEMESTER-II

21PS107	RESTRUCTURED POWER SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the restructuring of power industry and market models.
- To summarize fundamental concepts of congestion management.
- To explain the concepts of locational marginal pricing and financial transmission rights.
- To interpret the various ancillary services in restructured power system.
- To Illustrate about various power sectors in India

UNIT I — INTRODUCTION TO RESTRUCTURING OF POWER INDUSTRY — 9

Introduction: Deregulation of power industry, Restructuring process, Issues involved in deregulation, Deregulation of various power systems – Fundamentals of Economics: Consumer behavior, Supplier behavior, Market equilibrium, Short and long run costs, Various costs of production – Market models: Market models based on Contractual arrangements, Comparison of various market models, Market architecture, Case study

UNIT II — TRANSMISSION CONGESTION MANAGEMENT — 9

Introduction: Definition of Congestion, reasons for transfer capability limitation, Importance of congestion management, Features of congestion management – Classification of congestion management methods – Calculation of ATC - Non – market methods – Market methods – Nodal pricing – Inter zonal and Intra zonal congestion management – Price area congestion management – Capacity alleviation method.

UNIT III — LOCATIONAL MARGINAL PRICES AND INANCIALTRANSMISSION RIGHTS — 9

Mathematical preliminaries: - Locational marginal pricing– Lossless DCOPF model for LMP calculation – Loss compensated DCOPF model for LMP calculation – ACOPF model for LMP calculation – Financial Transmission rights – Risk hedging functionality –Simultaneous feasibility test and revenue adequacy – FTR issuance process: FTR auction, FTR allocation– Treatment of revenue shortfall – Secondary trading of FTRs – Flow gate rights – FTR and market power - FTR and merchant transmission investment

UNIT IV — ANCILLARY SERVICE MANAGEMENT AND PRICING OF TRANSMISSION NETWORK — 9

Introduction of ancillary services – Types of Ancillary services – Classification of Ancillary services – Load generation balancing related services – Voltage control and reactive power support devices – Black start capability service - How to obtain ancillary service – Transmission pricing – Principles – Classification– Rolled in transmission pricing methods – Marginal transmission pricing paradigm –Composite pricing paradigm – Merits and demerits of different paradigm.

UNIT V — REFORMS IN INDIAN POWER SECTOR — 9

Introduction – Framework of Indian power sector – Reform initiatives - Availability based tariff– Electricity act 2003 – Open access issues – Power exchange – Reforms in the near future

TOTAL: 45 PERIODS

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COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Illustrate restructuring of power industry

CO2:Explain basics of congestion management

CO3:Interpret locational margin prices and financial transmission rights

CO4:Summarize the significance of ancillary services and pricing of transmission network

CO5:Outline the reforms in Indian power sector

TEXT BOOKS :

1. Mohammad Shahidehpour, MuwaffaqAlomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility", 1st Edition, Pub., 2001.
2. Kankar Bhattacharya, Jaap E. Daadler, Math H.J. Boolen, "Operation of restructured power systems", 1st Edition, Kluwer Academic Pub., 2001.
3. Daniel Kirschen and GoranStrbac, 'Fundamentals of Power System economics', 1st Edition, John Wiley & Sons Ltd, 2004.
4. Sally Hunt, 'Making competition work in electricity',1st Edition, John Wiley & Sons, Inc., 2002.
5. Loi Lei Lai , 'Power system restructuring and deregulation', 1st Edition, John Wiley & Sons Ltd., 2001.

REFERENCES :

1. Steven Stoft, "Power system economics: designing markets for electricity", 1st Edition ,John Wiley & Sons2002.
2. LorrinPhilipson and H. Lee Willis, "Understanding Electric Utilities and Deregulation", 1st Edition Marcel Dekker Inc, New York, CRC Press, 2002.
3. Marijallic by Francisco Galiana and Lestor Fink, "Power System Restructuring Engineering & Economics" , 1st Edition, Kulwer Academic Publisher, USA,1998.
4. Mohammad Shahidehpour, MuwaffaqAlomoush, Marcel Dekker, "Restructured electrical power systems: operation, trading and volatility", 1st Edition, Pub., 2001.

21PS108	DIGITAL PROTECTION FOR POWER SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain about the concept of over current and earth fault protection
- To illustrate concepts of transformer protection
- To summarize the various schemes of Over current protection
- To interpret distance and carrier protection schemes
- To demonstrate the concepts of Generator protection and Numerical protection

UNIT I OVERCURRENT &EARTH FAULT PROTECTION 9

Zones of protection – Primary and Backup protection – operating principles and Relay Construction - Time – Current characteristics-Current setting – Time setting-Over current protective schemes –Concept of Coordination - Protection of parallel / ring feeders - Reverse power or directional relay –Polarisation Techniques – Cross Polarisation – Quadrature Connection -Earth fault and phase fault protection - Combined Earth fault and phase fault protection scheme - Phase fault protective - scheme directional earth fault relay - Static over

current relays – Numerical over – current protection; numerical coordination example for a radial feeder		
UNIT II	**TRANSFORMER & BUSBAR PROTECTION**	**9**
Types of transformers –Types of faults in transformers- Types of Differential Protection – High Impedance – External fault with one CT saturation – Actual behaviors of a protective CT – Circuit model of a saturated CT - Need for high impedance – Disadvantages - Percentage Differential Bias Characteristics – Vector group & its impact on differential protection - Inrush phenomenon – Zero Sequence filtering – High resistance Ground Faults in Transformers – Restricted Earth fault Protection - Inter-turn faults in transformers – Incipient faults in transformers - Phenomenon of overfluxing in transformers – Transformer protection application chart. Differential protection of busbars external and internal fault - Supervisory relay-protection of three – Phase busbars – Numerical examples on design of high impedance busbar differential scheme –Biased Differential characteristics – Comparison between Transformer differential & Busbar differential		
UNIT III	**DISTANCE AND CARRIER PROTECTION OF TRANSMISSION**	**9**
Drawback of over – Current protection – Introduction to distance relay – Simple impedance relay – Reactance relay – mho relays. Comparison of distance relay – Distance protection of a three – Phase line-reasons for inaccuracy of distance relay reach - Three stepped distance protection -Trip contact configuration for the three - Stepped distance protection - Three-stepped protection of three-phase line against all ten shunt faults - Impedance seen from relay side - Three-stepped protection of double end fed lines-need for carrier – Aided protection – Various options for a carrier –Coupling and trapping the carrier into the desired line section - Unit type carrier aided directional comparison relaying – Carrier aided distance schemes for acceleration of zone II; numerical example for a typical distance protection scheme for a transmission line.		
UNIT IV	**GENERATOR PROTECTION**	**9**
Electrical circuit of the generator –Various faults and abnormal operating conditions – Stator Winding Faults – Protection against Stator (earth) faults – third harmonic voltage protection – Rotor fault – Abnormal operating conditions - Protection against Rotor faults – Potentiometer Method – injection method – Pole slipping – Loss of excitation – Protection against Mechanical faults; Numerical examples for typical generator protection schemes		
UNIT V	**NUMERICALPROTECTION**	**9**
Introduction–Block diagram of numerical relay - Sampling theorem- Correlation with a reference wave–Least error squared (LES) technique-Digital filtering-numerical over - Current protection– Numerical transformer differential protection-Numerical distance protection of transmission line		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the knowledge on overcurrent and earth fault protection protection.

CO2: Outline the various schemes available in Transformer protection.

CO3: Infer about distance and carrier protection in transmission lines.

CO4: Summarize the concepts of Generator protection.
CO5 :Illustrate in detail about substation automation.

TEXT BOOKS:

1. Y.G. Paithankar and S.R Bhide, "Fundamentals of Power System Protection", 2nd Edition, Prentice-Hall of India, 2003
2. T.S. Madhava Rao, "Digital/Numerical Relays", 1st Edition, Tata McGraw- Hill Publishing Company, 2005
3. Badri Ram and D.N. Vishwakarma, "Power System Protection and Switchgear", 2nd Edition, Tata McGraw- Hill Publishing Company, 2002.
4. Sunil S.Rao, 'Switchgear and Protection', 14th Edition, Khanna Publishers, New Delhi, 2008.

REFERENCES :

1. B.Rabindranath and N.Chander, 'Power System Protection and Switchgear', 1st Edition ,New Age International (P) Ltd., 2011
2. P.Kundur, "Power System Stability and Control", 1st Edition ,McGraw-Hill, 1993.
3. Ravindra P.Singh, 'Switchgear and Power System Protection', 1st Edition ,PHI Learning Private Ltd., NewDelhi, 2009.
4. Rohit Metha and VK Metha," Principles of Power Systems", 3rd Edition, S. Chand Publishers, 2005.

21PS109	SMART GRID	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the need of smart grid technologies
- To demonstrate the integration of distributed generation and control elements of smart grid.
- To outline the various sensor used for smart grid system monitoring.
- To classify the various communication networks used for smart grid system monitoring.
- To illustrate the pricing and energy scheduling for effective demand side management.

UNIT I INTRODUCTION TO SMART GRID 9

Evolution of Electric Grid, Difference between conventional & Smart Grid, National and International Initiatives in Smart Grid, Basis for Smart Grid, Computational Intelligence, Power System Enhancement, Communication and Standards, Environment and Economics, Shareholders Roles and Function, Smart grid Architecture.

UNIT II DISTRIBUTED GENERATION 9

Distributed generation resources, Advantages and disadvantages of DG, Distributed Generation Utilization Barriers, Distributed Generation integration to power grid Smart Grid components control elements, Smart Grid Technologies

UNIT III SENSOR FOR SMART GRID TECHNOLOGIES 9

Sensors for Smart Grid, Monitoring and Measurement Technologies, PMU, Smart meters, Smart Appliances, Multi Agent Systems (MAS) Technology, Micro grid and Smart grid comparison, Wide Area Measurement, smart grid system monitoring, Phasor estimation, Dynamic Phasor estimation.

UNIT IV COMMUNICATION INFRASTRUCTURE IN SMART GRID 9

Power Line Communications, Two-way Digital Communications Paradigm, Network Architectures, IP-based Systems, Advanced Metering Infrastructure, Fiber Optical Networks, Wide Area Network WAN based on Fiber Optical Networks, IP based Real Time data Transmission, Substation communication network, Bluetooth, Zig-Bee, GPS, Geographic Information System (GIS), Broadband over Power line(BPL).

UNIT V DEMAND SIDE MANAGEMENT OF SMART GRID 9

Demand side management, Demand response analysis of Smart Grid, Pricing and Energy Consumption Scheduling, Controllable Load Models, Dynamics and Challenges, Electric Vehicles and Vehicle-to-Grid Systems, Demand Side Ancillary Services Energy Management, Practical study of Smart Grid.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Outline the concepts and need for Smart Grid.

CO2:Summarize the integration of distributed generation to power grid.

CO3:Illustrate the role of sensor in smart grid technologies.

CO4:Compare the various communication system used in smart grid.

CO5:Explain the demand side response analysis and various demand side ancillary services of smart gird

TEXT BOOKS:

1. James A.Momoh, "Smart Grid: Fundamentals of Design and Analysis", 1st Edition, Wiley-IEEE Press, 2012

2. Stuart Borlase "Smart Grid :Infrastructure, Technology and Solutions", 1st Edition, CRC Press, 2012.

3. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama,"Smart Grid: Technology and Applications", 1st Edition, Wiley, 2012.

4. A. Shunmugalatha, B. Ashok Kumar, S. Senthilrani, T. Chandrasekar, J.Rajeswari, " Smart Grid", 1st Edition, Technical Publications, 2021.

REFERENCES

1. Keyhani, Ali, "Design of smart power grid renewable energy systems", 3rd Edition, Wiley, 2011

2. Sawan Sen, Samarjit Sengupta, Abhijit Chakrabarti, "Electricity Pricing: Regulated, Deregulated and Smart Grid Systems", 1st Edition,CRC Press, 2014.

3. Hongjian Sun and Nikos Hatziargyriou, "Smarter Energy. From Smart Metering to the Smart Grid", 1st Edition,The Institution of Engineering and Technology, 2016.

4. Qing Chang Zhong, Tomas Hornik, "Control of Power Inverters in Renewable Energy and Smart Grid Integration", 1st Edition, Wiley-IEEE Press, 2013.

21PS110	POWER SYSTEM OPERATION AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To summarize the fundamentals of speed governing system and the concept of control areas.
- To explain load frequency control and its modelling.
- To illustrate hydrothermal scheduling, Unit commitment and solution techniques.
- To outline the requirements and methods of real and reactive power control in power system.
- To interpret the power system security issues and contingency studies.

UNIT I	INTRODUCTION	9

System load variation: System load characteristics, load curves - Daily, weekly and annual load duration curve, load factor, diversity factor. Reserve requirements: Installed reserves, spinning reserves, cold reserves, hot reserves. Overview of system operation and Control Load forecasting, techniques of forecasting, Indian power sector – Past and present status Recent growth of power sector in India – An overview, A time line of the Indian power sector Players in the Indian power sector, basics of power system operation and control.

UNIT II	LOAD FREQUENCY CONTROL	9

Need for frequency and voltage control - Plant and system level control - modeling of LFC of single area system - static and dynamic analysis - LFC of two area system - static and dynamic analysis – Tie line bias control - development of state variable model of single and two area system

UNIT III	HYDROTHERMAL SCHEDULING PROBLEM	9

Hydrothermal coordination – hydro electric plant models - short term and long term scheduling problem – gradient approach – Hydro units in series - Hydro-thermal scheduling with pumped hydro plant: Scheduling of systems using Dynamic programming and linear programming.

UNIT IV	UNIT COMMITMENT AND ECONOMIC DISPATCH	9

Statement of Unit Commitment (UC) problem; constraints in UC: spinning reserve, thermal unit constraints, hydro constraints, fuel constraints and other constraints; UC solution methods: Priority-list methods, forward dynamic programming approach, numerical problems. Incremental cost curve, coordination equations without loss and with loss, solution by direct method and λ-iteration method. Gradient method- Newton's method – Base point and participation factor method. Economic dispatch controller added to LFC control.

UNIT V	POWER SYSTEM SECURITY	9

Need for power system Security- - Contingency analysis – linear sensitivity factors – AC power flow methods – contingency selection – concentric relaxation – bounding-security constrained optimal power flow-Interior point algorithm-Bus incremental costs.

COURSE OUTCOMES: **TOTAL: 45 PERIODS**

At the end of the course, learners will be able to

CO1:Explain about the operation and control of power system and List the past and present status of Indian power sector.

CO2: Illustrate the static and dynamic model of Load Frequency Control in single and two area system.

CO3: Infer the problems associated with hydro thermal Scheduling and to construct the algorithm for feasible load management.

CO4: Summarize various methods involved in unit commitment and economic dispatch problems.

CO5: Outline the power system security factors and analyse the algorithms used for optimal power flow.

TEXT BOOKS:

1. Robert H. Miller, James H. Malinowski, 'Power system operation', 3rd Edition ,Tata McGraw-Hill, 2009.
2. Allen J. Wood, Bruce F. Wollenberg, 'Power Generation, Operation and Control', 2nd Edition, Wiley India Edition, 2009.
3. Olle. I. Elgerd, "Electric Energy Systems Theory – An Introduction", 2nd Edition, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2003.
4. D.P. Kothari and I.J. Nagrath, "Modern Power System Analysis", 3rd Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003.

REFERENCES

1. L.L. Grigsby, "The Electric Power Engineering, Hand Book", 3rd Edition, CRC Press & IEEE Press, 2001.
2. Ramana, " Power System Operation & Control", 1st Edition, Pearson India,2011.
3. B.R. Gupta and Singhal Vandana, "Power Systems Operation and Control", 1st Edition , S Chand Publishers,December 2010.

21PS111	POWER SYSTEM SIMULATION LABORATORY-II	L	T	P	C
		0	0	4	2

COURSE OBJECTIVES:

- To solve load flow studies and fault analysis of two bus systems with STATCOM.
- To analyze small-signal stability of Single machine and Multi machine configuration.
- To identify the effect of FACTS controllers by performing steady state analysis.
- To experiment with different wind energy conversion technologies.
- To model active filter for mitigating harmonics

LIST OF EXPERIMENTS

1. Small-signal stability analysis of single machine-infinite bus system using classical machine model
2. Small-signal stability analysis of multi-machine configuration with classical machine model
3. Induction motor starting analysis
4. Load flow analysis of two-bus system with STATCOM
5. Transient analysis of two-bus system with STATCOM
6. Available Transfer Capability calculation using an existing load flow program

B-G

7. Study of variable speed wind energy conversion system- DFIG
8. Study of variable speed wind energy conversion system- PMSG
9. Computation of harmonic indices generated by a rectifier feeding a R-Load
10. Design of active filter for mitigating harmonics

TOTAL: 60 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Analyze on various power system dynamic studies for single machine configuration using own program and validation of results using software packages.
CO2:Design steady state and transient analysis of two bus with STATCOM.
CO3:Solve for ATC calculation using load flow program .
CO4:Outline variable speed wind energy conversion system using DFIG and PMSG.
CO5:Design of active filter for mitigating harmonics.

21PS112	TECHNICAL SEMINAR	L	T	P	C
		0	0	2	1

COURSE OBJECTIVES:

- Select a technical topics for presenting engineering/technology concept.
- Make use of technical publications for literature review.
- Model a comprehensive proof of concepts for technical presentation.
- Plan a technical presentation using any suitable tool.
- Develop a technical report using current technology

METHOD OF EVALUATION:

During the seminar session, each student is expected to prepare and present a topic on engineering/ technology, for duration of about 8 to 10 minutes. In a session of three periods per week, 3 students are expected to present the seminar. Each student is expected to present atleast twice during the semester and the student is evaluated based on that. At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are given based on the report. A faculty guide is to be allotted and he / she will guide and monitor the progress of te student and maintain attendance also. Evaluation is 100% internal.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to
CO1: Plan any topic of interest for technical presentation.
CO2: Develop a literature survey with respect to technical publications.
CO3: Apply the comprehensive proof of concept and related data for technical presentation.
CO4: Make use of suitable tool for technical presentation.
CO5 :Select new and recent technology for creating technical reports.

SEMESTER-III

21RM102	RESEARCH METHODOLOGY AND IPR	L	T	P	C
	Common to M.E (Computer Science Engineering), M.E. (Power Systems) and M.E (Manufacturing Engineering)	3	0	0	3

COURSE OBJECTIVES:

- To impart knowledge of collecting data for carrying out research work effectively.
- To enable the students to use optimization technique for problem solving.
- To impart decision making skills using statistical tool.
- To gain exposure to write research reports.
- To impart knowledge about the procedure for filing patents and protecting intellectual property rights.

UNIT I	FUNDAMENTALS AND DATA COLLECTION	9

Research methodology - definition, mathematical tools for analysis, Research design. Types of research, exploratory research, conclusive research, modelling research, algorithmic research, Research process- steps. Data collection methods- Primary data – observation method, personal interview, telephonic interview, mail survey, questionnaire design.

UNIT II	HYPOTHESES TESTING AND ANALYSIS	9

Hypotheses testing – Testing of hypotheses concerning means, concerning variance – one tailed Chi-square test. Introduction to Discriminant analysis, Factor analysis, cluster analysis, multidimensional scaling, conjoint analysis.

UNIT III	REPORT WRITING AND PRESENTATION	9

Report writing- Types of report, guidelines to review report, report format, typing instructions, oral presentation, power point presentation, Data analysis using excel sheet, Proposal submission for funding agencies. Plagiarism, tools to avoid plagiarism, research ethics.

Case study: Report format, Prepare review paper, Reference formation end note, Grammar verification, Sample plagiarism report.

UNIT IV	PATENT RIGHTS	9

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc.

UNIT V	NATURE OF INTELLECTUAL PROPERTY	9

Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Understand the fundamental search concepts and data collection methods for conducting Research work.

CO2:Experiment the test hypothesis and analyze the outcome

CO3:Prepare a report for research work and write research proposals for various funding agencies

CO4:Analyze the procedure for filing patent rights, licensing and transfer of technology.

CO5:Analyze the nature of intellectual property

REFERENCES:

1. Ranjith Kumar, "Research Methodology", 4th Edition, SAGE publication, 2018.
2. Robert Coe, Michael Waring, Larry V Hadges, James Arthur, "Research Method and Methodology in Education", 2nd Edition, SAGE Publication, 2017.
3. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age, 3rd Edition, 2016.
4. T. Ramappa, "Intellectual Property Rights under WTO", 3rd Edition, Asia Law house, 2022

21PS113	PROJECT WORK PHASE I	L	T	P	C
		0	0	12	6

COURSE OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To analyze the project reports with their significance
- To identify the ability during project reviews
- To interview the students during viva voce examination.
- To Interpret with engineers and the society at huge in both written and oral forms

METHOD OF EVALUATION:

Student should work on a topic approved by the Head of the Department under the guidance of faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 300 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Solve any challenging practical problems and find solution by formulating proper methodology.

CO2: Demonstrate a sound technical knowledge of their selected project topic.

CO3:Examine problem identification, formulation and solution.

CO4:Design engineering solutions to complex problems utilizing a systems approach.

CO5:Interpret with engineers and the community at large in written and oral forms.

SEMESTER IV

21PS114	PROJECT WORK PHASE II	L T P C
		0 0 24 12

COURSE OBJECTIVES:

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To analyse the project reports with their significance and social impact
- To identify the ability during project reviews
- To interview the students during viva voce examination.
- To Interpret with engineers and the society at large in both written and oral forms

METHOD OF EVALUATION:

Student should work on a topic approved by the Head of the Department under the guidance of a faculty member and prepares a comprehensive project report after completing the work to the satisfaction of the supervisor. The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

TOTAL: 600 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Solve any challenging practical problems and find solution by formulating proper methodology.
CO2: Demonstrate a sound technical knowledge of their selected project topic.
CO3: Examine problem identification, formulation and solution.
CO4: Design engineering solutions to complex problems utilizing a systems approach.
CO5: Interpret with engineers and the community at large in written an oral forms.

PROFESSIONAL ELECTIVE - I

21PSP35	ANALYSIS OF ELECTRICAL MACHINES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the fundamentals of magnetic circuits, energy, force and torque of multi-excited systems
- To analyze the steady state and dynamic state operation of DC machine through mathematical modeling and simulation in digital computer
- To outline the knowledge of theory of transformation of three phase variables to two phase variables
- To relate the steady state and dynamic state operation of three-phase induction machines
- To summarize the synchronous machines using transformation theory based mathematical modeling and digital computer simulation.

UNIT I	PRINCIPLES OF ELECTROMAGNETIC ENERGY CONVERSION	9

Magnetic circuits, Permanent magnet, Stored magnetic energy, Co-energy - Force and Torque in singly and doubly excited systems – Machine windings and Air-gap mmf - Winding inductances and Voltage equations.

UNIT II	DC MACHINES	9

Elementary DC machine and Analysis of steady state operation - Voltage and Torque equations - Dynamic characteristics of permanent magnet and shunt D.C. motors – Time domain block diagrams - Solution of dynamic characteristic by Laplace transformation – Digital computer simulation of permanent magnet and shunt D.C machines.

UNIT III	REFERENCE FRAME THEORY	9

Historical background – Phase transformation and Commutator transformation – Transformation of variables from stationary to arbitrary reference frame - Variables observed from several frames of reference.

UNIT IV	INDUCTION MACHINES	9

Three phase induction machine, Equivalent circuit and Analysis of steady state operation – Free acceleration characteristics – Voltage and Torque equations in machine variables and arbitrary reference frame variables – Analysis of dynamic performance for load torque variations – Digital computer simulation.

UNIT V	SYNCHRONOUS MACHINES	9

Three phase synchronous machine and Analysis of steady state operation - Voltage and Torque equations in machine variables and rotor reference frame variables (Park's equations) – Analysis of dynamic performance for load torque variations – Generalized theory of rotating electrical machine and Krons primitive machine.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Illustrate the various electrical parameters in mathematical form.

CO2:Outline the concepts of DC machines.

CO3:Explain the different types of reference frame theories and transformation relationships.

CO4:Relate the equivalent circuit parameters and modeling of induction machine.

CO5:Analyze the different parameters of synchronous machines.

TEXT BOOKS :

1. R. Krishnan, "Electric Motor Drives - Modeling, Analysis& control", 1st Edition, Pearson Publications, 2002.
2. P.C.Krause, Oleg Wasynczuk, Scott D.Sudhoff, "Analysis of Electrical Machinery and Drive systems", 2nd Edition, IEEE Press, John Wiley, 2010.
3. Paul Krause "Reference Frame Theory, , 2nd Edition, IEEE Press, John Wiley,2021
4. Braham Ferreira" The principles of contemporary power electronics and electromechanic power conversion", 1st Edition, IEEE Press, John Wiley, 2014.

REFERENCES

1. P S Bimbhra, "Generalized Theory of Electrical Machines", 1st Edition, Khanna Publishers, 2008.
2. A.E, Fitzgerald, Charles Kingsley, Jr, and Stephan D, Umanx, " Electric Machinery", 5th Edition,Tata McGraw Hill, 1992.
3. U. A. Bakshi "Transformers & Induction Machines" , 2nd Edition, Technical Publications, 2013
4. T.A.Lipo " Analysis of Synchronous Machines", , 2nd Edition, CRC Press, Taylor & Francis,2017

21PSP36	SOFTCOMPUTING TECHNIQUES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To summarize the functions of feed forward and feedback neural networks.
- To explain the concept of fuzziness involved in various systems.
- To infer the idea about genetic algorithm
- To outline Fuzzy Logic Control and Neural Network toolbox
- To illustrate the concept of hybrid control systems

UNIT I	INTRODUCTION AND ARTIFICIAL NEURAL NETWORKS	9

Introduction to intelligent systems - Soft computing techniques - Conventional Computing versus Swarm Computing – Classification of meta-heuristic techniques – Properties of Swarm intelligent Systems -Application domain – Discrete and continuous problems - Single objective and multi-objective problems – Neuron – Nerve structure and synapse - Artificial Neuron and its model – activation functions – Neural network architecture – single layer and multilayer feed forward networks - Mc Culloch Pitts neuron model - perceptron model - Adaline and Madaline – multi layer perception model – back propagation learning methods – effect of learning rule coefficient – back propagation algorithm – factors affecting back propagation training - applications.

UNIT II	ARTIFICIAL NEURAL NETWORKS AND ASSOCIATIVE MEMORY	9

Counter propagation network – architecture – functioning & characteristics of counter

Propagation network - Hopfield/ Recurrent network configuration – stability constraints associative memory and characteristics – limitations and applications – Hopfield v/s Boltzman machine – Adaptive Resonance Theory – Architecture – classifications – Implementation and training - Associative Memory.		
UNIT III	**FUZZY LOGIC SYSTEM**	**9**
Introduction to crisp sets and fuzzy sets – basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control – Fuzzification inferencing and defuzzification – Fuzzy knowledge and rule bases – Fuzzy modeling and control schemes for nonlinear systems. Self organizing fuzzy logic control – Fuzzy logic control for nonlinear time delay system.		
UNIT IV	**GENETIC ALGORITHM**	**9**
Evolutionary programs – Genetic algorithms, genetic programming and evolutionary programming – Genetic Algorithm versus Conventional Optimization Techniques – Genetic representations and selection mechanisms; Genetic operators – different types of crossover and mutation operators – Optimization problems using GA – discrete and continuous - Single objective and multi-objective problems - Procedures in evolutionary programming.		
UNIT V	**HYBRID CONTROL SCHEMES**	**9**
Fuzzification and rule base using ANN – Neuro fuzzy systems – ANFIS – Fuzzy Neuron – Optimization of membership function and rule base using Genetic Algorithm – Introduction to Support Vector Machine – Evolutionary Programming – Particle Swarm Optimization (PSO) - Case study – Familiarization of NN,FLC and ANFIS Tool Box.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Explain the basic ANN architectures, algorithms and their limitations.

CO2:Summarize the different operations on the fuzzy sets.

CO3:Explain ANN based models and Fuzzy Logic control schemes for non-linear system.

CO4:Show the use of different ANN structures and online training algorithm.

CO5:Interpret hybrid control schemes and PSO and support vector regressive.

TEXT BOOKS:

1. Laurene V. Fausett, "Fundamentals of Neural Networks: Architectures, Algorithms And Applications", 1st Edition, Pearson Education. 1993.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", 3rd Edition, Wiley India, 2008.
3. Zimmermann H.J. "Fuzzy set theory and its Applications" ,4th Edition, Springer, 2011.
4. David E. Goldberg, "Genetic Algorithms in Search, Optimization, and Machine Learning",1st Edition, Pearson Education,2009.

REFERENCES

1. W.T.Miller, R.S.Sutton and P.J.Webrose,"Neural Networks for Control" 1st Edition, MIT Press", 1996.
2. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning Series)", 2nd Edition, MIT Press,2004.

3. Corinna Cortes and V. Vapnik, " Support –Vector Networks, Machine Learning" , 1st Edition, Springer, 1995.
4. Jyh-Shing Roger Jang, Chuen-Tsai Sun, Eiji Mizutani, —Neuro-Fuzzy and Soft Computing, 1st Edition, Prentice-Hall of India, 2002.

21PSP37	INDUSTRIAL POWER SYSTEM ANALYSIS AND DESIGN	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the industrial motor starting methods.
- To illustrate the power factor correction methods in industrial motors.
- To infer the harmonic elimination techniques in power system.
- To summarize the flickers and its effects in industrial loads.
- To demonstrate the effects of switching surges.

UNIT I	MOTOR STARTING STUDIES	9
Introduction - evaluation criteria - starting methods - system data - voltage drop calculations - calculation of acceleration time - motor starting with limited capacity generators – computer aided analysis.		
UNIT II	**POWER FACTOR CORRECTION**	**9**
Introduction - system description and modeling - acceptance criteria - frequency scan analysis - voltage magnification analysis - sustained over voltages - switching surge analysis - back-to-back switching.		
UNIT III	**HARMONIC ANALYSIS**	**9**
Harmonic sources - system response to harmonics - system model for computer - aided analysis - acceptance criteria - harmonic filters - harmonic evaluation - case study.		
UNIT IV	**FLICKER ANALYSIS**	**9**
Sources of flicker - flicker analysis – flicker criteria - data for flicker analysis - case study - arc furnace load - minimizing the flicker effects.		
UNIT V	**SWITCHING SURGES**	**9**
Modeling of system – effects of switching surges – capabilities - voltage acceptance criteria - insulation coordination - case study - methods of minimizing switching surges.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Explain various industrial motor starting methods.
CO2:Summarize different power factor correction methods.
CO3:Illustrate about computer-aided harmonic analysis to design filters.
CO4:Outline the various methods of flicker analysis.
CO5: Interpret the effects of switching surges.

TEXT BOOKS:

1. Ramasamy Natarajan, "Computer-Aided Power System Analysis", 1st Edition, Marcel Dekker Inc., 2002.
2. Roger.C.Dugan, Mark.F.Mc.Granagham,Surya Santoso, H.Wayne Beaty,"Electrical Power Systems Quality", 1st Edition, McGraw Hill,2003.

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PROFESSIONAL ELECTIVE-II

21PSP38	SOLAR AND ENERGY STORAGE SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain solar modules and PV system design and their applications.
- To summarize the concept of grid connected PV systems.
- To illustrate grid connected PV system.
- To classify different energy storage systems.
- To outline the various applications of solar PV.

UNIT I	INTRODUCTION	9

Characteristics of sunlight – Sun and its radiation –Apparent motion of the sun –solar energy and photo voltaic - semiconductors and P-N junctions –behavior of solar cells – cell properties – PV cell interconnection.

UNIT II	STAND ALONE PV SYSTEM	9

Modules –storage systems–- power conditioning and regulation-Diodes, regulators and inverters - MPPT-protection– standalone PV systems design–PV design approach -sizing

UNIT III	GRID CONNECTED PV SYSTEMS	9

Systems in buildings– Module mounting approaches – Utility applications for photo voltaics – design issues for central power stations–safety–Economic aspect– Efficiency and performance - International PV programs

UNIT IV	ENERGY STORAGE SYSTEMS	9

Impact of intermittent generation–Battery energy storage– Batteries – Types and applications – solar thermal energy storage– pumped hydro electric energy storage.

UNIT V	APPLICATIONS	9

Pumping–battery chargers–solar car–direct-drive applications–Space– Telecommunications-Marine navigational aids- Electric fences -Photovoltaic powered transport- Photovoltaic for developing countries

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the characteristics of solar energy storage systems.
CO2: Outline the concept of standalone PV system.
CO3: Summarize the issues in grid connected PV systems.
CO4: Interpret the modeling of different energy storage systems and their performances.
CO5: Illustrate different applications of solar energy.

TEXT BOOKS :

1. Solanki C.S., "Solar Photo voltaics: Fundamentals, Technologies And Applications", 1st Edition, PHI LearningPvt.Ltd.,2015.
2. Stuart R.Wenham, Martin A.Green, Muriel E.Wattand Richard Corkish, "Applied Photovoltaics", 1st Edition ,Earthscan, UK 2007.
3. Hee-Je Kim ,'Solar Power and Energy Storage Systems', Kindle Edition, Taylor and Francis, 2019

3. J. Arrillaga, N.R. Watson, S. Chen, "Power System Quality Assessment", 1st Edition, Wiley, New York, 2000.
4. Andrew R. Hileman, "Insulation Coordination for Power Systems" 1st Edition, CRC Press - Technology & Engineering, 1999.

REFERENCES:

1. J. C. Das, "Power System Analysis - Short-Circuit Load Flow and Harmonics", 1st Edition, Marcel Dekker Inc. New York, 2002.
2. Shoaib Khan , "Industrial power systems" , 1st Edition, CRC Press, Taylor & Francis , 2007.
3. N H Malik, "Electrical Insulation in Power Systems" , 1st Edition, Taylor and Francis, 2017.
4. P.S.R. Murty, "Electrical Power Systems", Butterworth-Heinemann Ltd., 1st Edition, 2017.

4. Ameta S C, Solar Energy Conversion And Storage Photochemical Modes, 1st Edition Taylor and Francis,2015

REFERENCES

1. Eduardo Lorenzo G. Araujo, "Solar electricity engineering of photovoltaic systems", 1st Edition , Progensa, 1994.
2. Frank S. Barnes & Jonah G.Levine, "Large Energy storage Systems Handbook", 1st Edition , CRC Press, 2011.
3. McNeils, Frenkel, Desai, "Solar &Wind Energy Technologies", 1st Edition ,Wiley Eastern, 1990.
4. Antonio D Lopez , "Solar Energy Batteries & Energy Storage Assessments of Federal Initiatives", 1st Edition,Nova Science 2013

21PSP39	HVDC Transmission	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To understand the concept, planning of DC power transmission and comparison with AC Power transmission.
- To analyze HVDC converters
- To explain about the HVDC system control.
- To illustrate harmonics and design of filters.
- To summarize various DC system under study state.

UNIT I INTRODUCTION — 9

DC Power transmission technology – Comparison of AC and DC transmission – Application of DC transmission – Description of DC transmission system – Planning for HVDC transmission – Modern trends in HVDC technology – DC breakers – Operating problems – HVDC transmission based on VSC – Types and applications of MTDC systems.

UNIT II ANALYSIS OF HVDC CONVERTERS — 9

Line commutated converter - Analysis of Graetz circuit with and without overlap - Pulse number – Choice of converter configuration – Converter bridge characteristics – Analysis of a 12 pulse converters – Analysis of VSC topologies and firing schemes.

UNIT III CONVERTER AND HVDC SYSTEM CONTROL — 9

Principles of DC link control – Converter control characteristics – System control hierarchy – Firing angle control – Current and extinction angle control – Starting and stopping of DC link – Power control – Higher level controllers – Control of VSC based HVDC link.

UNIT IV EHVAC SYSTEMS — 9

Limitations of extra long AC transmission-Voltage profile and voltage gradient of conductor, Electrostatic field of transmission line-Reactive Power planning and control, traveling and standing waves- EHV cable transmission system.

UNIT V POWER FLOW ANALYSIS IN AC/DC SYSTEMS — 9

Component models, solution of DC load flow-per unit system for DC quantities-solution techniques of AC-DC power flow equations, Parallel operation of HVDC/AC systems.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

BoS Chairman

CO1: Explain the principles and types of HVDC system
CO2: Outline the concept of HVDC converters
CO3: Interpret the operational characteristics and control of HVDC link.
CO4: Illustrate power flow in AC/DC systems
CO5: Summarize the concept of power system operation, stability, control and protection.

TEXT BOOKS:

1. Padiyar, K. R., "HVDC power transmission system", 2nd Edition, New Age International (P) Ltd., New Delhi, , 2016
2. Edward Wilson Kimbark, "Direct Current Transmission-vol.1", 1st Edition, Wiley Inter science, New York , 1971
3. Rakosh Das Begamudre, "Extra High Voltage AC Transmission Engineering", 1st Edition, New Age International (P) Ltd., New Delhi, 1990.
4. Begamudre R.D., EHV AC Transmission Engineering, 2nd Edition, Wiley Eastern Ltd., New Delhi, 1991.
5. V.K.Sood, "HVDC and FACTS controllers- Applications of Static Converters in Power System", 1st Edition. Springer Publishers, 2014

REFERENCES :

1. Kundur P., "Power System Stability and Control", 1st Edition, McGraw-Hill, 1993.
2. Hingorani N.G. and Gyugyi L., "Understanding Facts", 1st Edition,IEEE Press, New York,1999.
3. Arrillaga J. and Smith B.C., "AC-DC Power System Analysis", 1st Edition, IEE Press, London,1998.
4. S. Kamakshaiah, V. Kamaraju, 'HVDC Transmission',1st Edition, Tata McGraw Hill Education Private Limited, 2011

21PSP40	FACTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basic concepts of Flexible AC Transmission System(FACTS)controllers in power transmission.
- To illustrate the characteristics and applications of Static Var Compensator(SVC) & Static Compensator (STATCOM) in power transmission
- To summarize the applications of Thyristor Controlled Series Capacitor (TCSC) and Static Synchronous Series Compensator(SSSC)
- To outline the operational characteristics of Unified Power Flow Controller and Interline Power Flow Controllers
- To show the special purpose FACTS controllers and real time applications.

UNIT I — INTRODUCTION TO FACTS — 9

Reactive power control in electrical power transmission lines –Uncompensatedtransmission line – Fixed series and shunt compensation – Basic types of FACTScontrollers – Brief description and definitions of FACTS controllers..

UNIT II — STATIC SHUNT COMPENSATION — 9

Basic operating principle of Static Var Compensators and STATic COMpensator (STATCOM) –

Regulation slope - transfer function and dynamic performance- Comparison between SVC and STATCOM - V-I& V-Q characteristics - Applications: Enhancement of transient stability and power oscillation damping.

UNIT III	STATIC SERIES COMPENSATORS	9

Concepts of Controlled Series Compensation- Operation of Thyristor Controlled Series Capacitor (TCSC) - Modelling of TCSC for load flow studies - Modelling of Thyristor Switched Series Capacitor (TSSC) for power flow - Applications: Improvement of the system stability limit - Enhancement of power system damping - Sub Synchronous Resonance (SSR) Mitigation.

UNIT IV	COMBINED SERIES AND SHUNT CONTROLLERS	9

Unified Power Flow Controller (UPFC) - Operating principle - Independent real and reactive power flow control - Dynamic performance - Interline Power Flow Controllers (IPFC) - operating principle - control structure - practical application considerations.

UNIT V	SPECIAL PURPOSE FACTS CONTROLLERS	9

N G Hingorani (NGH) - SSR damping scheme - Thyristor Controlled Braking Resistor (TCBR)- Design and operating aspects - Application examples - Western Area Power Administration's (WAPA) substation with Advanced Series Capacitor (ASC), Bonneville Power Administration (BPA) system with TCSC.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Outline the need for Flexible AC Transmission System(FACTS) controllers in power system.

CO2: Relate applications of Static VAR Compensator (SVC) & Static Compensator (STATCOM) in power system networks

CO3: Show the applications of Thyristor Controlled Series Capacitor (TCSC) and Thyristor Switched Series Capacitor (TSSC) in power system stability enhancement.

CO4: Interpret the operational characteristics of UPFC and Interline Power Flow Controllers for power system stability improvement.

CO5:Explain the special purpose FACTS controllers in power system.

TEXT BOOKS:

1. N.G. Hingorani & L. Gyugyi, Understanding FACTS: Concepts and Technology Flexible AC Transmission Systems", 2nd Edition, Wiley India publishers, 2011.
2. Mohan Mathur, R., Rajiv. K. Varma, "Thyristor – Based Facts Controllers for Electrical Transmission Systems", 1st Edition, IEEE press and John Wiley & Sons, 2002
3. K.R.Padiyar, "FACTS Controllers in Power Transmission and Distribution", 2nd Edition, Reprint,New Age International Publishers, 2016.
4. V.K.Sood, "HVDC and FACTS controllers- Applications of Static Converters in Power System", 1st Edition, Springer Publishers, 2014.

REFERENCES:

1. K.R.Padiyar, "HVDC Power Transmission Systems", 2nd Edition,New Age International publishers,2016.
2. A.T.John,"Flexible A.C. Transmission Systems", 1st Edition, Institution of Electrical and Electronic Engineers publishers, 1999.

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BoS Chairman

3. Xiao-Ping Zhang, "Flexible AC transmission systems, Modelling & Control", 2nd Edition, Springer Publications, 2012.
4. Suman Bhowmick, "Flexible AC Transmission Systems (FACTS): Newton Power-Flow Modeling of Voltage-Sourced Converter-Based Controllers", 1st Edition, CRC Press, 2016.

PROFESSIONAL ELECTIVE-III

21PSP41	WASTE TO ENERGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To interpret the various types of wastes from which energy can be generated
- To develop knowledge on biomass pyrolysis process and its applications
- To outline various types of biomass gasifiers and their operations
- To explain the biomass combustors and its applications on generating energy
- To summarize the principles of bio-energy systems and their features

UNIT I	INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE	9
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors		
UNIT II	**BIOMASS PYROLYSIS**	**9**
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application –Manufacture of pyrolytic oils and gases, yields and applications.		
UNIT III	**BIOMASS GASIFICATION**	**9**
Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.		
UNIT IV	**BIOMASS COMBUSTION**	**9**
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types,inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.		
UNIT V	**BIO ENERGY**	**9**
Properties of biogas (Calorific value and composition), Biogas plant technology and status – Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion – biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production –Urban waste to energy conversion - Biomass energy programme in India.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Summarize the various types of wastes from which energy can be generated.

CO2:Explain about biomass pyrolysis process and its applications.

CO3:List the various types of biomass gasifiers and their operations.

CO4:Outline biomass combustors and its applications on generating energy.

CO5:Illustrate the principles of bio-energy systems and their features.

A. [signature]
BoS Chairman

TEXT BOOKS :

1. Khandelwal, K. C. and Mahdi, S. S., "Biogas Technology - A Practical Hand Book", Vol. I & II, 1st Edition,Tata McGraw Hill Publishing Co. Ltd., 1983.
2. C. Y. WereKo-Brobby and E. B. Hagan, John , "Biomass Conversion and Technology",1st Edition, Wiley & Sons, 1996.
3. D.S. Challal, "Food, Feed and Fuel from Biomass" , 1st Edition, IBH Publishing Co. Pvt. Ltd., 1991.
4. Desai and Ashok V, "Non Conventional Energy", 1st Edition, Wiley Eastern Ltd., 1990.

REFERENCES :

1. Marc Rogoff, Francois Screve, "Waste-to-Energy Technologies and Project Implementation" , 3rd Edition, Elsevier, March 9, 2019.
2. Naomi B. Klinghoffer and Marco J. Castaldi, "Waste to Energy Conversion Technology",1st Edition, Science Direct, 2013.
3. Paul Breeze, "Energy from Waste",1st Edition Elsevier, October 20, 2017.
4. Rajeev Pratap Singh, Vishal Prasad and Barkha Vaish, "Advances in Waste-to-Energy Technologies", 1st Edition, CRC Press, December 2, 2019.

21PSP42	DISTRIBUTED GENERATION AND MICROGRID	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To outline the concepts of renewable energy sources
- To explain the concept of distributed generation
- To extent the knowledge in impact of grid integration.
- To summarize the concept of Microgrid and its configuration
- To illustrate the various control operations of micro grid

UNIT I — INTRODUCTION — 9

Conventional power generation: advantages and disadvantages, Energy crises, Non- conventional energy (NCE) resources: review of Solar PV, Wind Energy systems, Fuel Cells, micro-turbines, biomass, and tidal sources.

UNIT II — DISTRIBUTED GENERATIONS (DG) — 9

Concept of distributed generations, topologies, selection of sources, regulatory standards/framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants.

UNIT III — IMPACT OF GRID INTEGRATION — 9

Requirements for grid interconnection, limits on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power qualityissues.

UNIT IV — BASICS OF MICROGRID — 9

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power

Electronics interfaces in DC and AC microgrids.

UNIT V	CONTROL AND OPERATION OF MICROGRID	9

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics, Introduction to smart microgrids.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Summarize the various schemes of conventional and Non-conventional power generation.
CO2:Explain different topologies and energy sources of distributed generation.
CO3:Illustrate the requirements for grid interconnection and its impact with NCE sources.
CO4:Outline the basic operation of Microgrid.
CO5:Relate the various control operations of micro grid.

TEXT BOKS:

1. Math H. J. Bollen, FainanHussain," Integration of distributed generation power system", 1st Edition, Wiley IEEE press, 2011.
2. Qing - Chang Zhong, Tomas Hornlk, " Control of Power Inverters in Renewable Energy and Smart Grid Integration", 1st Edition, Wiley IEEE press, 2012.
3. D. Hall and R. P. Grover, "Biomass Regenerable Energy", 1st Edition, John Wiley, New York,1987.
4. John Twidell and Tony Weir, "Renewable Energy Resources",3rd Edition,Taylor and Francis Publications, 2006

REFERENCES

1. Amirnaser Yezdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and Applications", 1st Edition, IEEE John Wiley Publications, 2010.
2. Dorin Neacsu, "Power Switching Converters: Medium and High Power", 3rd Edition, CRC Press,Taylor & Francis, 2006
3. Chetan Singh Solanki, "Solar Photo Voltaics, Fundamentals, Technologies and Applications", 3rd Edition, PHI learning Pvt. Ltd., New Delhi,2009.
4. J.F. Manwell, J.G. McGowan "Wind Energy Explained, Theory design and applications", 2nd Edition, Wiley publication 2010.

21PSP43	ENERGY EFFICIENCY IN ELECTRICAL UTILITIES	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To infer the basic knowledge on electrical utilities
- To explain the concepts behind energy efficiency in HVAC and Refrigeration System
- To summarize various energy saving opportunities in lighting system
- To outline the concept of energy management in diesel / natural gas power generating systems

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BoS Chairman

- To illustrate the energy conservation process in buildings

UNIT I	**ELECTRICAL SYSTEM**	9
Electricity billing, electrical load management and maximum demand control, power factor improvement and its benefit, Electric motors: Types, losses in induction motors, motor efficiency, factors affecting motor performance, rewinding and motor replacement issues Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation, Compressed air system components, capacity assessment, leakage test		
UNIT II	**HVAC AND REFRIGERATION SYSTEM**	9
Vapour compression refrigeration cycle, refrigerants, coefficient of performance- Vapour absorption refrigeration system: Working principle, types and comparison with vapour compression system- Fans and blowers: Types, performance evaluation, efficient system operation, Pumps and Pumping System: Types, performance evaluation, efficient system operation.		
UNIT III	**LIGHTING SYSTEM**	9
Light source, choice of lighting, luminance requirements, and energy conservation avenues. Diesel Generating system: Factors affecting selection, energy performance assessment of diesel conservation avenues.		
UNIT IV	**DIESEL / NATURAL GAS POWER GENERATING SYSTEMS**	9
Diesel / Natural gas Power Generating systems: Factors affecting selection, energy performance assessment of diesel conservation avenues, Waste heat recovery.		
UNIT V	**ENERGY CONSERVATION IN BUILDINGS AND ENERGY CONSERVATION BUILDING CODES (ECBC)**	9
Introduction about Energy Conservation Building Codes (ECBC), building envelope, insulation, lighting, Heating, ventilation, air conditioning (HVAC), fenestrations, water pumping, inverter and energy storage/captive generation, elevators and escalators, star labeling for existing buildings, Energy Service Companies based case studies.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Explain the performance of electrical utilities like electric motors and compressed air systems.

C21:Illustrate the role of HVAC and Refrigeration System, Lighting system to improve the efficiency in electrical utilities .

CO3:Explain the performance of Diesel / Natural gas Power Generating systems.

CO4:Outline the concept of Energy conservation in Buildings and Energy Conservation Building Codes (ECBC) .

CO5:Summarize various energy saving opportunities to improve the overall efficiency for electrical utilities.

TEXT BOOKS :

1. Energy Efficiency in Electrical Utilities , Guide book for National Certification Examination for Energy Manager and Auditors, 4th Edition ,Bureau of Energy Efficiency , 2015.
2. Rajiv Shankar, "Energy Auditing in Electrical Utilities" , 1st Edition ,MV Learning, , 2015
3. Scott Dunning and Larry S. Katz, Energy Calculations and Problem Solving Sourcebook: A Practical Guide for the Certified Energy Manager Exam, 1st Edition, River Publishers , 2017
4. D. Paul Mehta and Albert Thumann, "Handbook of Energy Engineering",7th Edition,Rivers Publishers,2013.

REFERENCES :

1. Frank Kreith, D. Yogi Goswami, " Energy management and conservation handbook", 1st Edition, CRC Press, 2008.
2. Patrik Thollander, Jenny Palm ,"Improving Energy Efficiency in Industrial Energy Systems: An Interdisciplinary Perspective on Barriers, Energy Audits, Energy Management, Policies, and Programs", 1st Edition , Springer-Verlag London, 2013.
3. David Thorpe, "Energy Management in Industry- The Earthscan Expert Guide", Routledge Publishers, 1st Edition, 2014.
4. Moncef Krarti, " Energy Audit of Building Systems: An Engineering Approach", 2nd Edition, CRC Press, 2010.
5. Sonal Desai,Hand book of Energy Audit, Kindle Edition, Tata McGraw Hill Publishers 2017.

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21PSP44	ELECTRICAL DISTRIBUTION SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the electrical characteristics of distribution system
- To relate the knowledge about planning and designing of distribution system
- To summarize the basic concept of power quality in distribution system
- To outline the concept of voltage regulation in electrical distribution system
- To interpret the concept of power flow analysis in distribution feeder systems

UNIT I INTRODUCTION — 9

Distribution System-Distribution Feeder Electrical Characteristics-Nature of Loads: Individual Customer Load, Distribution Transformer Loading and Feeder Load-Approximate Method of Analysis: Voltage Drop, Line Impedance, "K" Factors, and Lumping Loads in Geometric Configurations.

UNIT II DISTRIBUTION SYSTEM PLANNING — 9

Factors effecting planning, present techniques, planning models (Short term planning, long term planning and dynamic planning), planning in the future, future nature of distribution planning, Role of computer in Distribution planning, Load forecast and Load models.

UNIT III DISTRIBUTION SYSTEM LINE MODEL — 9

Exact Line Segment Model-Modified Line Model-Approximate Line Segment Model-Modified "Ladder" Iterative Technique-General Matrices for Parallel Lines.

UNIT IV VOLTAGE REGULATION — 9

Standard Voltage Ratings-Two-Winding Transformer Theory-Two-Winding Autotransformer-Step-Voltage Regulators: Single-Phase Step-Voltage Regulators-Three-Phase Step-Voltage Regulators- Application of capacitors in Distribution system.

UNIT V DISTRIBUTION FEEDER ANALYSIS — 9

Power-Flow Analysis- Ladder Iterative Technique -Unbalanced Three-Phase Distribution Feeder- Modified Ladder Iterative Technique- Load Allocation- Short-Circuit Studies.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Explain the knowledge about distribution system.
CO2:Apply the concepts of planning and design of distribution system for utility systems
CO3:Summarize the various concepts of distribution system line model
CO4:Make use of voltage control concept in distribution system.
CO5:Develop the power flow analysis in balanced and unbalanced systems

TEXT BOKS:

1. William H. Kersting," Distribution System Modeling and Analysis " ,3rd Edition ,CRC press,2012.
2. TuranGonen, "Electric Power Distribution System Engineering",2nd Edition, McGraw Hill Company. 1986.
3. Math H. J. Bollen, FainanHussain," Integration of distributed generation power system",

1st Edition, Wiley IEEE press, 2011
4.William H. Kersting," Distribution System Modeling and Analysis " 2nd Edition ,CRC press ,2006

REFERENCES

1. James Northcote – Green, Robert Wilson, "Control and Automation of Electrical Power Distribution Systems", 1st Edition, CRC Press, New York, 2007.
2. A.S.Pabla, "Electric Power Distribution", 4th Edition, Tata Mc Graw-Hill Publishing Company, ,1997.
3.Kamaraju V, "Electrical Power Distribution Systems", 2nd Edition, Tata McGraw Hill. 2004.
4.Dale R.patrick, "Electrical Power Distribution Systems", 2nd Edition, S.Chand (G/L) & Company Ltd.,2009.

21PSP45	CONTROLLERS FOR POWER CONVERTERS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the various types of power converters
- To interpret Sliding Mode Controller Design and types of converters
- To classify Linear and Nonlinear Controller Design for converters
- To relate System Faults and Diagnosis in Power Converters.
- To illustrate the predictive controllers for fault diagnosis in power converters

UNIT I — **MODELLING OF DC-TO-DC POWER CONVERTERS** — 9

Modeling of Buck Converter , Boost Converter ,Buck-Boost Converter, Cuk Converter ,Sepic Converter, Zeta Converter, Quadratic Buck Converter ,Double Buck-Boost Converter, Boost-Boost Converter Forward converter , Fly back Converter and Push –Pull Converter- General Mathematical Model for Power Electronics Devices

UNIT II — **SLIDING MODE CONTROLLER DESIGN** — 9

Variable Structure Systems. Single Switch Regulated Systems Sliding Surfaces, Accessibility of the Sliding Surface Sliding Mode Control-Implementation of Boost Converter ,Buck-Boost Converter, Cuk Converter ,Sepic Converter, Zeta Converter, Quadratic Buck Converter ,Double Buck-Boost Converter, Boost-Boost Converter - Forward converter , Fly back Converter and Push –Pull Converter

UNIT III — **APPROXIMATE LINEARIZATION CONTROLLER DESIGN** — 9

Linear Feedback Control, Pole Placement by Full State Feedback , Pole Placement Based on Observer Design ,Reduced Order Observers , Generalized Proportional Integral Controllers, Passivity Based Control , Sliding Mode Control Implementation of Buck Converter , Boost Converter ,Buck-Boost Converter –Performance indices design examples.

UNIT IV — **NONLINEAR CONTROLLER DESIGN** — 9

Feedback Linearization Isidori's Canonical Form , Input-Output Feedback Linearization ,State Feedback Linearization, Passivity Based Control , Full Order Observers , Reduced Order Observers-Design on Closed loop control performance of converter.

UNIT V — **PREDICTIVE CONTROL OF POWER CONVERTERS** — 9

Basic Concepts, Theory, and Methods, Application of Predictive Control in Power Electronics,

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AC-DC-AC Converter System, AC-DC converter system-Resonant converter-Faults and Diagnosis Systems in Power Converters.	**TOTAL: 45 PERIODS**

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Classify the various dc-dc power converters

CO2:Illustrate sliding mode controller technique in power converters

CO3:Explain the different linear controller techniques for power converters

CO4:Identify the various non-linear controller techniques for power converters

CO5: Summarize the predictive controllers for fault diagnosis in power converters

TEXT BOOKS:

1.M.H.Rashid, "Power Electronics: Circuits, Devices and Applications", 3rd Edition, Pearson Education, PHI, New Delhi, 2004.

2. P.S.Bimbra ,"Power Electronics", 3rd Edition, Khanna Publishers, 2003.

3. Ashfaq Ahmed 'Power Electronics for Technology', 1st Edition, Pearson Education, Indian reprint, 2003.

4. Hebertt Sira-Ramírez PhD, Ramón Silva-Ortigoza, "Control Design Techniques in Power Electronics Devices", 2012th Edition, Springer 2012

REFERENCES

1. Enrique Acha, Vassilios Agelidis, Olimpo Anaya, TJE Miller, "Power Electronic Control in Electrical Systems", 1st Edition Newnes, 2002.

2. Marija D. Aranya Chakrabortty, Marija , "Control and Optimization Methods for Electric Smart Grids", 12th Edition, Springer, 2012.

3. Joseph Vithayathil,' Power Electronics, Principles and Applications', 6th Edition, McGraw Hill Series Reprint, 2013.

4. Philip T. Krein, "Elements of Power Electronics", 2nd Edition, Oxford University Press, 2004.

21PSP46	**ENERGY EFFICIENCY IN THERMAL UTILITIES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES:

- To infer basic Knowledge in fuels and combustion process
- To outline the concept of boilers in thermal utilities
- To demonstrate the role of steam system
- To explain the concepts behind energy efficiency in thermal utilities
- To summarize various energy saving opportunities in thermal utilities

UNIT I	**FUELS AND COMBUSTION**	**9**

Introduction to fuels, properties of fuel oil, coal and gas, storage, handling and preparation of fuels, principles of combustion, combustion of oil, coal and gas. Agro-residue/biomass handling, preparation and combustion.

UNIT II	**BOILERS**	**9**

Types, combustion in boilers, performances evaluation, analysis of losses, feed water treatment, blow down, energy conservation opportunities. Boiler efficiency calculation, evaporation ratio and efficiency for coal, oil and gas. Soot blowing and soot deposit reduction, reasons for boiler tube failures, start up, shut down and preservation, Thermic fluid heaters, super critical boilers.

UNIT III	STEAM SYSTEM	9
Properties of steam, assessment of steam distribution losses, steam leakages, steam trapping, condensate and flash steam recovery system, identifying opportunities for energy savings. Steam utilization, Performance assessment, installation, thermo-compressor, steam pipe insulation, condensate pumping, steam dryers		
UNIT IV	**FURNACES , INSULATION AND REFRACTORIES**	9
Classification, general fuel economy measures in furnaces, excess air, heat distribution, temperature control, draft control, waste heat recovery. Forging furnace heat balance, Cupola, non ferrous melting, Induction furnace, performance evaluation of a furnace, hot air generators-Insulation and Refractories : Insulation-types and application, economic thickness of insulation, heat savings and application criteria, Refractory-types, selection and application of refractories, heat loss. Cold insulation.		
UNIT V	**COGENERATION & HEAT EXCHANGERS**	9
Cogeneration : Definition, need, application, advantages, classification, saving potentials. heat balance, steam turbine efficiency, tri-generation, micro turbine. Heat Exchangers : Types, networking, pinch analysis, multiple effect evaporators, condensers, distillation column, etc		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Illustratethe concept of fuels and combustion system

CO2:Explain the role of boilers, steam , Furnaces , Insulation and Refractories to improve the efficiency

CO3:Summarize the impact of co-generation system to improve the efficiency

CO4:Outline the role of heat exchangers to improve the efficiency

CO5:Summarize various energy saving opportunities to improve the overall efficiency for thermal utilities.

TEXT BOOKS :

1. Energy Efficiency in Thermal Utilities Guide book for National Certification Examination for Energy Manager and Auditors,4th Edition, Bureau of Energy Efficiency, 2015.
2. Rajiv Shankar, "Energy Auditing in Electrical Utilities" , 1st Edition, MV Learning, 2015.
3. Scott Dunning and Larry S. Katz, Energy Calculations and Problem Solving Sourcebook: A Practical Guide for the Certified Energy Manager Exam, 1st Edition, River Publishers , 2017.
4.D. Paul Mehta and Albert Thumann, "Handbook of Energy Engineering", 7th Edition, Rivers Publishers, 2013.

REFERENCES :

1. David Thorpe, "Energy Management in Industry- The Earthscan Expert Guide", 1st Edition, Routledge Publishers, 2014.
2. Sonal Desai, Handbook of Energy Audit, Kindle Edition, Tata McGraw Hill Publishers 2017.
3 . Dr. Subhash Gadhave Anup Goel Siddu S. Laxmikant D. Jathar, Energy Audit &Management, 1st Edition, Technical Publishers , 2019
4. Y P Abb, Handbook on Energy Audit and Environment Management , Kindle Edition ,The Energy Resources Institute.,2009

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PROFESSIONAL ELECTIVE-V

21PSP47	ENERGY MANAGEMENT AND AUDITING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the various step involved in an energy auditing process.
- To classify the concepts behind electricity billing and load management.
- To outline the energy management on various electrical equipment and metering system.
- To illustrate the concept of lighting systems.
- To summarize the performance assessment made on various utilities and its need.

UNIT I	**INTRODUCTION**	**9**
Definition, Energy audit- Need for energy management - energy basics- energy accounting - energy monitoring, targeting and reporting- energy audit process- Types of energy audit, matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution, Energy audit instruments		
UNIT II	**ECONOMIC ANALYSIS AND LOAD MANAGEMENT**	**9**
Definition of load management- Demand control techniques- Utility monitoring and control system -HVAC and energy management- Economic justification for load management systems -Economic analysis - Economic models- models- applications and limitations-Time value of money-Utility rate structures- Calculating the cost of electricity-Loss evaluation.		
UNIT III	**ENERGY MANAGEMENT FOR ELECTRICAL EQUIPMENTS AND METERING SYSTEM**	**9**
Systems and equipment- Electric motors-Transformers and reactors-Capacitors and synchronous machines. Relationships between parameters-Units of measure-Typical cost factors- Utility meters - Timing of meter disc for kilowatt measurement - Demand meters - Paralleling of current transformers - Instrument transformer burdens-Multitasking solid-state meters - Metering location vs. requirements- Metering techniques and practical examples.		
UNIT IV	**ENERGY MANAGEMENT FOR LIGHTING SYSTEMS**	**9**
Concept of lighting systems - Task and working space -Light sources - Ballasts - Luminaries - Lighting controls-Optimizing lighting energy - Power factor and effect of harmonics on power quality - Cost analysis techniques-Lighting and energy standards.		
UNIT V	**ENERGY PERFORMANCE ASSESSMENT FOR UTILITY SYSTEMS**	**9**
Performance terms- definition- Purpose of performance test- Performance on Thermal power station- Steel industry- Cement industry- Paper and pulp industry- Textile industry- Fertilizer industry-Building & commercial establishments		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Outline the need for energy management and auditing process

CO2:Explain the load management and economic analysis performed in a system.

CO3:Summarize the energy management concepts for electrical equipments and metering system.

CO4:Classify lighting systems and energy standards.

CO5:Illustrate the performance assessment made on various utility systems.

TEXT BOOKS:

1. Barney L. Capehart, Wayne C. Turner, and William J. Kennedy, "Guide to Energy Management", 7th Edition, The Fairmont Press, Inc., 2011.
2. Amit K. Tyagi, "Handbook on Energy Audits and Management", TERI, 2003.
3. Ian M . Shapiro , "Energy audits and improvements for commercial buildings : a guide for energy managers and energy auditors", 1st Edition, John Wiley & Sons, 2016.
4. Anil Kumar , Om Prakash , Prashant Singh Chauhan, Samsher Gautam, "Energy Management-Conservation and Audits",1st Edition, CRC Press, 2020.

REFERENCES

1. Frank Kreith, D. Yogi Goswami, " Energy management and conservation handbook", 1st Edition, CRC Press, 2008.
2. Patrik Thollander, Jenny Palm ,"Improving Energy Efficiency in Industrial Energy Systems: An Interdisciplinary Perspective on Barriers, Energy Audits, Energy Management, Policies, and Programs", 1st Edition , Springer-Verlag London, 2013.
3. General Aspects of Energy Management and Energy Audit, 4th Edition, Bureau of Energy Efficiency India, 2015.
4. Moncef Krarti, " Energy Audit of Building Systems: An Engineering Approach", 2nd Edition,CRC Press, 2010.

		L	T	P	C
21PSP48	**ELECTRIC VEHICLES AND POWER MANAGEMENT**	3	0	0	3

COURSE OBJECTIVES:

- To summarize the concept of electrical vehicles and its operations
- To outline the architecture of EVs
- To illustrate the various controls for EVs.
- To infer the need for energy storage in hybrid vehicles
- To explain the various energy storage technologies in electric vehicles

UNIT I	**ELECTRIC VEHICLES AND VEHICLE MECHANICS**	**9**

Electric Vehicles (EV), Hybrid Electric Vehicles (HEV), Engine ratings, Comparison of EV with internal combustion Engine vehicles, Fundamentals of vehicle mechanics.

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UNIT II	ARCHITECTURE OF EV's AND POWER TRAIN COMPONENTS	9
Architecture of EV's and HEV's – Plug-in Hybrid Electric Vehicles (PHEV)- Power train components and sizing, Gears, Clutches, Transmission and Brakes		
UNIT III	**CONTROL OF DC AND AC DRIVES**	**9**
DC/DC chopper based four quadrant operations of DC drives – Inverter based V/f Operation (motoring and braking) of induction motor drive system – Induction motor and permanent motor based vector control operation – Switched reluctance motor (SRM) drives.		
UNIT IV	**BATTERY ENERGY STORAGE SYSTEM**	**9**
Battery Basics, Different types, Battery Parameters, Battery modeling, Traction Batteries		
UNIT V	**ALTERNATIVE ENERGY STORAGE SYSTEMS**	**9**
Fuel cell – Characteristics- Types – hydrogen Storage Systems and Fuel cell EV – UltraCapacitors		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Explain the fundamental operation of Electric vehicles

CO2:Illustrate the architecture and components of Electric vehicles and Plug-in Hybrid Electric Vehicles

CO3:Compare the operation of inverter based operation of induction motor and Switched reluctance motor drive system

CO4:Summarize various types of batteries and their operation

CO5:Interpret the characteristics of hydrogen storage systems Fuel cell EV systems with Ultra capacitor

TEXT BOOKS:

1. Tom Denton, 'Electric and Hybrid Vehicle' ,Newyork,NY,Routledge,1st Edition, Taylor& Francis Group, 2016.
2. Ali Emadi, MehrdadEhsani, John M.Miller, "Vehicular Electric Power Systems", Indian Edition, Reprint, New York Marcel Dekker, Inc, 2010.
3. Iqbal Hussein, "Electric and Hybrid Vehicles: Design Fundamentals" , 2nd Edition, CRC Press, Taylor & Francis Group,2011.
4. Amir Khajepour, M. Saber Fallah, AvestaGoodarzi, 'Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach' ,1st Edition ,Wiley, 2014.

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1. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, HybridElectric and Fuel Cell Vehicles: Fundamentals, Theory and Design, 3rd Edition, CRC Press,2018.
2.JamesLarminie, John Lowry, Electric Vehicle Technology Explained, 2nd Edition,Wiley, 2012.
3.A.K.Babu, ' Electric& Hybrid Vehicles' , 1st Edition, Khanna Publishing, 2019.

4.Ronald K. Jurgen, 'Electric and Hybrid-Electric Vehicles: Batteries', 1st Edition, SAE International ,2011.

21PSP49	DESIGN OF SUBSTATIONS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate the layout of Air Insulated Substation (AIS) and Gas Insulated Substation (GIS).
- To explain the operation of Air Insulated Substation (AIS) and Gas Insulated Substation (GIS).
- To summarize various substations insulation co-ordination of AIS and GIS
- To outline various grounding and protection schemes.
- To interpret the effects of transients on substations.

UNIT I	INTRODUCTION TO AIS AND GIS	9
Introduction – characteristics – comparison of Air Insulated Substation (AIS) and Gas Insulated Substation (GIS) – main features of substations, Environmental considerations, Planning and installation- Gas insulated bushing/Gas insulated line (GIB / GIL)		
UNIT II	**MAJOR EQUIPMENT AND LAYOUT OF AIS AND GIS**	**9**
Major equipment – design features – equipment specification, types of electrical stresses,mechanical aspects of substation design- substation switching schemes- single feeder circuits; single or main bus and sectionalized single bus- double main bus-main and transfer bus- main, reserve and transfer bus.		
UNIT III	**INSULATION COORDINATION OF AIS AND GIS**	**9**
Introduction – stress at the equipment – insulation strength and its selection – standard Basic insulation level (BIL) –Application of simplified method – Comparison with Institute of Electrical and Electronics Engineers (IEEE) and International Electrotechnical Commission (IEC) guides.		
UNIT IV	**GROUNDING AND SHIELDING**	**9**
Definitions – soil resistivity measurement – ground fault currents – ground conductor – design of substation grounding system – shielding of substations – Shielding by wires and masts		
UNIT V	**FAST TRANSIENTS PHENOMENON IN AIS AND GIS**	**9**
Introduction – Disconnector switching in relation to very fast transients – origin of Very Fast Transient Overvoltages(VFTO) –propagation and mechanism of VFTO – VFTO characteristics – Effects of VFTO.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Explain the basic layout of AIS and GIS.

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CO2:Illustrate the electrical and mechanical aspects of AIS and GIS. CO3:Outline the need for insulation co-ordination and protection schemes for substations. CO4:Relate grounding and shielding schemes in substations. CO5:Show the effects of very fast transient over voltages on substations.
TEXT BOOKS: 1. Andrew R. Hileman, "Insulation coordination for power systems", 1st Edition, Taylor and Francis ,1999. 2. M.S. Naidu, "Gas Insulation Substations",2nd Edition , I.K. International Publishing House Private Limited, ,2008. 3. Klaus Ragallar, "Surges in high voltage networks", 1st Edition ,Plenum Press,New York, ,1980. 4. Hermann Koch , "Gas Insulated Substations", 3rd Edition, Wiley-IEEE Press, , 2014.
REFERENCES 1. John Finn, Terry Krieg, "Substations", 1st Edition, CIGRE green books, Springer Reference series,2019 2. "Design guide for rural substation", 1st Edition, United States Department of Agriculture, RUS Bulletin, 1724E-300, June 2001. 3. Pritindra Chowdhuri, "Electromagnetic transients in power systems", 2nd Edition, PHI Learning Private Limited, New Delhi, 2009.

PROFESSIONAL ELECTIVE-VI

21PSP50	WIND ENERGY CONVERSION SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To explain the basic principles of WECS.
- To outline the various aspects of Wind Turbine.
- To summarize the concepts of fixed speed wind energy conversion systems.
- To discuss about the variable speedwind energy conversion systems.
- To illustrate the grid integration issues with wing energy conversion systems.

UNIT I INTRODUCTION — 9

Components of WECS-WECS schemes-Power obtained from wind-simple momentum theory-Power coefficient-Sabinin's theory-Aerodynamics of Wind turbine.

UNIT II WIND TURBINES — 9

HAWT-VAWT (Horizontal and Vertical Axis Wind Turbine) -Power developed-Thrust-Efficiency-Rotor selection-Rotor design considerations- Tip speed ratio-No. of Blades-Blade profile-Power Regulation-yaw control-Pitch angle control and stall control-Schemes for maximum power extraction.

UNIT III FIXED SPEED SYSTEMS — 9

Generating Systems- Constant speed constant frequency systems -Choice of Generators-Deciding factors-Synchronous Generator-Squirrel Cage Induction Generator- Model Wind speed - Model wind turbine rotor - Drive Train model- Generator model for Steady state and Transient stability analysis.

UNIT IV VARIABLE SPEED SYSTEMS — 9

Need of variable speed systems-Power-wind speed characteristics-Variable speed constant frequency systems synchronous generator- DFIG (doubly-fed induction generator) - PMSG (Permanent Magnet synchronous Generator) -Variable speed generators modeling - Variable speed variable frequency schemes.

UNIT V GRID CONNECTED SYSTEMS — 9

Wind interconnection requirements, low-voltage ride through (LVRT), ramp rate limitations, and supply of ancillary services for frequency and voltage control, current practices and industry trends wind interconnection impact on steady-state and dynamic performance of the power system including modeling issue.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Explain the basic concepts of Wind energy conversion system.
CO2:Illustrate the mathematical modeling and control of the Wind turbine.
CO3:Construct the different types of Fixed speed system.
CO4:Identify the characteristics of variable speed systems.
CO5:Interpret the issues of Grid connected wind energy conversion system .

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TEXT BOOKS:

1. L.L.Freris "Wind Energy conversion Systems",1st Edition, Prentice Hall, 1990
2. S.N.Bhadra, D.Kastha, S.Banerjee,"Wind Electrical Sytems",1st Edition, Oxford University Press,2005.
3. Ion Boldea, "Variable speed generators", 1st Edition Taylor & Francis group, 2006.
4. S.M.Muyeen, "Wind Energy conversion Systems Technology and Trends" 12th Edition , Springer, 2012.

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1. E.W.Golding "The generation of Electricity by wind power", 1st Edition, Redwood burn Ltd., Trowbridge,1976.
2. N. Jenkins," Wind Energy Technology" , 1st Edition, John Wiley & Sons,1997
3. S.Heir "Grid Integration of WECS", 1st Edition, Wiley 1998.
4. N. Jenkins," Wind Energy Technology" , 1st Edition (June 12, 1997) John Wiley & Sons,1997
5. Iulian Munteanu, Antoneta IulianaBratcu, Nicolaos-Antonio Cutululis " Optimal Control of Wind Energy Systems: Towards a Global" , 1st Edition,. Springer, 2008.

21PSP51	POWER SYSTEM DYNAMICS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To illustrate dynamic modeling of a synchronous machine.
- To explain the modeling concepts of excitation system.
- To classify transient, steady state and dynamic stability.
- To demonstrate the stability for power system by numerical integration methods.
- To infer the effects of stability in single machine infinite bus system.

UNIT I	MODELLING OF SYNCHRONOUS MACHINES	9

Simplest model of the synchronous machine – circuit equations – equation in physical quantities - Inductance of Synchronous Machine - Park's transformation - dq0 components – assumptions of balanced currents and voltages in the armature – phasor diagram – equivalent circuit – reactance – final machine dynamic equations – inclusion of damper winding.

UNIT II	MODELLING OF EXCITATION SYSTEMS	9

Excitation system requirements - elements of an excitation system – types of excitation system – dynamic performance measure – control and protective functions – modelling of excitation system.

UNIT III	POWER SYSTEM STABILITY	9

Power system stability considerations – definitions - classification of stability - rotor angle and voltage stability - stability of interconnected systems – bad effects of instability – Importance of stability to system operation and design.

UNIT IV	TRANSIENT STABILITY	9

Inertia constant and equivalent inertia constant – power angle curve – swing equation – point by point solution- transient stability - swing equation - equal area criterion - solution of swing equation - Euler method - Runge-Kutte method - critical clearing time and angle.		
UNIT V	**SMALL SIGNAL STABILITY**	**9**
State space representation - small signal stability of single machine infinite bus system (SMIB) – synchronous machine classical model representation - effect of field circuit dynamics- effect of excitation system – Power system stabilizer for small signal stability improvement.		
	TOTAL: 45 PERIODS	

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Explain the dynamic modelling of synchronous machine.

CO2:Illustrate the modeling of excitation system for stability analysis.

CO3:Classify the power system stability with its effects on interconnected systems.

CO4:Demonstrate the stability for power system by point-by point method, Modified Euler's and Runke – Kutta method.

CO5:Show the effects of small signal stability analysis in power system.

TEXT BOOKS:

1. P. W. Sauer and M. A. Pai, "Power System Dynamics and Stability", 1st Edition, Stipes Publishing Co, 2007.
2. P. Kundur, "Power System Stability and Control", 1st Edition, McGraw-Hill, 1993.
3. P.M Anderson and A.A Fouad, "Power System Control and Stability", 1st Edition, Iowa State University Press, Ames, Iowa, 1978.
4. R.Ramunujam," Power System Dynamics Analysis and Simulation, 1st Edition, PHI Learning Private Limited, New Delhi, 2009.

REFERENCES:

1. E.W.Kimbark, Power System Stability Vol.1, John Wiley, 1995.
2. James A.Momoh, Mohamed. E. El-Hawary. "Electric Systems, Dynamics and Stability with Artificial Intelligence applications", Marcel Dekker, USA First Edition, 2000.
3. Mircea Eremia and Mohammad Shahidehpour, "Handbook of Electrical Power System Dynamics: Modeling, Stability and Control", IEEE Press Series on Power Engineering, 2013.
4. L.P.Singh, Advanced Power system Analysis and Dynamics, 6th Edition New Age International Publishers, 2012.

		L	T	P	C
21PSP52	**MACHINE LEARNING**	3	0	0	3

COURSE OBJECTIVES:

- To infer the concepts of Machine Learning.
- To outline supervised learning and their applications.
- To relate the concepts and algorithms of unsupervised learning.
- To summarize the theoretical and practical aspects of Probabilistic Graphical Models.
- To illustrate the concepts and algorithms of advanced learning.

UNIT I INTRODUCTION	9
Machine Learning– Machine Learning process- Preliminaries for Machine Learning algorithms Turning data into Probabilities and Statistics for Machine Learning- Probability theory – Probability Distributions – Decision Theory.	
UNIT II SUPERVISEDLEARNING	9
Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning – Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks , Multi- layer Perceptron – Deriving Back Propagation - Support Vector Machines.	
UNIT III UNSUPERVISED LEARNING	9
Clustering- K-means – EM Algorithm- Mixtures of Gaussians – Dimensionality Reduction – Linear Discriminant Analysis - Principal Components Analysis – Locally Linear Embedding – Isomap	
UNIT IV PROBABILISTIC GRAPHICAL MODELS	9
Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical Models –Bayesian Networks – Conditional Independence properties – Markov Random Fields- Hidden Markov Models – Conditional Random Fields(CRFs).	
UNIT V ADVANCED LEARNING	9
Sampling-Basic Sampling methods, Monte Carlo, Gibbs Sampling – Computational Learning Theory-Mistake Bound Analysis – Reinforcement learning – Markov Decision processes, Deterministic and Non-deterministic Rewards and Actions, Temporal Difference Learning Exploration.	
	TOTAL: 45PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Apply a learning model appropriate to the application.

CO2:Construct a Neural Network for an application of your choice.

CO3:Identify Probabilistic Discriminative and Generative algorithms for an application of your choice and analyze the results.

CO4:Develop an HMM for a Sequence Model type of application.

CO5:Choose applications suitable for different types of Machine Learning with suitable justification.

TEXT BOOKS:

1. Christopher Bishop, "Pattern Recognition and Machine Learning" 1st Edition, Springer, 2007.
2. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2nd Edition, Chapman and Hall, CRC Press, 2014.
3. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 1st Edition, MIT Press, 2012.
4. EthemAlpaydin, "Introduction to Machine Learning", 3rd Edition, MIT Press, 2014.

REFERENCES

1. Tom Mitchell, "Machine Learning", 1st Edition, McGraw-Hill, 1997.

2. Ethem Alpaydin, "Introduction to Machine Learning (Adaptive Computation and Machine Learning)", 1st Edition, The MIT Press, 2004
3. T. astie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", 2nd Edition, Springer, 2009
4. David E. Goldberg, "Genetic Algorithm in Search, Optimization and Machine Learning", 13th Edition, Addison Wesley, 1989

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AUDIT COURSES

21AC101	**ENGLISH FOR RESEARCH PAPER WRITING** *(Common to all PG Programmes)*	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To explain writing skills and level of readability
- To outline content writing in each section
- To summarize the skills needed for framing a title
- To demonstrate the skills needed for writing the conclusion
- To compare the quality of paper with plagiarism report

UNIT I	**INTRODUCTION TO RESEARCH PAPER WRITING**	6

Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

UNIT II	**PRESENTATION SKILLS**	6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III	**TITLE WRITING SKILLS**	6

Key skills –Title, Abstract, Introduction, Review of the Literature, Methods, Results, Discussion and Conclusions.

UNIT IV	**RESULT WRITING SKILLS**	6

Skills -Methods, Results, Discussion and Conclusions.

UNIT V	**VERIFICATION SKILLS**	6

Useful phrases, checking Plagiarism, ensuring quality paper submission.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1:Explain the writing skills and level of readability

CO2: Outline the contents of research paper in each section

CO3:Classify the skills needed for writing a title

CO4: Summarize the content for presenting research conclusion note.

CO5: Illustrate the quality of paper by checking plagiarism.

TEXT BOOKS:

1. Adrian Wallwork , "English for Writing Research Papers", Springer New York Dordrecht Heidelberg London, 2011
2. Day R ,"How to Write and Publish a Scientific Paper", Cambridge University Press 2006.
3. Goldbort R , "Writing for Science", Yale University Press ,2006
4. Highman N, "Handbook of Writing for the Mathematical Sciences", SIAM. Highman's book 1998.

REFERENCES

1. Stephen Howe, Kristina Henriksson, "Phrase Book for Writing Papers and Research in English", 4th Edition, CreateSpace Independent Publishing Platform,2007.
2. Adrian Wallwork ,"English for Research: Usage, Style, and Grammar", Springer,2012.
3. John Flowerdew, Pejman Habibie, "Introducing English for Research Publication Purposes", 1st Edition,Routledge, ,2021.
4. Wendy Laura Belcher, Writing Your Journal Article in Twelve Weeks: A Guide to Academic Publishing Success, 1st Edition, SAGE Publications, Inc, , 2009

21AC102	**CONSTITUTION OF INDIA** *(Common to all PG Programmes)*	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

- To understand the premises informing the twin themes of liberty and freedom from a civil rights perspective
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional Role and entitlement to civil and economic rights as well as the emergence nationhood in the early years of Indian nationalism
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917and its impact on the initial drafting of the Indian Constitution.
- To understand the importance of local body administration
- To know the role and function of election commission

UNIT I	HISTORY AND PHILOSOPHY OF THE INDIAN CONSTITUTION	6
History - Drafting Committee - (Composition & Working)- Philosophy - Preamble, Salient Features		
UNIT II	**CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES**	**6**
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.		
UNIT III	**ORGANS OF GOVERNANCE**	**6**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions		

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UNIT IV	LOCAL ADMINISTRATION	6

District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayati raj: Introduction, PRI: Zila Panchayat. Elected officials and their roles, CEO Zila Panchayat: Position and role. Block level: Organizational Hierarchy(Different departments), Village level:Role of Elected and Appointed officials, Importance of grass root democracy.

UNIT V	ELECTION COMMISSION	6

Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

At the end of the course, learners will be able to

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3: Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.

CO4: Discuss the passage of the Hindu Code Bill of 1956.

CO5: Familiarize with basic Structure and functions of Election Commission.

REFERENCES:

1. Dr. S. N. Busi, "Dr. B. R. Ambedkar, Framing of Indian Constitution", 1st Edition, Ava Publishers, 2016.
2. M.P. Jain, "Indian Constitution Law", 7th Edition, Lexis Nexis, 2014.
3. D.D. Basu, "Introduction to the Constitution of India", 26th Edition, Lexis Nexis, 2022.