VISION OF THE DEPARTMENT
To develop disciplined, socially committed and technically competent Production Engineers with Creativity, Comprehension and Managerial skills to design and manufacture innovative cost effective quality products for the benefit of mankind.

MISSION OF THE DEPARTMENT
1. Train the students who will be able to design and manufacture Innovative, Environment Friendly, Ergonomic and Cost Effective Quality Products and Services.
2. Improve the technical quality of the students to meet the challenges, competitions and opportunities in production engineering.
3. Prepare the students who will be able to solve socially relevant engineering problems and other complex problems by means of inculcating Managerial Skills.
4. Enhance the department industry / research centre interaction by means of training, internship and student projects to solve industrial problems.
PROGRAM EDUCATIONAL OBJECTIVES (PEOs)
I. Find gainful employment in Industry and Academic sector.
II. Enter into doctoral studies leading to research career.
III. Ability to analyse manufacturing system and provide optimal solutions to practical problems of any organization.
IV. Gain managerial leadership in their career path by their engineering and manufacturing management skill.
V. Become an ethically responsible person to work as an individual and part of team for societal cause.

PROGRAMME OUTCOMES (POs)
After going through post graduate Manufacturing Engineering, the graduates will exhibit ability to:

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<tr>
<td>1</td>
<td>Engineering knowledge</td>
<td>Apply the knowledge of mathematics, science, engineering fundamentals, and engineering specialization to the solution of complex engineering problems.</td>
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<tr>
<td>2</td>
<td>Problem analysis</td>
<td>Identify, formulate, research literature, and analyse engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.</td>
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<tr>
<td>3</td>
<td>Design/development of solutions</td>
<td>Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.</td>
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<tr>
<td>4</td>
<td>Conduct investigations of complex problems</td>
<td>Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.</td>
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<tr>
<td>5</td>
<td>Modern tool usage</td>
<td>Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.</td>
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<tr>
<td>6</td>
<td>The engineer and society</td>
<td>Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.</td>
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<tr>
<td>7</td>
<td>Environment and sustainability</td>
<td>Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.</td>
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<tr>
<td>8</td>
<td>Ethics</td>
<td>Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.</td>
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<tr>
<td>9</td>
<td>Individual and team work</td>
<td>Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.</td>
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Communication
Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

Project management and finance
Demonstrate knowledge and understanding of engineering and management principles and apply these to one’s own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

Life-long learning
Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)
By completion of post graduate Manufacturing Engineering, the graduates will have following Program specific outcomes:

2. Knowledge on design, analysis and development of manufacturing processes, automation and quality systems.
3. Foundation of sustainable development: Knowledge on application of appropriate materials and manufacturing system and development of an optimal solution to the needs of Industry and society.

Mapping of PEOs with POs

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* Audit Course is optional.

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**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE - 70**

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**PROGRESS THROUGH KNOWLEDGE**

---

**Attested**

**DIRECTOR**

Centre for Academic Courses
Anna University, Chennai-600 025
## SEMESTER I

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* Audit Course is optional.

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# RESEARCH METHODOLOGY AND IPR COURSES (RMC)

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# OPEN ELECTIVE COURSES [OEC]

(Out of 6 Courses one Course must be selected)

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# AUDIT COURSES (AC)

Registration for any of these courses is optional to students

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# EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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### SUMMARY

#### M.E MANUFACTURING ENGINEERING (PART TIME)

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**Total Credit**: 12 11 12 11 12 12 70
Objective:
- To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
- To introduce the concepts of sampling distributions and the test statistics.
- To provide an understanding of the statistical methods and concepts by which real life problems are analyzed.
- To analyze various data using statistical techniques.
- To train the students in designing experiments and use these concepts for research.

Unit I: Probability Theory
Random variables – probability density and distribution functions – moment generating and characteristic functions – Binomial, Poisson, Normal distributions and their applications.

Unit II: Sampling Theory
Sampling distributions – Standard error – t, F, Chi square distributions – applications.

Unit III: Estimation Theory
Interval estimation for population mean, standard deviation, difference in means, preparation ratio of standard deviations and variances.

Unit IV: Testing of Hypothesis and ANOVA

Unit V: ANOVA
Design of experiments – One, Two factor Models

Outcomes:
At the end of the course, the student will be
- Able to analyze the performance in terms of probabilities and distributions achieved by the determined solution.
- Aware of various test statistics for the samples.
- Able to develop an ability to apply statistical tests in experiments as well as to analyze and interpret data.
- Able to use the statistical tools for their project and future research.
- Able to use the concepts in design of experiments in real life problems.

References:
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

UNIT II  ELECTRICAL AND CHEMICAL AIDED MACHINING PROCESSES

UNIT III  HIGH ENERGY AIDED MACHINING PROCESSES

UNIT IV  FABRICATION OF MICRO DEVICES

UNIT V  MICROFABRICATION TECHNOLOGY

TOTAL: 45 PERIODS

OUTCOMES:
Students 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:
**Course Outcomes**

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**MN5102 MATERIALS TECHNOLOGY**

**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**

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**


**UNIT III MODERN METALLIC MATERIALS**


**UNIT IV NON METALLIC MATERIALS**

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 tools – Properties and applications of CNT – Graphene based Material

**UNIT V SELECTION OF MATERIALS**

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.
OUTCOMES:
Students will be able to
CO1: Get knowledge of mechanism of failure of materials and methods.
CO2: Fully appreciate modification of material property to suit the specific requirements.
CO3: Express and appreciate the existing materials and development of upcoming new materials.
CO4: Have the knowledge to select the various non-metallic materials to suit required applications.
CO5: Identify and select suitable material for relevant application.

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MN5103 ROBOT DESIGN AND PROGRAMMING

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
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
Introduction – Matrix representation Homogeneous transformation, forward and inverse – Kinematic equations, Denvit – Hartenbers 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  
Lagrangeon mechanics, dynamic equations for sing, 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 AND AI TECHNIQUES  
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  
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.

OUTCOMES:
Students will able to
CO1 : Apply their knowledge on calculation of end effector coordinate position and angle based on the application.
CO2 : Calculate force involved in the robot while under operation (i.e. gripping force).
CO3 : Compute the trajectory of robot based on both joint space and Cartesian space.
CO4 : Understand the traditional programming in robot and Modern AI Techniques.
CO5 : Identify appropriate sensors and actuators based on the application.

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RM5151 RESEARCH METHODOLOGY AND IPR

COURSE OBJECTIVES:
To impart knowledge and skills required for research and IPR:
- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6
Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6
Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICAL WRITING /PRESENTATION 6
Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

TOTAL: 30 PERIODS

COURSE OUTCOMES:
1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

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CO1, CO2, CO3, CO4, CO5
REFERENCE:

MN5111 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 analyse and observe the principles and its importance.
- To study the major application in manufacture of micro and macro devices.

LIST OF EXERCISES
1. Plate cutting in abrasive water jet machine
2. Micro hole drilling in ECM
3. Model fabrication in simple CNC router
4. 3D model fabrication using RPT
5. Profile cutting using WEDM
6. Ultrasonic welding
7. Ultrasonic machining
8. Ultrasonic cavitations –Stir Casting
9. Squeeze Casting
10. Incremental forming
11. Robot aided Welding
(Any 10 for Conduct of end semester examination)

OUTCOMES:
Students will be able to
CO1: Understand and grasp the significance of modern machining process and its applications through hands-on experience.
CO2: Identify the selection of machining processes and its process parameters.
CO3: Express and perform project related works.

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OBJECTIVES:
- To understand the various contact and non-contact measurement methods through practical skill set.
- To introduce to Vision system for quality inspection process.
- To understanding over the kinematic analysis on various robot configurations of serial manipulators.
- To train students on robot programming for basic work handling operations.

LIST OF EXPERIMENTS
1. Experimentation on contact and non-contact temperature measurement
2. Experimentation on optical sensors for light measurement
3. Experimentation on LVDT based distance measurements
4. Experimentation on load cell and Strain gauge for force and weight measurements
5. Experimentation on Torque measurements
6. Experimentation on Ultrasonic non-contact distance measurements
7. Experimentation on vibration measurements
8. Experimentation on machine vision for quality inspection
9. Embedded System
10. Modelling and simulation of basic mechanisms
12. Kinematic analysis six DOF serial manipulators
13. Trajectory planning of one DOF and two DOF R, RR, P, PP configuration of serial manipulators.
14. Trajectory planning of six DOF serial manipulators.
15. Robot programming for pick and place operation
16. Robot programming for palletizing operation

(Any 10 for Conduct of end semester examination)

OUTCOMES:
Students will be able to
CO1: Perform contact and non-contact measurements practically.
CO2: Work on the suitable sensors and transducers for the required application.
CO3: Work on sophisticated Machine vision systems for quality inspection process.
CO4: Perform kinematic analysis on various configurations of serial manipulators.
CO5: To write robot program for basic work handling operations.

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OBJECTIVES:
- To introduce to fundamentals of finite element techniques.
- To analyse one dimensional phenomena using finite element techniques.
- To analyse 2D and 3D phenomena using finite element techniques.
- To impart knowledge about various factors, pre-processing and post-processing steps with implementation of computer in FEA.
- To impart knowledge in the area of finite element methods and its application in manufacturing.

UNIT I INTRODUCTION 12
Fundamentals – Initial, boundary and Eigen value problems – weighted residual, Galerkin and Rayleigh Ritz methods - Integration by parts – Basics of variational formulation – Polynomial and Nodal approximation.

UNIT II ONE DIMENSIONAL ANALYSIS 12
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 SHAPE FUNCTIONS AND HIGHER ORDER FORMULATIONS 12
Shape functions for one and two dimensional elements- Three noded triangular and four noded 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 12
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 ANALYSIS OF PRODUCTION PROCESSES 12

TOTAL =60 PERIODS

OUTCOMES:
Students will be able to
- CO1: Perform the fundamentals of solving Finite element problems.
- CO2: Discretize and solve one-dimensional solid mechanics and heat transfer problems in FEA.
- CO3: Identify the impact of shape functions and usage of higher order formulation in converging solution to FEA problem.
- CO4: Implementation of computer on solving FEA based problems.
- CO5: Structuring a production process through FEA and control it’s parameters.

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DIRECTOR
Centre for Academic Courses
Anna University, Chennai-600 025
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MN5202  
FLUID POWER AUTOMATION  
L T P C  
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OBJECTIVES:
- To make the students to learn the basics of hydraulics and pneumatics
- To understand and select appropriate pumps and actuators in fluid power.
- To familiarize the various controlling elements in fluid power.
- To train the students in designing the hydraulic and pneumatic circuits using various design procedures.
- To make the students to understand the various methods of control of hydraulic and pneumatic circuits.

UNIT I  
INTRODUCTION
Need for Automation – Basics of hydraulic and pneumatic principles- applicable to pump, motor, valves and losses-ISO symbols for fluid power elements, Hydraulic and Pneumatic - Comparison – Selection criteria.

UNIT II  
FLUID POWER GENERATING/UTILIZING ELEMENTS

UNIT III  
CONTROL AND REGULATION ELEMENTS
Direction flow and pressure control valves-Methods of actuation, types, sizing of ports-pressure and temperature compensation, overlapped and under lapped spool valves-operating characteristics-electro hydraulic servo valves-Different types-charactersitics and performance.
UNIT IV  CIRCUIT DESIGN
Typical industrial hydraulic circuits-Design methodology – Ladder diagram-cascade method- Truth Table-Karnaugh–Veitch (KV) maps method-sequencing circuits-combinational and logic circuit.

UNIT V  CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS
Electrical control of pneumatic and hydraulic circuits-use of relays, timers, counters, Ladder diagram. Programmable logic control of Hydraulics Pneumatics circuits, Introduction to PLC – Architecture of PLC - ladder diagram for various circuits.

OUTCOMES:
The students will be able to
- CO1: Understand the working principle of hydraulic and pneumatic components.
- CO2: Select and design the hydraulic and pneumatic circuits for different applications.
- CO3: Control hydraulic and pneumatic circuits for various applications.
- CO4: Solve the problems related to hydraulic and pneumatic circuits.
- CO5: Solve the problems related to fluid power applications.

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MN5211  MODELLING AND SIMULATION LABORATORY

OBJECTIVES:
- To study the fundamentals of finite element analysis from classical method to nodal approximation method in various fields of manufacturing applications.
- To make the students to design an element by Finite element analysis.
- To develop the knowledge related to modelling and simulation in field of manufacturing.
LIST OF EXERCISES
1. One Dimensional FEA Problem like beam, Truss etc.
2. Two Dimensional FEA Problems like plane stress, plane strain, axisymmetric and vibration.
3. Three Dimensional FEA Problems like shell and contact.
4. FEA Application in metal forming like superplastic forming, deep drawing etc.
5. FEA Application in Metal cutting
6. FEA Application in Casting process
7. 3D Modelling and Assemble of Engine
8. Modelling of Crack Shaft
9. Modelling of Connecting Rod
10. Modelling of Cotter Joint
11. Modelling of Plummer Block and Coupling
   (Any 10 for Conduct of end semester examination)

OUTCOMES:
Students will be able to
CO1: Apply the principles of Finite Element Analysis to solve problems in the field of production engineering.
CO2: design and analyse various problems in field of manufacturing
CO3: identify the problems and simulate using Finite element analysis
CO4: Relate to Finite element analysis in various manufacturing applications.
CO5: Develop skills in field of design and simulation using FEA.

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MN5212 AUTOMATION LABORATORY

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.
- To make the students gain an experience in the field of fluid power applications.
- To gain knowledge related to fluid power elements and its control.
- To train the students to simulate various hydraulic and pneumatic circuits using software.
LAB EXPERIMENTS:
1. Study and use of pneumatic and hydraulic elements.
2. Simulation of speed control circuits in a hydraulic trainer.
3. Simulation of hydraulic circuits in a hydraulic trainer.
4. Simulation of single and double acting cylinder circuits using different directional control values.
5. One shot and regenerative pneumatic circuits.
7. Simulation of Logic pneumatic circuits.
8. Simulation of electro pneumatic sequencing circuits.
9. Simulation of PLC based electro pneumatic sequencing circuits.
10. To compare the ladder diagram for electrical and PLC control for the given sequence.
12. Offline – Manufacturing process planning for specific operation sequence graphically using simulation software.
13. Estimation of manufacturing operation time and perform line balancing
15. Internet of things application for pilot project.

(Any 10 for Conduct of end semester examination)

OUTCOMES:
Students will be able to
CO1: Design, model and automate simple and complicated industrial automation using hydraulics and pneumatics.
CO2: Perform simulation for various hydraulics and pneumatics circuits.
CO3: Design and develop circuits for various hydraulics and pneumatics applications.
CO4: Practically experience of various hydraulic and pneumatic elements.
CO5: Simulate various hydraulics and pneumatics circuits using software.

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Programme Outcomes: PO1, PO2, PO3, PO4, PO5, PO6, PO7, PO8, PO9, PO10, PO11, PO12
**MN5213  MINI PROJECT WITH SEMINAR  L T P C**

0 0 2 1

**OBJECTIVES**
- To prepare students to identify a problem for study.
- To do literature review of a problem.
- To enable to comprehend information in form of presentation both written and oral, to develop technical communication skills.
- To carry out modelling/conduct experiments beyond regular laboratory exercises in developing solution to the identified problem.
- To cultivate spirit of team work in working as a group.

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.

**TOTAL: 30 PERIODS**

**OUTCOMES**
Students at the end of course will be
- To critically observe the world around and identify a problem that can be solved.
- To develop skills of read and comprehensively analysing the facts.
- To exhibit skill of presentation both orally and in written form.
- To get hands on experience to doing experimental/theoretical analysis in synthesis of solution to the problem
- Able to appreciate the importance of team work

**MN5311  DISSERTATION - I  L T P C**

0 0 12 6

**OBJECTIVES:**
- To enable students to select and define a problem/need for analysis in the field of manufacturing engineering.
- To review and analyse literature/data of selected problem for study and propose objective and scope of dissertation work.
- To develop hypothesis and identify methodology based on ethical, scientific and systematic application of knowledge in the field of problem
- To design, model and experiment/develop optimal solution for problem being investigated
- To analysis and interpretation of data, and synthesis of the information to provide valid conclusions and submit dissertation.

**EVALUATION:**
- A project topic may be selected based on the literature survey and the creative ideas of the students themselves in consultation with their project supervisor. The topic should be so chosen that it will improve and develop the skills to design, fabricate, analyse, test and research. Literature survey and a part of the project work be carried out in dissertation I.
- The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.
- A project report for dissertation I is to be submitted at the end.
- Project work evaluation is based on the Regulations of the Credit system for the Post graduate programmes of Anna University

**TOTAL: 90 PERIODS**
OUTCOMES:
CO1: The students would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative and get trained in planning, organizing and coordination various components of dissertation work.

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MN5311 DISSEPTION - II

OBJECTIVES:
- Based on practical experience in dissertation-I work, the students will be able to propose and define a problem/need for analysis in the field of manufacturing engineering.
- To comprehensively review and analyse literature/data to develop hypothesis and identify methodology based on ethical, scientific and systematic application of knowledge in the field of problem.
- To design experiments, develop model and conduct experiments/simulations for development of sustainable and economical solution for problem being investigated.
- To analyse and interpret data, and synthesize of the factual information’s to arrive at valid conclusions.
- To enable students to communicate technical information in form of oral presentation and technical report in form of dissertation.

EVALUATION:
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Division based on oral presentation and the project report.
- Project work evaluation is based on the Regulations of the Credit system for Post graduate programmes of Anna University.

OUTCOMES:
CO1: The students’ would apply the knowledge gained from theoretical and practical courses in solving problems, so as to give confidence to the students to be creative, well planned, organized, coordinated project outcome of the aimed work.

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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

UNIT II ELECTRON MICROSCOPY

UNIT III CHEMICAL AND THERMAL ANALYSIS

UNIT IV MECHANICAL TESTING – STATIC TESTS

UNIT V MECHANICAL TESTING – DYNAMIC TESTS

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
- CO1: To characterize the engineering materials.
- CO2: Know the fundamental principle of Top-notch characterization tools.
- CO3: Choose appropriate mechanical static testing methods.
- CO4: Choose appropriate mechanical dynamic testing methods
- CO5: Identify the crystal structure and analysis can be made.
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MN5002 COMPUTER AIDED PRODUCT DESIGN

OBJECTIVES:
- To review the basics of Computer aided design
- To familiarize students on use of modelling tools of CAD software.
- To apply the various design concepts and design tools and techniques while designing a product.
- To understand the product modelling method and its relationship with computer graphics.
- To create awareness on product life cycle management.

UNIT I INTRODUCTION
Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – CAD/CAM hardware and Softwares – software packages for design and drafting.

UNIT II COMPUTER GRAPHICS FUNDAMENTALS AND GEOMETRIC

UNIT III PRODUCT DESIGN CONCEPTS AND PRODUCT DATA MANAGEMENT
UNIT IV  PRODUCT DESIGN TOOLS AND TECHNIQUES


UNIT V  PRODUCT DESIGN TECHNIQUES


TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

CO1 : Understand the design phases and various design hardware and software.
CO2 : Relating basics of various geometrical feature creation.
CO3 : Systematically work on each stages in the development of a new product and its management.
CO4 : Predicting on various factors for various design applications.
CO5 : Mixing the techniques in the design of new product.

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MN5003  THEORY OF METAL FORMING

OBJECTIVES:

- To provide knowledge on the mechanism involved in plastic deformation and parameter representation.
- Enable students to understand various bulk forming process and its recent technology.
- To provide overview of various sheet metal forming process.
- To study the powder metallurgy techniques and Special metal forming processes.
- To introduce the significance of surface treatment and industrial application of metal forming.

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UNIT I  THEORY OF PLASTICITY  9

UNIT II  THEORY AND PRACTICE OF BULK FORMING PROCESSES  9
Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming.

UNIT III  SHEET METAL FORMING  9

UNIT IV  POWDER METALLURGY AND SPECIAL FORMING PROCESSES  9

UNIT V  SURFACE TREATMENT AND METAL FORMING APPLICATIONS  9

TOTAL: 45 PERIODS

OUTCOMES:
Students will able to
CO1 : Understand the state of stress in metal forming process.
CO2 : To identify the appropriate bulk forming process based on the application.
CO3 : Understand the conventional sheet metal forming process and various high energy rate forming techniques.
CO4 : Understand the powder metallurgy forming technique.
CO5 : Select appropriate surface heat treatment technique.

REFERENCES:
## 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

### UNIT II  COST ESTIMATION AND ACCOUNTING

### UNIT III  ESTIMATION OF MATERIAL AND LABOR COST
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

### UNIT V  ESTIMATION OF COST FOR MANUFACTURING PROCESS
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: 45 PERIODS**
OUTCOMES:
Students 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.

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MN5005 MICRO SYSTEM TECHNOLOGY

OBJECTIVES:
- To Provide Knowledge of Semiconductors and Solid Mechanics of MEMS Devices
- To introduce to various types of fabrication processes in MEMS Devices.
- To educate on the Rudiments of micro devices.
- To provide overview of properties and methods of nanomaterials.
- To educate on the analytical tools for imaging and characterization of MEMS.

UNIT I OVER VIEW OF MEMS AND MICROSYSTEMS
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, Gallium arsenide, quartz, polymers for MEMS, conductive polymers.

UNIT II FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING
UNIT III MICRO DEVICES

UNIT IV SCIENCE AND SYNTHESIS OF NANO MATERIALS

UNIT V INSPECTION OF MICRO/NANO SYSTEMS

OUTCOMES:
Students will be able to
CO1: Understand the properties of various polymers, different materials used for MEMS and working principle of MEMS.
CO2: Get knowledge about various fabrication techniques of MEMS.
CO3: Get awareness of various micro actuators and its application.
CO4: Impart the knowledge to the students about nano materials and techniques in synthesis of nano materials.
CO5: Understand the various nano measurements techniques.

REFERENCES:
1. Mahalik N P, MEMS, McGraw Hill (India), 2009

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OBJECTIVES:
- To provide overview of various electrical and electronic control techniques used in modern manufacturing systems.
- To know the basic working principle of sensors and transducers of use for manufacturing systems
- To know the basic working principle of drives and actuators of use for manufacturing systems
- To know the features, modules and interfaces of microcontrollers and microprocessors
- To gain the knowledge of integration of mechatronic systems in automation of modern manufacturing systems

UNIT I INTRODUCTION TO MECHATRONICS IN MODERN MANUFACTURING


UNIT II SENSORS AND TRANSDUCERS


UNIT III DRIVES AND ACTUATORS


UNIT III MICROPROCESSORS AND MICROCONTROLLERS


UNIT V INTEGRATION OF MANUFACTURING SYSTEMS


OUTCOMES:
Students will be able to
CO1 : Imply the knowledge to study the mechatronics in modern manufacturing systems.
CO2 : Identify and select the sensors and transducers based on the application.

TOTAL: 45 PERIODS
CO3: Identify the principles and functions of drives and actuators.
CO4: Get knowledge of microprocessor and microcontrollers and its functions.
CO5: Apply the knowledge about integration of mechatronic systems in manufacturing.

REFERENCES:
1. Beno Benhabib, Manufacturing, design, production, automation and integration, Marcel Dekker, 2003

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MN5006  ADVANCED WELDING TECHNOLOGY  L T P C
                                                3 0 0 3

OBJECTIVES:
- To provide overview of different arc and gas welding processes.
- To know various solid state and special welding processes.
- To introduce to metallurgy of welding.
- To design the weldments for various materials.
- To gain knowledge on various welding defects and inspection methods.

UNIT I  ARC AND GAS WELDING PROCESSES  9

UNIT II  SOLID STATE AND SPECIAL WELDING PROCESSES  9
UNIT III WELDING METALLURGY


UNIT IV DESIGN OF WELDMENTS

Type of joints, joint efficiency, factor of safety, symbols, selection of edge preparation, design considerations, types of loading, Permissible stress, allowable defects, computation of stresses in welds, weld size calculation, code requirement for statically loaded structures - Design for fluctuating and impact loading - dynamic behaviour of joints – stress, concentrations - fatigue analysis - fatigue improvement techniques - permissible stress- life prediction, Concept of stress intensity factors - LEFM and EPFM concepts - brittle fracture- transition, temperature approach - fracture toughness testing, application of fracture mechanics to fatigue Welding residual stresses - causes, occurrence, effects and measurements - thermal and mechanical relieving; types of distortion - factors affecting distortion - distortion control methods - prediction - correction, jigs, fixtures and positioners.

UNIT V WELDING DEFECTS AND INSPECTION


TOTAL : 45 PERIODS

OUTCOMES:

Students will be able to

CO1 : Understand the different arc and gas welding processes.
CO2 : Know and perform solid state and special welding process.
CO3 : Understand and analyze the material structures after welding.
CO4 : Design the weldments for various materials.
CO5 : Attain the knowledge about various welding defects and inspection methods.

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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 –

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.

OUTCOMES:
Student will be able to
CO1: Understand the basic techniques of quality improvement, fundamental knowledge of
statistics and probability and use control charts.
CO2: Describe different sampling plans.
CO3: Solve problems by various design methods.
CO4: Acquire basic knowledge of reliability.
CO5: Implement the concepts of reliability and maintainability.

TOTAL: 45 PERIODS
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MN5007 MANUFACTURING METROLOGY

OBJECTIVES:
- To instruct through basic nomenclature of metrology.
- To create awareness of tools for inspection of surface, threads and gears.
- To introduce to laser metrology and CMM.
- To introduce to machine vision and electro-optical devices.
- To impart knowledge on basic quality tools and role of metrology in quality control.

UNIT I BASICS OF METROLOGY


UNIT II SURFACE METROLOGY, INSPECTION OF THREADS AND GEARS

Measurement of straightness and flatness- Measurement of roundness – surface texture measurement methods– Surface texture measuring instruments- Metrology of screw threads -two wire and three wire methods -gear terminology - measurement of various elements of gears - pitch circle method, constant chord method, base tangent method

UNIT III LASER METROLOGY AND COMPUTER AIDED METROLOGY

UNIT IV   MACHINE VISION

UNIT V   APPLICATION OF QUALITY CONTROL IN MANUFACTURING
Need for quality management system — ISO 9001 and other management system and models - Benchmarking - Continuous process improvement – PDCA cycle - 5s - Kaizen Quality Function Deployment (QFD) – Taguchi method – Total Productive Maintenance - Failure mode and effect analysis – Six sigma

OUTCOMES:
Students will be able to
CO1 : Understand the basic definitions of metrology.
CO2 : Know the advance working principles of modern measurement systems
CO3 : Get knowledge in selection of various quality tools for proper application.
CO4 : Apply the machine vision techniques in measurements.
CO5 : Know the basics of quality management system (ISO), six sigma tools.

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OBJECTIVES:

- To introduce to types of tool, wear and tool life in metal cutting process.
- To understand the mechanisms of metal removal in metal cutting operations.
- To understand the process of heat generation during metal cutting process and knowledge about various cutting fluids and its properties.
- To train students on identifying the machining parameters.
- To familiarize the various types of cutting tool materials.

UNIT I TOOL NOMENCLATURE, TOOL WEAR AND TOOL LIFE


UNIT II MECHANICS OF METAL CUTTING


UNIT III THERMAL ASPECTS AND CUTTING FLUIDS


UNIT IV MACHINING PARAMETERS AND RELATED QUANTITIES

Machining parameters and related quantities to various metal cutting operations – turning, drilling, reaming, boring, milling, broaching, thread cutting, grinding, fine finishing processes and gear cutting.

UNIT V CUTTING TOOL MATERIALS


TOTAL: 45 PERIODS

OUTCOMES:

Students will be able to

CO1 : Evaluate the tool wear and tool life for various type of cutting tools (single point, multi-point etc.)

CO2 : Calculate various mechanics (cutting force relationships) during metal cutting operations.

CO3 : Determine the tool temperature and heat generation during cutting operation using various measurement techniques and also select optimal cutting fluid based on the application.

CO4 : Select the machining parameters for various machining operations.

CO5 : Get knowledge of various recent cutting tool materials and its properties to aid them in the selection of efficient tool material for the machining process.
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MN5009 COMPUTER INTEGRATED MANUFACTURING

OBJECTIVES:
- To provide the overview of evolution of automation and CIM.
- To understand the various Automation tools include various material handling system and its Principles.
- To train students to apply group technology and FMS.
- To familiarize the computer aided process planning in manufacturing.
- To introduce to basics of data transaction, information integration and control of CIM.

UNIT I INTRODUCTION

UNIT II AUTOMATED MANUFACTURING SYSTEMS
UNIT III GROUP TECHNOLOGY AND FMS


UNIT IV PROCESS PLANNING


UNIT V TYPES OF PROCESS CONTROL AND AUTOMATIC DATA CAPTURE


OUTCOMES:

Students will be able to

- CO1 : Understand the basics of computer aided engineering.
- CO2 : Choose appropriate automotive tools and material handling systems.
- CO3 : Understand the overview of group technology, FMS and automation identification methods.
- CO4 : Design using computer aided process planning for manufacturing of various components
- CO5 : Acquire knowledge in computer process control techniques.

REFERENCES:

OBJECTIVES:
- To familiarize with various forecasting models.
- To impress upon the importance of sequencing problem in industries.
- To design and develop inventory control models for a given industry.
- To familiarize with project management techniques such as CPM and PERT.
- To train on plant engineering techniques such as plant location, plant layout, materials handling and work study.

UNIT I FORECASTING

UNIT II SCHEDULING AND SEQUENCING

UNIT III INVENTORY

UNIT IV PROJECT MANAGEMENT

UNIT V PLANT ENGINEERING AND WORK STUDY

OUTCOMES:
Students will be able to
CO1 : Select an appropriate forecasting method for a given industry.
CO2 : Obtain optimal solutions for sequencing problem in industry.
CO3 : Design a suitable inventory system for any particular industry.
CO4 : Use the project management techniques to minimize the project time.
CO5 : Design plant layout and materials handling systems and can make use of the concepts of work study for work design.

TOTAL : 45 PERIODS
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MN5011 PROCESSING OF POLYMERS AND COMPOSITES L T P C 3 0 0 3

OBJECTIVES:
- To introduce the various processing methods of polymers.
- To enlighten the students about the different types of fibres and matrix materials.
- To analyse the different polymer matrix composites processing methods and their applications.
- To expose the students to the various metal matrix composite processing methods.
- To analyse the various processing techniques of various ceramic matrix composites.

UNIT I PROCESSING OF POLYMERS

UNIT II FIBRES AND MATRIX MATERIALS

UNIT III PROCESSING OF POLYMER MATRIX COMPOSITES
UNIT IV PROCESSING OF METAL MATRIX COMPOSITES


UNIT V PROCESSING OF CERAMIC MATRIX COMPOSITES AND CARBON-CARBON COMPOSITES

Processing of CMCs: cold pressing, sintering, reaction bonding, liquid infiltration, lanxide process – in situ chemical reaction techniques: chemical vapour deposition, chemical vapour impregnation, sol-gel – interfaces in CMCs – mechanical properties and applications of CMCs – Carbon-carbon Composites – applications.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to

CO1: Get knowledge on various processing methods of polymers.
CO2: Get knowledge about various types of fibres and matrix materials.
CO3: Understand the various polymer matrix composites processing methods.
CO4: Analyse the various processing methods of metal matrix composites.
CO5: Analyse the various processing techniques of ceramic matrix composites.

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MN5072 GREEN CONCEPTS

OBJECTIVES
- To impart knowledge about air pollution and its effects on the environment.
- To enlighten the students with knowledge about noise and its effects on the environment.
- To enlighten the students with knowledge about water pollution and its effects on the environment.
- To impart the knowledge of fire safety and its production.
- To impart the knowledge about the need, procedure and benefits of Green-Co rating.
UNIT I
AIR POLLUTION SAMPLING AND MEASUREMENT
9
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 behaviour 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-sulphur dioxide-nitrogen dioxide, carbon monoxide, oxidants and ozone

UNIT II
NOISE POLLUTION AND CONTROL
9
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 AND WATER QUALITY
9
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
9

UNIT V
GREEN CO-RATING
9

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
CO1 : Understand manufacturing processes towards minimization or prevention of air pollution.
CO2 : Understand manufacturing processes towards minimization or prevention of noise pollution.
CO3 : Understand manufacturing processes towards minimization or prevention of water pollution.
CO4 : Presenting the knowledge of fire safety and its production.
CO5 : Predicting green co-rating and its benefits.

REFERENCES:
OBJECTIVES:
- To introduce the students about the requirement of materials for automobile components
- To familiarize students on typical materials used in manufacturing of automobile components
- To impart knowledge on material and manufacturing techniques of piston, valves and battery parts
- To impart knowledge on material and manufacturing techniques of engine blocks, cables and locks in automobile.
- To impart knowledge on material and manufacturing techniques of general transmission parts of automobile

UNIT I MATERIAL NEEDS IN AUTOMOBILE

UNIT II MATERIALS AND TECHNOLOGIES FOR AUTOMOBILE

UNIT III MANUFACTURING OF PISTON, VALVES AND BATTERY PARTS

UNIT IV MANUFACTURING OF ENGINE BLOCK, CABLES AND LOCKS

UNIT V MANUFACTURING OF TRANSMISSION PARTS

TOTAL: 45 PERIODS

OUTCOMES:
The students will
CO1 : Have the knowledge about material requirements, its recycling and life cycle aspects.
CO2 : Gain an insight over the latest materials adopted in automobile manufacture.
CO3 : Have the knowledge of methods adopted in manufacture of piston, valves and battery parts.
CO4 : Know the methods of manufacturing engine block, cables and locks in automobile.
CO5 : Have the idea of various manufacturing methods of automobile structure, transmission parts.

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MN5071 FINANCIAL MANAGEMENT L T P C 3 0 0 3

OBJECTIVES:
- To introduce the concepts of financial accounting.
- To introduce the various functions of financial management to handle higher level financial decisions.
- To gain the knowledge about concepts of financial and various budgeting and cost accounting.
- To develop the knowledge in the field of capital budgeting and cost accounting.
- To gain the knowledge about financial management techniques to make a profit.

UNIT I FINANCIAL ACCOUNTING

UNIT II FINANCIAL MANAGEMENT

UNIT III CAPITAL BUDGETING
UNIT IV  COST ACCOUNTING

UNIT V  DEPRECIATION AND PROFIT PLANNING

OUTCOMES:
Students will be able to
CO1 : Train in various functions of finance such as working capital management, current assets managements to make investment decisions.
CO2 : Handle the highest level financial decisions.
CO3 : Work in a capital financing policy and handle the cash management.
CO4 : Perform the various method in capital budgeting, understand and analyse different costs involved in financial managements.
CO5 : Make investment decisions when they take up senior managerial position.

REFERENCES:
UNIT I  FRICTION  7
Topography of Surfaces – Surface features – Properties and measurement – Surface interaction – Adhesive Theory of Sliding Friction – Rolling Friction – Friction properties of metallic and non-metallic materials – Friction in extreme conditions – Thermal considerations in sliding contact

UNIT II  WEAR  6

UNIT III  CORROSION  10

UNIT IV  SURFACE TREATMENTS  12

UNIT V  CASE STUDIES ON TRIBOLOGY AND CORROSION  10
Bio-fouling, Tribology and corrosion applicable in biomedical implants, Nano Tribology – electronic devices, hot corrosion in power plants – corrosion in nuclear industry – Machining through controlled Wear and corrosion.

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
CO1 : Understand the surface engineering and surface modification methods that will come in handy to solve the industrial problems.
CO2 : Examining related to various materials failure due to friction, wear and corrosion.
CO3 : Predicting the surface problems and select a suitable surface treatment.
CO4 : Integrating case studies in various applications related to surface engineering.
CO5 : Learn various process and techniques developed for surface treatment.

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OUTCOME:

Programme Outcomes

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YEAP

53
OBJECTIVES:
- To acquaint the students with evolution of Solid Freeform Manufacturing (SFM) / Additive Manufacturing (AM), proliferation into various fields and its effects on supply chain.
- To gain knowledge on Design for Additive Manufacturing (DFAM) and its importance in quality improvement of fabricated parts.
- To acquaint with polymerization and sheet lamination processes and their applications.
- To acquaint with material extrusion and powder bed fusion processes.
- To gain knowledge on jetting and direct energy deposition processes and their applications.

UNIT I  INTRODUCTION

UNIT II  DESIGN FOR ADDITIVE MANUFACTURING

UNIT III  VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES

UNIT IV  MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES

UNIT V  JETTING AND DIRECT ENERGY DEPOSITION PROCESSES

TOTAL: 45 PERIODS
COURSE OUTCOMES:
At the end of this course, the students shall be able to:
CO1: Recognize the importance in the evolution of SFM/AM, proliferation into the various fields and its effects on supply chain.
CO2: Evaluate the design for AM and its importance in the quality of fabricated parts.
CO3: Acquire knowledge on principles and applications of polymerization and sheet lamination processes with case studies.
CO4: Acquire knowledge on principles of material extrusion and powder bed fusion processes and design guidelines.
CO5: Perceive jetting and direct energy deposition processes and their applications.

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REFERENCES:

MN5014  ADVANCED CASTING TECHNOLOGY  L  T  P  C  3 0 0 3

OBJECTIVES:
- To gain the knowledge about principles of foundry
- To gain the knowledge about principles of casting technology
- To gain the knowledge about principles of Moulding technology.
- To familiarize the casting of ferrous and non-ferrous alloys
- To know the advanced casting technology.

UNIT I  PATTERN MAKING, MOULDING AND CORE MAKING  9
UNIT II SOLIDIFICATION AND GATING
Solidification principles – planar and dendritic solidification – constitutional super cooling - Freezing of a pure metal –Freezing of alloys – Properties related to freezing mechanism- Directional solidification – progressive solidification - Gates and risers-their functions – types-design principles, design of gating and riser - illustrative problems in riser and gating design-

UNIT III MOULDING METHODS AND QUALITY CONTROL
Green sand moulding-dry sand moulding-CO2 moulding-no bake moulding- shell moulding, investment casting-permanent moulding-die casting - centrifugal casting-continuous casting- Defects in casting – Inspection and testing of castings – fettling and heat treatment of castings

UNIT IV CASTING OF FERROUS AND NON FERROUS ALLOYS
Melting equipment for foundries – Types of furnaces – Refractories for melting units -Casting of Aluminium, Magnesium, Copper and their alloys – Casting of steel, cast iron and gray iron

UNIT V ADVANCES IN CASTING

TOTAL: 45 PERIODS

OUTCOMES:
Students will be able to
CO1 : Imply the techniques to make the pattern, core and moulding.
CO2 : Evaluate the process parameters involved in casting processes.
CO3 : Identify the appropriate casting techniques for various materials.
CO4 : Know about various equipments and furnaces used in casting process.
CO5 : Grasp the significance of advanced casting process and its applications.

REFERENCES
OBJECTIVES
1. Students will be able to study the concepts in facility planning.
2. Students will be able to study types of plant layout and capacity planning methods.
3. Students will be able to study the concepts of Project management.
4. Students will be able to study the concepts and methods in production planning and control.
5. Students will be able to study the concepts in Inventory and maintenance management.

UNIT-I FACILITY PLANNING 9
Facility planning – Factors affecting selection of plant location, Factor rating analysis: Break – even analysis, Load distance model, closeness ratings – case study

UNIT-II CAPACITY & LAYOUT PLANNING 9
Types of plant layout, criteria for good layout, Process layout, Assembly line balancing. Computer based solutions to layout problems such as CRAFT, ALDEP, CORELAP and PREP. Capacity planning – Analysis of designed capacity, installed capacity, commissioned capacity, utilized capacity, factors affecting productivity and capacity expansion strategies.

UNIT-III PROJECT MANAGEMENT 9
Demand forecasting – Quantitative and qualitative techniques, measurement of forecasting errors, Project management – its role in functional areas of management, network representation of a project, CPM and PERT techniques – case study

UNIT-IV PRODUCTION PLANNING & CONTROL 9
Aggregate production planning, production planning strategies, Disaggregating the aggregate plan, Materials Requirement Planning (MRP), MRP-II, Supply chain management, Operation scheduling, prioritization.

UNIT-V INVENTORY AND MAINTENANCE MANAGEMENT 9
Introduction to EOQ models, Inventory control techniques – ABC, FSN, VED etc. Types of inventory control – Perpetual, two-bin and periodic inventory system – JIT, SMED, Kanban, Zero inventory, Maintenance strategies and planning, Maintenance economics: quantitative analysis, optimal number of machines, Replacement strategies and policies – economic service life, opportunity cost, replacement analysis using specific time period.

TOTAL :45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. Able to acquire knowledge on facility, and problems associated with it.
2. Ability to learn the various capacity and layout planning models
3. Understand the concepts of demand forecasting and project management with relevant case studies.
4. Able to understand the concepts of production planning and scheduling.
5. Understand the various inventory and maintenance management techniques.
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MN5015 INDUSTRIAL DESIGN AND ERGONOMICS

OBJECTIVES
- To introduce to industrial design based on ergonomics.
- To consider ergonomics concept in manufacturing
- To apply ergonomics in design of controls and display.
- To apply environmental factors in ergonomics design.
- To understand aesthetics applicable to manufacturing and product

UNIT I INTRODUCTION
An approach to industrial design, Elements of design structure for industrial design in engineering application in modern manufacturing systems- Ergonomics and Industrial Design: Introduction to Ergonomics, Communication system, general approach to the man-machine relationship, Human component of work system, Machine component of work system, Local environment-light, Heat, Sound.

UNIT II ERGONOMICS AND PRODUCTION
Introduction, Anthropometric data and its applications in ergonomic, working postures, Body Movements, Work Station Design, Chair Design. Visual Effects of Line and Form: The mechanics of seeing, Psychology of seeing, Figure on ground effect, Gestalt’s perceptions - Simplicity, Regularity, Proximity, Wholeness. Optical illusions, Influences of line and form.
UNIT III DESIGN PRINCIPLES FOR DISPLAY AND CONTROLS
Displays: Design Principles of visual Displays, Classification, Quantitative displays, Qualitative displays, check readings, Situational awareness, Representative displays, Design of pointers, Signal and warning lights, colour coding of displays, Design of multiple displays Controls: Design considerations, Controls with little efforts – Push button, Switches, rotating Knobs. Controls with muscular effort – Hand wheel, Crank, Heavy lever, Pedals. Design of controls in automobiles, Machine Tools

UNIT IV ENVIRONMENTAL FACTORS
Colour: Colour and light, Colour and objects, Colour and the eye – after Image, Colour blindness, Colour constancy, Colour terms – Colour circles, Munsel colour notation, reactions to colour and colour combination – colour on engineering equipments, Colour coding, Psychological effects, colour and machine form, colour and style

UNIT V AESTHETIC CONCEPTS
Concept of unity, Concept of order with variety, Concept of purpose, Style and environment, Aesthetic expressions - Symmetry, Balance, Contrast, Continuity, Proportion. Style - The components of style, House style, Style in capital good. Introduction to Ergonomic and plant layout softwares.

OUTCOMES
Students at the end of course will be able to
CO1: Appreciate ergonomics need in the industrial design.
CO2: Apply ergonomics in creation of manufacturing system
CO3: Discuss on design of controls and display.
CO4: Consider environmental factors in ergonomics design.
CO5: Report on importance of aesthetics to manufacturing system and product

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COURSE OBJECTIVES

- To introduce and familiarize the industry 4.0 and its physical structure and inter-connectivity.
- To understand the architecture, IOT and its protocols
- To outline the cloud computing and data analytics
- To familiar the concepts of integrated IOT.
- To learn the IOT, cloud computing, data analytics and Industry 4.0

UNIT I INDUSTRY 4.0

Digitalization and the Networked Economy - Introduction to Industry 4.0 - Comparison of Industry 4.0 Factory and Today's Factory - Internet of Things (IoT) - Industrial Internet of Things (IIoT) - Smart Devices and Products - Smart Logistics - Support System for Industry 4.0 - Cyber-physical Systems Requirements - Data as a New Resource for Organizations - Cloud Computing - Trends of Industrial Big Data and Predictive Analytics for Smart Business - Architecture of Industry 4.0.

UNIT II IOT AND ITS PROTOCOLS


UNIT III CLOUD COMPUTING


UNIT VI INTEGRATED IOT


UNIT V APPLICATIONS


TOTAL: 45 PERIODS

COURSE OUTCOMES

Upon completion of this course, the students will be able to:

- CO1: Realize the need of industry 4.0 and its inter-connectivity.
- CO2: Interpret the architecture of IOT and its protocols
- CO3: Recognize the uses of cloud computing and data analytics
- CO4: Familiar the concepts of integrated IOT.
- CO5: Plan the uses of IOT, cloud computing, data analytics and Industry 4.0 technologies.
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COURSE OUTCOMES

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OBJECTIVES
- To introduce to fundamentals of Jigs and Fixtures and tool materials.
- To understand geometrical features and design of cutting tools.
- To introduce the design steps of tools for metal forming operation.
- To learn the design process of clamping, locator and fixtures.
- To familiarize the design process of Jigs and tool guides

UNIT I  INTRODUCTION

UNIT II  DESIGN OF CUTTING AND METROLOGY TOOLS
Introduction to metal cutting process and tools, Revision of metal cutting tools-Single point cutting tools, Milling cutters, Drills and Drilling, Reamers, Taps. Selection of carbide tools, determining the insert thickness for carbide tools. Introduction to Design of Tools for Inspection and Gauging, Geometrical Dimensioning and Tolerance, Work piece quality criteria, Principles of gauging, Types of gages and their applications, Amplification and magnification of error, Gage Tolerances, Indicating gages, Automatic gages, Gauging positional tolerance parts, problems.
UNIT III  DESIGN OF PRESS TOOLS 9

UNIT IV  DESIGN OF CLAMPS LOCATING METHODS AND FIXTURES 9

UNIT V  DESIGN OF JIGS AND TOOL GUIDES 9
Types Of Jigs –plate Jig, Box Jig, Leaf Jig, Channel Jig, Post, Turnover, Channel, Latch, Pot, Angular Post Jigs – Indexing Jigs – Design of Drill Jigs: Introduction, Types of drill jigs, General considerations in the design of drill jigs, Drill bushings, Methods of construction. Guiding Elements: Introduction, Guiding the tools, Types of drill bushes.

OUTCOMES
Students at the end of course will be able to
CO1: Discuss on fundamentals Jigs and Fixtures and tool materials.
CO2: Brief on geometrical features and design of cutting tools.
CO3: Understand the design steps of tools for metal forming operation.
CO4: Carryout design process for clamping, locator and fixtures.
CO5: To design of Jigs and tool guides

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# IL5071 ADVANCED OPTIMIZATION TECHNIQUES

**OBJECTIVES:**
- Learn to solve integer programming problems
- To know how to solve the Dynamic programming problems
- Learn to solve non-linear programming problems with unconstrained optimization problems
- Understand to solve non-linear programming problems using KKT conditions, quadratic and separable programming
- To create awareness of Meta heuristic algorithms.

## UNIT I  INTEGER PROGRAMMING
- Branch and Bound technique – cutting plane algorithm method - Travelling Salesman problem - Traveling Salesman Problem - Branch and Bound Algorithms for TSP - Heuristics for TSP - Chinese Postman Problem - Vehicle Routeing Problem

## UNIT II  DYNAMIC PROGRAMMING

## UNIT III  NONLINEAR PROGRAMMING - I:
- Types of Nonlinear Programming Problems - One-Variable Unconstrained Optimization - Multivariable Unconstrained Optimization

## UNIT IV  NONLINEAR PROGRAMMING – II:

## UNIT V  NON-TRADITIONAL OPTIMIZATION

**OUTCOMES:**
- CO1: Know how to solve integer programming problems
- CO2: Able to solve Dynamic programming problems
- CO3: Familiar in solving unconstrained non linear optimization problems
- CO4: Familiar in solving constrained liner optimization problems
- CO5: Know how to solve non linear optimization problems using Meta heuristic algorithms

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TOTAL: 45 PERIODS

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*Attested*  
**DIRECTOR**  
Centre for Academic Courses  
Anna University, Chennai-600 025
REFERENCES:

OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS

COURSE OBJECTIVES:
- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS

Suggested Activities:
- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:
- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS

Suggested Activities:
- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.
Suggested Evaluation Methods:
- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III  MODELING UNCERTAINTY AND STATISTICAL INFERENCE  

Suggested Activities:
- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:
- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV  ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK  

Suggested Activities:
- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:
- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V  OTHER DATA ANALYTICAL FRAMEWORKS  
Overview of Application development Languages for Hadoop – Pig Latin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:
- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:
- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS
COURSE OUTCOMES:
On completion of the course, the student will be able to:
- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

OE5092 INDUSTRIAL SAFETY L T P C
3 0 0 3

COURSE OBJECTIVES:
- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9
UNIT IV  FAULT TRACING
Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: i. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

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OE5093  OPERATIONS RESEARCH

COURSE OBJECTIVES:
- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation , assignment problems
- Solve project management problems
- Solve scheduling problems
UNIT I  LINEAR PROGRAMMING  9
Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II  ADVANCES IN LINEAR PROGRAMMING  9
Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III  NETWORK ANALYSIS – I  9
Transportation problems -Northwest corner rule, least cost method, Voges’s approximation method - Assignment problem - Hungarian algorithm

UNIT IV  NETWORK ANALYSIS – II  9
Shortest path problem: Dijkstra’s algorithms, Floyd’s algorithm, systematic method -CPM/PERT

UNIT V  NETWORK ANALYSIS – III  9
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL : 45 PERIODS

COURSE OUTCOMES:
CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

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OE5094  COST MANAGEMENT OF ENGINEERING PROJECTS  L T P C
3 0 0 3

OBJECTIVES:
- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management
UNIT I  INTRODUCTION TO COSTING CONCEPTS
Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II  INTRODUCTION TO PROJECT MANAGEMENT
Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member, Importance Project site: Data required with significance, Project contracts.

UNIT III  PROJECT EXECUTION AND COSTING CONCEPTS
Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV  COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL
Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V  QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT
Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

COURSE OUTCOMES:
CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

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2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
OE5095                                        COMPOSITE MATERIALS

COURSE 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
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
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

UNIT IV  MANUFACTURING OF POLYMER MATRIX COMPOSITES

UNIT V  STRENGTH
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: 45 PERIODS

COURSE OUTCOMES:
- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know 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.

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OE5096 WASTE TO ENERGY L T P C
3 0 0 3

OBJECTIVES:
- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNIT I INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE
Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS
Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION

UNIT IV BIOMASS COMBUSTION
Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT V BIO ENERGY
Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features
REFERENCES:

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C

2 0 0 0

COURSE 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

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: 30 PERIODS
COURSE OUTCOMES
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

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AX5092 DISASTER MANAGEMENT
COURSE OBJECTIVES
- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

UNIT I INTRODUCTION
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

UNIT III DISASTER PRONE AREAS IN INDIA
Study of Seismic Zones; Areas Prone To Floods and Droughts, Landslides And Avalanches; Areas Prone To Cyclonic and Coastal Hazards with Special Reference To Tsunami; Post-Disaster Diseases and Epidemics
UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT  6
Preparedness: Monitoring Of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological And Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT  6
Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People’s Participation in Risk Assessment. Strategies for Survival

TOTAL : 30 PERIODS

COURSE OUTCOMES
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: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

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AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C 2 0 0 0

COURSE OBJECTIVES
- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS
Alphabets in Sanskrit
UNIT II    TENSES AND SENTENCES  6
Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS  6
Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE  6
Technical information about Sanskrit literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING  6
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

COURSE OUTCOMES
- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

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REFERENCES
1. “Abhyaspustakam” – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbhasasti, Rashtriya Sanskrit Sansthanam, New Delhi Publication

AX5094    VALUE EDUCATION  L T P C
          2 0 0 0

COURSE OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I

UNIT II
UNIT III

UNIT IV

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

SUGGESTED READING

AX5095 CONSTITUTION OF INDIA L T P C
2 0 0 0

COURSE OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION:
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION:
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES:

UNIT IV ORGANS OF GOVERNANCE:
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.
UNIT V    LOCAL ADMINISTRATION:

UNIT VI    ELECTION COMMISSION:
Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.

TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to:
- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

SUGGESTED READING
1. The Constitution of India,1950 (Bare Act),Government Publication.

AX5096    PEDAGOGY STUDIES

COURSE OBJECTIVES
Students will be able to:
- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I    INTRODUCTION AND METHODOLOGY:
Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions - Overview of methodology and Searching.
UNIT II THETAMIC OVERVIEW
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES
Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers’ attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT
Professional development: alignment with classroom practices and follow up support - Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning: limited resources and large class sizes

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS
Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact. TOTAL: 30 PERIODS

COURSE OUTCOMES
Students will be able to understand:
- What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

SUGGESTED READING
UNIT I
Definitions of Eight parts of yoga (Ashtanga)

UNIT II
Yam and Niyam - Do’s and Don’ts in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III
Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects - Types of pranayam

COURSE OBJECTIVES
- To achieve overall health of body and mind
- To overcome stress

COURSE OUTCOMES
Students will be able to:
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING
1. ‘Yogic Asanas for Group Training-Part-I’: Janardan Swami Yoga bhyasi Mandal, Nagpur
2. “Rajayoga or conquering the Internal Nature” by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

UNIT I
Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (doot’s) - Verses-71,73,75,78 (do’s)

UNIT II
Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III
Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS
COURSE OUTCOMES
Students will be able to
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakan will help in developing versatile personality of students.

SUGGESTED READING
1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari’s Three Satakam, Niti-sringar-vairagya, New Delhi, 2010