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	21MA124	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

22/3/22

BoS Chairman

9	21MF111	Contemporary manufacturing Research practices	PC	0	0	4	2
						Total	**23**

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**

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

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
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	Category	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

22/3/22

BoS Chairman

21MA124	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 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

BoS Chairman

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

1. Brahem T. Smith, “Advanced Machining” I.F.S. UK 2016.
2. Jaeger R.C., “Introduction to Microelectronic Fabrication” Addison Wesley, 2nd Edition, 1998.
3. Jain V K, “Micromanufacturing Processes”, CRC Press, 2012.
4. Julian W. Gardner, Vijay K Varadan and Osama O Awadelkarim, Microsensors “MEMS

22/3/22

BoS Chairman

and Smart devices", John Willey, 2013.
5. Pandey P.C. and Shan HS "Modern Machining Processes", Standard Publishing Co., 1stEdition,1980.
6. Serope Kalpakjian and Steven R. Schmid- "Manufacturing Process for Engineering Material" – Pearson Education, 6thEdition, 2018

22/3/22

BoS Chairman

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.

CO2: Apply the material property to suit the specific requirements.

CO3: Select the existing materials and development of upcoming new materials.

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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

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.

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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.

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”

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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

1. 2D modelling and 3D modelling of components such as
2. Bearing
3. Couplings
4. Gears
5. Sheet metal components

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

21MF105	TECHNICAL SEMINAR	L	T	P	C
		0	0	2	1

OBJECTIVES

- To enrich the communication skills of the student through presentation of topics in recent advances in engineering/technology.

- 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.

TOTAL PERIODS **30**

OUTCOMES

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.

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

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.
2. Bhattacharyya A., "Metal Cutting Theory and Practice", Central Book Publishers, Calcutta, 1984

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

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

OUTCOMES

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

CO1: Comprehend the basic concepts of additive manufacturing

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

21MF110	ADVANCED MANUFACTURING PROCESSES LABORATORY	L	T	P	C
		0	0	4	2

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. Study on FRL unit
2. Experiment on variable speed tensile testing using UTM
3. Experiment on PLC with input and output devices
4. Experiment on 5 by2 solenoid operated dcv
5. Experiment on 5 by2 pneumatic direction control valve dcv
6. Study on 3 by2 pneumatic limit switches
7. Study on 24v dc power supply
8. Experiment on 3d printer
9. Study on Friction stir welding setup
10. Experiment on Compression moulding machine
11. Study on muffle furnace
12. Study on cost efficient advanced manufacturing equipment's egg cleaver paper bag maker cracker knotter button riveter
13. Study on biomedical devices
14. Experiment on Coordinate measuring machine

(Any 8 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.

22/3/22

BoS Chairman

21MF111	CONTEMPORARY MANUFACTURING RESEARCH PRACTICES	L	T	P	C
		0	0	4	2

OBJECTIVES

- To give broad expertise on various research field in mechanical engineering.

LIST OF EXPERIMENTS

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

TOTAL PERIODS **45**

OUTCOMES

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

CO1: Exhibit knowledge in emerging research fields of mechanical engineering.

22/3/22

BoS Chairman

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

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.

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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 Polishining.

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

1. Bandyopadhyay. A.K., “Nano Materials”, New age international publishers, New Delhi, 2008, ISBN:8122422578.
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

22/3/22

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 component.

22/3/22

BoS Chairman

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.

22/3/22

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.

22/3/22

BoS Chairman

SEMESTER II, ELECTIVE – II & III

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

22/3/22

BoS Chairman

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

CO4: Explain the Ultrasonic testing and Acoustic Emission methods

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

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

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.

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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.
3. Groover M.P., "Automation, production systems and computer integrated manufacturing", Prentice Hall of India Pvt., New Delhi, 1996.

22/3/22

BoS Chairman

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.

22/3/22

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

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

CO1: Describe the concepts of MEMS and microsystems.

22/3/22

BoS Chairman

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

22/3/22

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.

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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.

REFERENCES

1. Ibrahim Zeid, "CAD/CAM theory and Practice", Tata McGraw Hill, 1991.
2. Biren Prasad, "Concurrent Engineering Fundamentals Vol.11", Prentice Hall, 1997.

22/3/22

BoS Chairman

3. David F.Rogers.J, Alan Adams, “Mathematical Elements for Computer Graphics”, McGraw Hill, 1990
4. James G.Bralla, “Handbook of Product Design for Manufacturing”, McGraw Hill, 1994
5. Kevin Otto, Kristin Wood, “Product Design”, Pearson Education, 2000

22/3/22

BoS Chairman

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.

REFERENCES

1. Dr. R. Kesavan, C. Elanchezian, and B.Vijayaramnath, "Principles of Management" – Eswar Press – Chennai – 2004
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

22/3/22
BoS Chairman

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

CO1: Summarize the concept of fabrication of nano systems

CO2: Discuss about the nano defects and various doping methods.

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

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.
3. Singiresu S.Rao, "Finite element Method in Engineering", 5ed, Elsevier, 2012.
4. Bathe, K.J., "Finite Element procedures in Engineering Analysis", 1990
5. Kobayashi,S, Soo-ik-Oh and Altan,T, "Metal Forming and the Finite Element Methods", Oxford University Press, 1989.
6. Lewis R.W. Morgan, K, Thomas, H.R. and Seetharaman, K.N. "The Finite Element Method in Heat Transfer Analysis", John Wiley, 1994.
7. Seshu P, "Textbook of Finite Element Analysis", PHI. 2004

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

1. Groover.M.P. “Industrial Robotics”, McGraw – Hill International edition, 2012.
2. Fu K S, Gonzalez, Lee C S G, “Robotics: Control, Sensing, Vision and Intelligence”, McGraw- Hill Book Company, 1987.
3. Gordon Mair, ‘Industrial Robotics‘, Prentice Hall U.K, 1998.
4. John J. Craig, “Introduction to Robotics: Mechanics and Control”, Pearson, 3rd edition, 2004.
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.

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

Company, 2001.
2. M.A. Mazidi & J.G. Mazidi, “8051 Micrcontroller and embedded systems”, 2002.
3. R.K.Rajput.A “Text Book of Mechatronics”, Chand &Co, 2007.
4. W.Bolton, “MECHATRONICS” Pearson Education Limited, 2004

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

2. Stark, John. “Product Lifecycle Management: 21st Century Paradigm for Product
3. Realization”, Springer-Verlag, 2004. ISBN 1852338105.
4. Antti Saaksvuori,“Product Life Cycle Management” - Springer, 1st Edition, 2003

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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.

REFERENCES

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
4. Prasanna Chandra, “Projects – Planning, Analysis, Selection, Implementation and Reviews”, Tata McGraw-Hill, 1996.

22/3/22

BoS Chairman

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.
CO5: Articulate to run an industry with utmost safety precautions.

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

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

CO4: Summarize the processing of metal and ceramic matrix composites

CO5: Examine the selection of materials for industrial applications

REFERENCES

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

21MFP26	SMART MANUFACTURING AND INDUSTRY 4.0	L	T	P	C
		3	0	0	3

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

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.

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

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.

REFERENCES

22/3/22

BoS Chairman

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.

22/3/22

BoS Chairman

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.

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

22/3/22

BoS Chairman

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

22/3/22

BoS Chairman

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
   - பயண இலக்கியம்
   - நாடகம்

22/3/22

BoS Chairman

TOTAL PERIOD	**30**

REFERENCES

1. (Tamil Virtual University) - www.tamilvu.org
2. (Tamil Wikipedia) -https://ta.wikipedia.org

22/3/22

BoS Chairman