1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

| I. | To Impart knowledge to students in recent advances in the Computer Aided Manufacturing to educate them to prosper in Manufacturing engineering and research related professions. |
| II. | To enhance the scientific and engineering fundamentals the provide students with a solid foundation in required to solve analytical problems |
| III. | To coach students with good design and engineering skills so as to comprehend, analyze, design, and produce novel materials, products and solutions for the contemporary manufacturing issues. |
| IV. | To inculcate students with professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate Computer Integrated Manufacturing engineering issues to broader engineering and social context. |

2. PROGRAMME OUTCOMES(POs):

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<tr>
<td>1</td>
<td>An ability to independently carry out research/investigation and development work to solve practical problems</td>
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<td>An ability to write and present a substantial technical report/document</td>
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<td>Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program</td>
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<td>Graduate will demonstrate skills to use modern engineering tools, software and equipment to analyze engineering problems.</td>
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<td>5</td>
<td>Graduates will demonstrate an ability to visualize and work on laboratory and multidisciplinary tasks in the design and manufacturing applications</td>
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<td>6</td>
<td>Responsibility of understanding ethically and professionally and develop confidence for self-education and ability for life-long learning</td>
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3. PEO/PO Mapping:

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1,2,3,\ldots scale against the correlation PO’s with PEO’s
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NON-AUTONOMOUS COLLEGES AFFILIATED TO ANNA UNIVERSITY
M.E. CAD/CAM
REGULATIONS – 2021
CHOICE BASED CREDIT SYSTEM
I TO IV SEMESTERS CURRICULA AND SYLLABI

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### EMPLOYABILITY ENHANCEMENT COURSES (EEC)

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AUDIT COURSES (AC)
Registration for any of these courses is optional to students

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COURSE OBJECTIVES:
- To understand fundamental concepts of computer graphics and its tools in a generic framework.
- To impart the parametric fundamentals to create and manipulate geometric models using curves, surfaces and solids.
- To impart the parametric fundamentals to create and manipulate geometric models using NURBS and solids.
- To provide clear understanding of CAD systems for 3D modeling and viewing.
- To create strong skills of assembly modeling and prepare the student to be an effective user of a standards in CAD system.

UNIT – I INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS 9
Geometric Transformations: Coordinate Transformations, Windowing and Clipping, 2D Geometric transformations - Translation, Scaling, Shearing, Rotation and Reflection, Composite transformation, 3D transformations.

UNIT – II CURVES AND SURFACES MODELLING 9
Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations.

UNIT – III NURBS AND SOLID MODELING 9

UNIT – IV VISUAL REALISM 9
Hidden Line removal, Hidden Surface removal, Hidden Solid Removal algorithms - Shading – Coloring.
Animation - Conventional, Computer animation, Engineering animation - types and techniques.

UNIT – V ASSEMBLY OF PARTS AND PRODUCT LIFE CYCLE MANAGEMENT 9

TOTAL: 45 PERIODS
COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Solve 2D and 3D transformations for the basic entities like line and circle.
2. Formulate the basic mathematics fundamental to CAD system.
3. Use the different geometric modeling techniques like feature based modeling, surface modeling and solid modeling.
4. Create geometric models through animation and transform them into real world systems.

REFERENCES:

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CD4152 DESIGN FOR SUSTAINABILITY

COURSE OBJECTIVES
1. Selecting the relevant process; applying the general design principles for manufacturability; GD &T.
2. Applying the design considerations while designing the cast and welded components.
3. Applying the design considerations while designing the formed and machined components.
4. Apply design considerations for assembled systems.
5. Apply design considerations for environmental issues.
UNIT- I  INTRODUCTION
Introduction - Economics of process selection - General design principles for manufacturability; Geometric Dimensioning & Tolerance (GD&T) - Form tolerancing: straightness, flatness, circularity, cylindricity - Profile tolerancing: profile of a line, and surface - Orientation tolerancing: angularity, perpendicularity, parallelism - Location tolerancing: position, concentricity, symmetry - run out tolerancing: circular and total-Supplementary symbols.

UNIT- II  CAST & WELDED COMPONENTS DESIGN

UNIT- III  FORMED & MACHINED COMPONENTS DESIGN
Design considerations for: Metal extruded parts - Impact/Cold extruded parts - Stamped parts - Forged parts. Design considerations for: Turned parts- Drilled parts - Milled, planned, shaped and slotted parts-Ground parts.

UNIT- IV  DESIGN FOR ASSEMBLY
Design for assembly - General assembly recommendations - Minimizing the no. of parts - Design considerations for: Rivets - Screw fasteners - Gasket & Seals - Press fits - Snap fits - Automatic assembly- Computer Application for DFMA.

UNIT- V  DESIGN FOR ENVIRONMENT

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Select relevant process; apply the general design principles for manufacturability; GD&T.
2. Apply design considerations while designing the cast and welded components.
3. Apply design considerations while designing the formed and machined components.
4. Apply design considerations for assembled systems.
5. Apply design considerations for environmental issues.

REFERENCES:
2. Bralla, Design for Manufacture handbook, McGrawhill,1999
CC4101  ADVANCED MANUFACTURING PROCESSES  L  T  P  C  
3  0  0  3

COURSE OBJECTIVES:
1. To analyze and determine material fabrication processes.
2. To use laboratory instrument doing routine metrological measurements
3. To operate regular machine shop equipment such as grinders, drill presses, lathes, milling machines, shapers and etc.
4. To recognize engine machine tool requirements and be selective in the choice of tools.
5. To setup and operate machines, index and determine machine speeds, feeds, and depth of cut requirements.
6. To identify with numerical control machining and computer programming.

UNIT–I  SURFACE TREATMENT  9
Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT–II  NON-TRADITIONAL MACHINING  9

UNIT–III  LASER BEAM MACHINING  9
UNIT – IV PROCESSING OF CERAMICS

UNIT – V FABRICATION OF MICROELECTRONIC DEVICES
Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in microelectronics, surface mount technology, Integrated circuit economics. E-Manufacturing, nanotechnology, and micromachining, High speed Machining

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- At the end of the course, the student will be able to understand the working principle of Electron beam, laser beam and laser hybrid welding processes.
- Able to understand different types of composite material characteristics, types of micro & macro machining processes.
- Understand the e-manufacturing & nano materials
- To make the students get acquainted with the design for manufacturing, assembly and environment.

REFERENCES:

Mapping of CO with PO and PSO

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1-low, 2-medium, 3-high, ‘--‘- no correlation
COURSE OBJECTIVES:
The main learning objective of this course is to prepare the students for computer aided tools that can be implemented in various industrial applications.

UNIT–I COMPUTER AIDED MANUFACTURING

UNIT–II COMPUTER AIDED PROCESS PLANNING

UNIT–III COMPUTER AIDED INSPECTION

UNIT–IV REVERSE ENGINEERING

UNIT–V DATA MANAGEMENT

REFERENCES:

TOTAL:45 PERIODS
Mapping of CO with PO and PSO

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1-low, 2-medium, 3-high, 'no correlation'

RM4151 RESEARCH METHODOLOGY AND IPR  L T P C  2 0 0 2

UNIT I RESEARCH DESIGN  6
Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II DATA COLLECTION AND SOURCES  6
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING  6
Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV INTELLECTUAL PROPERTY RIGHTS  6

UNIT V PATENTS  6

TOTAL : 30 PERIODS

REFERENCES
COURSE OBJECTIVES:
- To impart knowledge on how to prepare drawings for various mechanical components using any commercially available 3D modeling software's
- CAD Introduction.
- Sketcher
- Solid modeling - Extrude, Revolve, Sweep and variational sweep, Loft
- Surface modeling - Extrude, Sweep, Trim and Mesh of curves, Freeform.
- Feature manipulation - Copy, Edit, Pattern, Suppress, History operations etc.
- Assembly - Constraints, Exploded Views, Interference check

Exercises in modeling and drafting of mechanical components-assembly using parametric and feature-based packages like PRO-E/SOLIDWORKS/CATIA/NX

TOTAL = 60 PERIODS

OUTCOMES:
On completion of the course the student will be able to
- Use the modern engineering tools necessary for engineering practice
- Draw 2D part drawings, sectional views, and assembly drawings as per standards.
- Create 3D Model on any CAD software.
- Convert 3D solid models into 2D drawings and prepare different views, sections, and dimensioning of part models.
- Examine interference to ensure that parts will not interfere.

Mapping of CO with PO

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COURSE OBJECTIVES:
- To familiarize students with manual CNC part programming for milling and turning machines.
- To generate part programs using CAM packages for milling and turning machines.
- To train students with dimensional and geometric measurements for machined features using video measuring system and coordinate measuring machine.
- To get hands on knowledge on programming logic controller - ladder programming and robot programming.
- To introduce the concept of printing parts using additive manufacturing and to introduce Relational database management system in Material requirements planning.

LIST OF EXPERIMENTS
1. Programming and simulation for various operations using canned cycle for CNC turning Centre.
2. Programming and simulation for machining of internal surfaces in CNC turning Centre
3. Programming and simulation for profile milling operations
4. Programming and simulation for circular and rectangular pocket milling
5. Programming and simulation using canned cycle for CNC Milling such as peck drilling and tapping cycle
6. CNC code generation using CAM software packages – Milling
7. CNC code generation using CAM software packages – Turning
8. Dimensional and geometric measurement of machined features using VMS and CMM
9. PLC ladder logic programming.
10. Robot programming for Material handling applications.
11. Study on RDBMS and its application in problems like inventory control MRP.
12. Design and fabrication of a component using extrusion based additive manufacturing.

COURSE OUTCOMES:
At the end of this course, the students shall be able to:
CO1: Explain the manual CNC part programming for milling and turning machines.
CO2: Create part programs using CAM packages for milling and turning Machines.
CO3: Appraise dimensional and geometric measurements of machined features using video measuring system and coordinate measuring machine.
CO4: Construct PLC ladder programming and robot programming.
CO5: Relate the concept of printing parts using additive manufacturing and appreciate the application RDBMS in MRP.

LIST OF EQUIPMENTS REQUIRED:
1. Computers 30
2. CAM Software for 3 axis machining or more
3. CNC Production type turning or Machining center
4. Video Measuring System
5. Coordinate Measuring Machine
6. Surface Roughness tester
7. 5-axis Robot
8. Programmable Logic Controller with ladder logic programming software
9. RDMBS Package with relevant modules like Inventory Control and MRP
10. 3D Printer

TOTAL: 60 PERIODES
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**PD4391 PRODUCT LIFECYCLE MANAGEMENT**  
**L T P C**  
**3 0 0 3**

**OBJECTIVES:**
1. To understand history, concepts and terminology of PLM
2. To understand functions and features of PLM/PDM
3. To understand different modules offered in commercial PLM/PDM tools
4. To demonstrate PLM/PDM approaches for industrial applications
5. To Use PLM/PDM with legacy data bases, CAx & ERP systems

**UNIT I HISTORY, CONCEPTS AND TERMINOLOGY OF PLM**  
Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM - Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure - Network and Communications, Data Management, Heterogeneous data sources and applications.

**UNIT II PLM/PDM FUNCTIONS AND FEATURES**  

**UNIT III DETAILS OF MODULES IN APDM/PLM SOFTWARE**  
Case studies based on top few commercial PLM/PDM tools

**UNIT IV ROLE OF PLM IN INDUSTRIES**  
Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for business, organization, users, product or service, process performance.
UNIT V  BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE

PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP

TOTAL: 45 PERIODS

OUTCOMES:
The students will be able to
1. Summarize the history, concepts and terminology of PLM
2. Use the functions and features of PLM/PDM
3. Use different modules offered in commercial PLM/PDM tools.
4. Implement PLM/PDM approaches for industrial applications.
5. Integrate PLM/PDM with legacy data bases, CAx& ERP systems.

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01 Low 02 Medium 03 High

REFERENCES
COURSE OBJECTIVES
1. To learn mathematical models for one dimensional problems and their numerical solutions
2. To learn two dimensional scalar and vector variable problems to determine field variables
3. To learn Iso parametric transformation and numerical integration for evaluation of elements matrices
4. To study various solution techniques to solve Eigen value problems
5. To learn solution techniques to solve non-linear problems

UNIT-I FINITE ELEMENT ANALYSIS OF ONE DIMENSIONAL PROBLEMS 9+3

UNIT-II FINITE ELEMENT ANALYSIS OF TWO DIMENSIONAL PROBLEMS 9+3

UNIT-III ISO-PARAMETRIC FORMULATION 9+3
Natural Co-ordinate Systems – Lagrangian Interpolation Polynomials – Iso parametric Elements – Formulation – Shape functions - one dimensional, two dimensional triangular and quadrilateral elements - Serendipity elements- Jacobian transformation - Numerical Integration – Gauss quadrature – one, two and three point integration

UNIT-IV EIGEN VALUE PROBLEMS 9+3
Dynamic Analysis – Equations of Motion – Consistent and lumped mass matrices – Free Vibration analysis – Natural frequencies of Longitudinal, Transverse and torsional vibration – Solution of Eigenvalue problems - Introduction to transient field problems

UNIT-V NON-LINEAR ANALYSIS 9+3
Introduction to Non-linear problems - some solution techniques- computational procedure-material non-linearity-Plasticity and viscoplasticity, stress stiffening, contact interfaces- problems of gaps and contact - geometric non-linearity - modeling considerations - Free and Mapped meshing -Mesh quality- Error estimate

TOTAL = 60 PERIODS
COURSE OUTCOMES:
On Completion of the course the student will be able to

- Develop mathematical models for one dimensional problems and their numerical solutions
- Determine field variables for two dimensional scalar and vector variable problems
- Apply Isoparametric transformation and numerical integration for evaluation of element matrices
- Apply various solution techniques to solve Eigen value problems
- Formulate solution techniques to solve non-linear problems

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CM4152 SOLID FREEFORM MANUFACTURING

COURSE 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  9
Need - Development of SFM systems – Hierarchical structure of SFM - SFM process chain –
Classification – Applications. Case studies: Bio printing- Food Printing- Electronics printing – Rapid
Tooling - Building printing. AM Supply chain. Economics aspect: Strategic aspect- Operative
aspect.

UNIT II  DESIGN FOR ADDITIVE MANUFACTURING  9
Concepts and Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimization -
Lightweight Structures - DFAM for Part Quality Improvement - CAD Modeling - Model
Reconstruction - Data Processing for AM - Data Formats - Data Interfacing - Part Orientation -
Support Structure Design and Support Structure Generation - Model Slicing - Tool Path
Generation. Design Requirements of Additive Manufacturing: For Part Production, For Mass
Production, For Series Production. Case Studies.

UNIT III  VAT POLYMERIZATION AND SHEET LAMINATION PROCESSES  9
Stereolithography Apparatus (SLA): Principles – Photo Polymerization of SL Resins - Pre Build
Process – Part-Building and Post-Build Processes - Part Quality and Process Planning, Recoating
Issues - Materials - Advantages - Limitations and Applications. Digital Light Processing (DLP) -
Laminated Object Manufacturing (LOM): Working Principles - Process - Materials, Advantages,
Limitations and Applications. Ultrasonic Additive Manufacturing (UAM) - Process - Parameters -
Applications. Case Studies.

UNIT IV  MATERIAL EXTRUSION AND POWDER BED FUSION PROCESSES  9
Materials - Surface Deviation and Accuracy - Applications. Multijet Fusion.
Selective Laser Melting (SLM) and Electron Beam Melting (EBM): Principles – Processes –

UNIT V  JETTING AND DIRECT ENERGY DEPOSITION PROCESSES  9
Binder Jetting: Three dimensional Printing (3DP): Principles – Process - Physics of 3DP - Types of
printing: Continuous mode – Drop on Demand mode - Process – Materials - Advantages -
Limitations - Applications.
Material Jetting: Multi Jet Modelling (MJM) - Principles - Process - Materials - Advantages and
Limitations.
Laser Engineered Net Shaping (LENS): Processes- Materials- Advantages - Limitations and
Applications. Case Studies.

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

TOTAL: 45 PERIODS
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II4091 INDUSTRY 4.0 L T P C 3 0 0 3

OBJECTIVES:
The students will be able to
- Understand Industry 4.0
- Apply IOT and IIOT for Industry 4.0
- Understand CPS for Industry 4.0

UNIT I
Introduction to Industry 4.0 The Various Industrial Revolutions - Digitalisation and the Networked Economy - Drivers, Enablers, Compelling Forces and Challenges for Industry 4.0 - Comparison of Industry 4.0 Factory and Today’s Factory - Trends of Industrial Big Data and Predictive Analytics for Smart Business Transformation

UNIT II
Road to Industry 4.0 - Internet of Things (IoT) & Industrial Internet of Things (IIoT) & Internet of Services - Smart Manufacturing - Smart Devices and Products - Smart Logistics - Smart Cities - Predictive Analytics
UNIT III 9

UNIT IV 9
Role of data, information, knowledge and collaboration in future organizations - Resource- based view of a firm - Data as a new resource for organizations - Harnessing and sharing knowledge in organizations - Cloud Computing Basics - Cloud Computing and Industry 4.0

UNIT V 9
Industry 4.0 IloT case studies - Opportunities and Challenges - Future of Works and Skills for Workers in the Industry 4.0 Era - Strategies for competing in an Industry 4.0 world – Society 5.0

OUTCOMES:
The students will be able to
- Use Industry 4.0 for Industrial Applications
- Use IoT and IIoT for Industry 4.0
- Apply smart devices Industrial Applications

TEXT BOOKS
1. Alasdair Gilchrist, Industry 4.0: The Industrial Internet of Things

CC4211 RAPID PROTOTYPING LABORATORY L T P C
0 0 4 2

COURSE OUTCOMES:
At the end of the course, the student shall be able to:
1. Optimize the process parameters of FDM machine to improve the quality of the parts produced.
2. Build complex engineering assemblies in plastic material with less process planning.
3. Improve surface finish of fabricated plastic components for the engineering applications.
4. Design and fabricate working models for the conceptual testing applications.

DETAILED SYLLABUS:
1. Review of CAD Modeling Techniques and Introduction to RP
2. Forming Groups & Assigning Creative Idea
3. Generating STL files from the CAD Models & Working on STL files
4. Modeling Creative Designs in CAD Software
5. Assembling Creative Designs in CAD Software
6. Processing the CAD data in Catalyst software (Selection of Orientation, Supports generation, Slicing, Tool path generation)
7. Sending the tool path data to FDM RP machine
8. Removing the supports & post processing (cleaning the surfaces)
9. Demonstrating Creative Working Models
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ED4261 SIMULATION AND ANALYSIS LABORATORY L T P C 0 0 4 2

OBJECTIVES:
- To give exposure to software tools needed to analyze engineering problems.

LIST OF EXPERIMENTS
1. Force and Stress analysis using link elements in Trusses.
2. Stress and deflection analysis in beams with different support conditions.
5. Thermal stress and heat transfer analysis of plates.
7. Vibration analysis of spring-mass systems.
8. Modal analysis of Beams.
9. Harmonic, transient and spectrum analysis of simple systems.
10. Analysis of machine elements under dynamic loads
11. Analysis of non-linear systems

TOTAL:60 PERIODS

LIST OF EQUIPMENTS / SOFTWARE:
Finite Element Analysis packages

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1 Solve engineering problems numerically using Computer Aided Finite Element Analysis packages
CO2 Analyze the force, stress, deflection in mechanical components.
CO3 Analyze thermal stress and heat transfer in mechanical components.
CO4 Analyze the vibration of mechanical components.
CO5 Analyze the modal, harmonic, transient and spectrum concepts in mechanical components.
## CC4311 TECHNICAL SEMINAR

### COURSE OBJECTIVES:
- To work on a specific technical topic in Engineering design related topics in order to acquire the skills of oral presentation
- To acquire technical writing abilities for seminars and conferences

The students will work for two hours per week guided by a group of staff members. They will be asked to talk on any topic of their choice related to Engineering design topics and to engage in dialogue with the audience. A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will also answer the queries on the topic. The students as audience also should interact. Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

### TOTAL: 30 PERIODS

### COURSE OUTCOMES:
On completion of the course the student will be able to:
- **CO1**: Students comprehend concepts and methods adequate to understand inductive and deductive reasoning, and increase their general problem solving skills.
- **CO2**: Students develop communicative skills (e.g. speaking, listening, reading, and/or writing).

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COURSE OBJECTIVES
1. To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
2. To develop the methodology to solve the identified problem.
3. To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:
The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design and manufacturing applications. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

COURSE OUTCOMES:
On Completion of the course the student will be able to
CO1 Demonstrate a sound technical knowledge of their selected project topic.
CO2 Undertake problem identification, formulation and solution.
CO3 Design and manufacturing engineering solutions to complex problems utilising a systems approach.
CO4 The students will have a clear idea of their area of work and they will be in a position to carry out the remaining phase II work in a systematic way.

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TOTAL: 360 PERIODS
OUTCOME:
On completion of the project work students will be in a position to take up any challenging practical problem in the field of engineering design and find better solutions to it.

COURSE OUTCOMES:
On Completion of the course the student will be able to
CO1 Demonstrate a sound technical knowledge of their selected project topic.
CO2 Undertake problem identification, formulation and solution.
CO3 Design engineering solutions to complex problems utilising a systems approach
CO4 Demonstrate the knowledge, skills and attitudes of a professional engineer to take up any challenging practical problem in the field of engineering design and manufacturing engineering and find better solutions to it.

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PD4152 INTEGRATED PRODUCT DEVELOPMENT

COURSE OBJECTIVES:
1. To Understand the principles of generic development process; product planning; customer need analysis for new product design and development.
2. To enhance the understanding of setting product specifications and generate, select, screen, and test concepts for new product design and development.
3. To apply the principles of product architecture and the importance of industrial design principles and DFM principles for new product development.
4. To expose the different Prototyping techniques, Design of Experiment principles to develop a robust design and importance to patent a developed new product.
5. Applying the concepts of economics principles; project management practices in development of new product.

UNIT– I INTRODUCTION TO PRODUCT DESIGN

UNIT– II PRODUCT SPECIFICATIONS, CONCEPT GENERATION, SELECTION AND TESTING
Establish Target and Final product specifications – Activities of Concept Generation - Concept Screening and Scoring - Concept Testing Methodologies.
UNIT–III PRODUCT ARCHITECTURE AND INDUSTRIAL DESIGN

Product Architecture – Implications and establishing the architecture – Delayed Differentiation – Platform Planning – Related system level design issues - Need and impact of industrial design - Industrial design process - management of the industrial design process - assessing the quality of industrial design

UNIT– IV DESIGN FOR MANUFACTURE, PROTOTYPING AND ROBUST DESIGN

DFM Definition - Estimation of Manufacturing cost - Reducing the component costs, costs of supporting function and assembly costs – Impact of DFM decision on other factors - Prototype basics - Principles of prototyping – Prototyping technologies - Planning for prototypes - Robust design –Robust Design Process

UNIT– V PRODUCT DEVELOPMENT ECONOMICS AND MANAGING PROJECTS

Economic Analysis – Elements of Economic Analysis - Understanding and representing tasks- Baseline Project Planning - Accelerating the project - Project execution – Postmortem project evaluation.

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply the principles of generic development process; product planning; customer need analysis for new product design and development.
2. Set product specifications and generate, select, screen, test concepts for new product design and development.
3. Apply the principles of product architecture, industrial design and design for manufacturing principles in new product development.
4. Apply the adopt Prototyping techniques and Design of Experiment principles to develop a robust design and document a new product for patent.

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ED4072 COMPOSITE MATERIALS AND MECHANICS

COURSE OBJECTIVES:
1. Study of different composite materials and finding its mechanical strength
2. Fabrication of FRP and other composites by different manufacturing methods
3. Stress analysis of fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4. Calculation of stresses in the lamina of the laminate using different failure theories
5. Calculation of residual stresses in different types of laminates under thermo-mechanical load using the Classical Laminate Theory.

UNIT-I INTRODUCTION TO COMPOSITE MATERIALS
Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments-ceramic fibers-fiber fabrication-natural composite wood, Jute-
Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiber-reinforced composites Rule of mixtures-Characteristics of fiber-Reinforced composites, Manufacturing fiber and composites

UNIT- II MANUFACTURING OF COMPOSITES
Manufacturing of Polymer Matrix Composites (PMCs)-handlay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM)-bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) - Solid state, liquid state, vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs)--hot pressing-reaction bonding process-infiltration technique, directoxidation-interfaces

UNIT-III LAMINA CONSTITUTIVE EQUATIONS

30
UNIT-IV LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES


UNIT- V THERMO-STRUCTURAL ANALYSIS


Case studies: Implementation of CLT for evaluating residual stresses in the components made with different isotropic layers such as electronic packages etc.

TOTAL(L:45)=45 PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to

1. Calculate for mechanical strength of the composite material
2. Fabricate the FRP and other composites by different manufacturing methods
3. Analyze fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4. Evaluate the stresses in the lamina of the laminate using different failure theories
5. Analyze thermo-mechanical behavior and evaluate residual stresses in different types of laminates using the Classical Laminate Theory.

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CC4001        COMPUTER CONTROL IN PROCESS PLANNING        L    T    P    C
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COURSE OBJECTIVES:

- To provide the student with an understanding of the importance of process planning role in manufacturing and the application of Computer Aided Process Planning tool in the present manufacturing scenario

UNIT I    INTRODUCTION
The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning – Process Planning and Concurrent Engineering, CAPP, Group Technology

UNIT II    PART DESIGN REPRESENTATION

UNIT III   PROCESS ENGINEERING AND PROCESS PLANNING
Experienced, based planning - Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, Al.

UNIT IV    COMPUTER AIDED PROCESS PLANNING SYSTEMS
Logical Design of a Process Planning - Implementation considerations -manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

UNIT V    AN INTERGRADED PROCESS PLANNING SYSTEMS

TOTAL: 45 PERIODS

COURSE OUTCOMES:

- To understand the need of process planning in manufacturing
- To know handle the computer aided process planning tool
- To apply the knowledge of Expert systems, Group technology and part representation for various applications
- To interpret the use of computer aided process panning for CAD/CAM Systems
- To analyse the computer aided planning systems for various industrial applications

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ED4091 ADVANCED FINITE ELEMENT ANALYSIS  L  T  P  C  3  0  0  3

COURSE OBJECTIVES
1. To study concept of Finite Element Analysis to solve problems involving plate and shell elements
2. To learn concept of Finite Element Analysis to solve problems involving geometric and material nonlinearity
3. To study solution techniques to solve dynamic problems
4. To study the concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems
5. To study error norms, convergence rates and refinement.

UNIT-I BENDING OF PLATES AND SHELLS 9
Review of Elasticity Equations – Bending of Plates and Shells – Finite Element Formulation of Plate and Shell Elements - Conforming and Non-Conforming Elements – C0 and C1 Continuity Elements – Degenerated shell elements-Application and Examples.

UNIT-II NON-LINEAR PROBLEMS 9

UNIT-III DYNAMIC PROBLEM 9
UNIT-IV  FLUID MECHANICS AND HEAT TRANSFER  9


UNIT-V  ERROR ESTIMATES AND ADAPTIVE REFINEMENT  9

Error norms and Convergence rates–h-refinement with adaptivity–Adaptive refinement.

TOTAL= 45 PERIODS

COURSE OUTCOMES:
On Completion of the course the student will be able to

CO1 Apply concept of Finite Element Analysis to solve problems involving plate and shell elements

CO2 Apply concept of Finite Element Analysis to solve problems involving geometric and material non linearity

CO3 Formulate solution techniques to solve dynamic problems

CO4 Apply concepts of Finite Element Analysis to solve fluid mechanics and heat transfer problems

CO5 Investigate error norms, convergence rates and refinement.

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COURSEOBJECTIVES:

1. To understand the basic concepts of unconstrained optimization techniques.
2. To understand the basic concepts of constrained optimization techniques.
3. To provide the mathematical foundation of artificial neural networks and swarm intelligence for design problems.
4. To implement optimization approaches and to select appropriate solutions for design applications.
5. To demonstrate selected optimization algorithms commonly used in static and dynamic applications.

UNIT– I  UNCONSTRAINED OPTIMIZATION TECHNIQUES

Introduction to optimum design - General principles of optimization – Problem formulation & their classifications- Single variable and multivariable optimization, Techniques of unconstrained minimization – Golden section, Random, pattern and gradient search methods – Interpolation methods.

UNIT– II  CONSTRAINED OPTIMIZATION TECHNIQUES

Optimization with equality and inequality constraints-Direct methods–Indirect methods using penalty functions, Lagrange multipliers–Geometric programming.

UNIT– III  ARTIFICIAL NEURAL NETWORKS AND SWARM INTELLIGENCE

Introduction–Activation functions, types of activation functions, neural network architectures, Single layer feed forward network, multi layer feed forward network, Neural network applications.
Swarm intelligence-Various animal behaviors, Ant Colony optimization, Particle Swarm optimization.

UNIT– IV  ADVANCED OPTIMIZATION TECHNIQUES

Multistage optimization–dynamic programming, stochastic programming Multi objective optimization Genetic algorithms and Simulated Annealing technique.

UNIT– V  STATIC AND DYNAMIC APPLICATIONS

Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms–Optimum design of simple linkage mechanisms.

COURSE OUTCOMES:

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

CO1 Formulate unconstrained optimization techniques in engineering design application.
CO2 Formulate constrained optimization techniques for various applications.
CO3 Implement neural network technique to real-world design problems.
CO4 Apply genetic algorithms to combinatorial optimization problems.
CO5 Evaluate solutions by various optimization approaches for a design problem.
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CC4071 ADVANCED MACHINE TOOL DESIGN

COURSE OBJECTIVES
The main learning objective of this course is to prepare the students for:
1. Selecting the different machine tool mechanisms.
2. Designing the Multi speed Gear Box and feed drives.
3. Designing the machine tool structures.
4. Designing the guideways and power screws.
5. Designing the spindles and bearings.

UNIT I INTRODUCTION TO MACHINE TOOL DESIGN

UNIT II REGULATION OF SPEEDS AND FEEDS
Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design

UNIT III DESIGN OF MACHINE TOOL STRUCTURES
UNIT IV  DESIGN OF GUIDEWAYS AND POWER SCREWS  9

UNIT V  DESIGN OF SPINDLES AND SPINDLE SUPPORT  9

TOTAL = 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
1. Select the different machine tool mechanisms.
2. Design the Multi speed Gear Box and feed drives.
3. Design the machine tool structures.
4. Design the guideways and power screws.
5. Design the spindles and bearings.

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PD4153 REVERSE ENGINEERING L T P C 3 0 0 3

COURSE OBJECTIVES:
1. Applying the fundamental concepts and principles of reverse engineering in product design and development.
2. Applying the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
3. Applying the concept and principles of material identification and process verification in reverse engineering of product design and development.
4. Applying the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
5. Analyzing the various legal aspect and applications of reverse engineering in product design and development.

UNIT I INTRODUCTION TO REVERSE ENGINEERING & GEOMETRIC FORM

UNIT II MATERIAL CHARACTERISTICS, PART DURABILITY AND LIFE LIMITATION
Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness – Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure

UNIT III MATERIAL IDENTIFICATION AND PROCESS verification

UNIT IV DATA PROCESSING, PART PERFORMANCE AND SYSTEM COMPATIBILITY

UNIT V ACCEPTANCE, LEGALITY AND INDUSTRIAL APPLICATIONS OF RE

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Apply the fundamental concepts and principles of reverse engineering in product design and development.
2. Apply the concept and principles material characteristics, part durability and life limitation in reverse engineering of product design and development.
3. Apply the concept and principles of material identification and process verification in reverse engineering of product design and development.
4. Apply the concept and principles of data processing, part performance and system compatibility in reverse engineering of product design and development.
5. Analyze the various legal aspect and applications of reverse engineering in product design and development.
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CC4002 INDUSTRIAL SAFETY MANAGEMENT L T P C
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COURSE OBJECTIVES:
1. To achieve an understanding of principles of safety management.
2. To enable the students to learn about various functions and activities of safety department.
3. To have knowledge about sources of information for safety promotion and training.
4. To familiarize students with evaluation of safety performance.

UNIT– I SAFETY MANAGEMENT

UNIT– II OPERATIONAL SAFETY

UNIT–III SAFETY MEASURES
Layout design and material handling – Use of electricity – Management of toxic gases and chemicals - Industrial fires and prevention - Road safety - highway and urban safety - Safety of sewage disposal and cleaning - Control of environmental pollution - Managing emergencies in Industries-planning, security and risk assessments, on-site and offsite. Control of major industrial hazards.
UNIT– IV ACCIDENT PREVENTION
Human side of safety - personal protective equipment - Causes and cost of accidents. Accident prevention programmes - Specific hazard control strategies - HAZOP - Training and development of employees-First Aid-Fire fighting devices-Accident reporting, investigation.

UNIT– V SAFETY, HEALTH, WELFARE & LAWS

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- To understand the functions and activities of safety engineering department.
- To carry out a safety audit and prepare a report for the audit.
- To prepare an accident investigation report.
- To estimate the accident cost using supervisors report and data.
- To evaluate the safety performance of an organization from accident records.
- To identify various agencies, support institutions and government organizations involved in safety training and promotion.

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Mapping of CO with PO

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COURSE OBJECTIVES:
1. The student will understand the principle of force and strain measurement.
2. The student will understand the vibration measurement and their applications.
3. To impart knowledge on the principle behind acoustics and wind flow measurements.
4. To familiarize with the distress measurements
5. To realize the non destructive testing principle and application

UNIT-I FORCES AND STRAIN MEASUREMENT
Strain gauge, principle, types, performance and uses. Photo elasticity–Principle and applications

UNIT-II VIBRATION MEASUREMENTS

UNIT-III ACOUSTICS AND WIND FLOW MEASUREMENTS

UNIT- IV DISTRESS MEASUREMENTS

UNIT- V NON DESTRUCTIVE TESTING METHODS
Load testing on structures, buildings ,bridges and towers–Rebound Hammer –acoustice mission –ultrasonic testing principles and application–Holography–use of laser for structural testing–Brittle coating

COURSEOUTCOMES:
Upon completion of this course the students will be able to:
CO1 Measure physical quantities such as forces and strains.
CO2 Apply different vibration measurements techniques.
CO3 Measure physical quantities such as pressure and flow.
CO4 Apply techniques involved in crack measurement.
CO5 Select the appropriate nondestructive testing methods for various engineering applications.

TOTAL:45 PERIODS
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RELIABILITY IN ENGINEERING SYSTEMS

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COURSE OBJECTIVES:
1. The ability to use statistical tools to characterize the reliability of an item;
2. The working knowledge to determine the reliability of a system a
3. To suggest approaches to enhancing system reliability;
4. The ability to select appropriate reliability validation methods

UNIT– I RELIABILITY CONCEPT

UNIT– II FAILURE DATA ANALYSIS

UNIT–III RELIABILITY ASSESSMENT
UNIT- IV  RELIABILITY MONITORING


UNIT- V  RELIABILITY IMPROVEMENT


TOTAL: 45 PERIODS

COURSE OUTCOMES:
- Analyse the interference between strength and stress, or life data for estimating reliability;
- Apply the appropriate methodologies and tools for enhancing the inherent and actual reliability of components and systems, taking into consideration cost aspects; specify life test plans for reliability validation

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COURSE OBJECTIVES:
1. To develop an understanding of the use and benefits of modeling and simulation in manufacturing systems design and operation.
2. To develop an understanding of techniques to assess factory performance and identify areas for improvement.
3. To develop an understanding of techniques to assess and manufacturing performance.
4. To develop an understanding of techniques to enable responsive manufacturing systems.
5. To provide the students with knowledge of a set of tools to enable them to assess the performance of a manufacturing facility.

UNIT– I MANUFACTURING SYSTEMS & CONTROL

UNIT– II MANUFACTURING PROCESSES

UNIT– III QUEUING MODELS
Notation for queues - Examples of queues in manufacturing systems - Performance measures - Little's result-Steady state analysis of M/M/m queue, queues with general distributions and queues with breakdowns-Analysis of a flexible machine center.

UNIT– IV QUEUING NETWORKS

UNIT– V PETRINETS

TOTAL: 45 PERIODS
COURSE OUTCOMES:
1. Model and simulate the operation of a small manufacturing system.
2. Use simulation as a manufacturing system design technique.
3. Justify the use of manufacturing modeling and simulation.
4. Use techniques such as value stream mapping and IDEF to identify improvements required in a manufacturing system.

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PD4151

CREATIVITY AND INNOVATION

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COURSE OBJECTIVES:
1. Applying the principles of essential theory of creativity in new product design and development.
2. Applying the principles of various methods and tools for creativity in new product design and development.
3. Applying the design principles of creativity in new product design and development.
4. Applying the various innovation principles and practices in new product design and development.
5. Applying the principles of innovation management in new product design and development.

UNIT I
INTRODUCTION TO ESSENTIAL THEORY OF CREATIVITY

UNIT II
METHODS AND TOOLS FOR CREATIVITY
Three basic principles behind the tools of directed creativity – Tools that prepare the mind for creative thought – Tools that stimulate the imagination for new idea – Development and action: the bridge between mere creativity and the rewards of innovation - ICEDIP: Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation – Creativity and Motivation
UNIT III DESIGN AND APPLICATION OF CREATIVITY
Three levels of emotional design: Visceral, Behavioral and Reflective – Process design, reengineering, and creativity – Creativity and customer needs analysis – Innovative product and service design – Creative problem solving and incremental improvement.

UNIT IV INNOVATION PRINCIPLES & PRACTICES
Methods of Creativity Activation: Morphological Box – Requirements for Inventive Problem Solving – Altshuller’s Engineering Parameters– Altshuller’s Inventive Principles– Altshuller’s Contradiction Matrix Algorithm.

UNIT V INNOVATION MANAGEMENT

TOTAL : 45 PERIODS

COURSE OUTCOMES:
Upon completion of the course, the students will be able to
1. Apply the principles of essential theory of creativity in new product design and development.
2. Apply the principles of various methods and tools for creativity in new product design and development.
3. Apply the design principles of creativity in new product design and development.
4. Apply the various innovation principles and practices in new product design and development.
5. Apply the principles of innovation management in new product design and development.

REFERENCES
3. Geoffrey Petty,” how to be better at Creativity”, The Industrial Society 1999

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OBJECTIVES:

- To appreciate the need and scope for robotics and to understand the principles of robot kinematics
- To design the drive systems and its control
- To understand the principles of sensors and vision systems
- To envision the industrial applications of robots and its safety
- To gain knowledge on artificial intelligence and expert systems.

UNIT I INTRODUCTION AND ROBOT KINEMATICS 9

UNIT II ROBOT DRIVES AND CONTROL 9

UNIT III ROBOT SENSORS 9

UNIT IV ROBOT CELL DESIGN AND APPLICATION 9

UNIT V ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS 9

OUTCOMES:
On Completion of the course the student will be able to

- Understand robot kinematics
- Incorporate mechanical components and concepts in robotics
- Understand the basics of various sensors to effectively design a robot
- Design suitable robots for specific applications
- Optimize the robots using Artificial Intelligence
REFERENCES

Mapping of CO with PO

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CC4005 DESIGN FOR CELLULAR MANUFACTURING SYSTEMS L T P C
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COURSE OBJECTIVES:
1. At the end of this course the student should be able to understand
2. Concepts and applications of Cellular manufacturing systems
3. Traditional and non-traditional approaches of Problem solving Performance measurement
4. Human and economical aspects of CMS.

UNIT – I INTRODUCTION
Introduction to Group Technology, Limitations of traditional manufacturing systems, characteristics and design of groups, benefits of GT and issues in GT.

UNIT – II CMS PLANNING AND DESIGN

UNIT – III IMPLEMENTATION OF GT/CMS
Inter and Intra cell layout, cost and non-cost based models, establishing a team approach, Managerial structure and groups, batch sequencing and sizing, life cycle issues in GT/CMS.
UNIT– IV PERFORMANCE MEASUREMENT AND CONTROL

UNIT– V ECONOMICS OF GT/CMS:
Conventional Vs group use of computer models in GT/CMS, Human aspects of GT/CMS - cases.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
- To impart knowledge on group technology, optimization algorithms
- To learn the aspects of cellular manufacturing and its design
- To know the implementation of GT/CMS
- To understand Performance measurements of CMS.
- To understand the economics of GT/CMS

REFERENCES:
1. Askin, R.G. and Vakharia, A.J., G.T " Planning and Operation, in The automated factory-Hand

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OBJECTIVES:
- To impart knowledge on wafer preparation and PCB fabrication
- To introduce Through Hole Technology (THT) and Surface Mount Technology (SMT) with various types of electronic components
- To elaborate various steps in Surface Mount Technology (SMT)
- To be acquainted with various testing and inspection methods of populated PCBS
- To outline repair, rework and quality aspects of Electronic assemblies.

UNIT I INTRODUCTION TO ELECTRONICS MANUFACTURING
History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed Circuit Boards, types- single sided, double sided, multi layer and flexible printed circuit board, design, materials, manufacturing, inspection. Electronic packaging – Through Hole Technology (THT) and Surface Mount Technology (SMT)

UNIT II COMPONENTS AND PACKAGING
Through-hole components – axial, radial, multi leaded, odd form. Surface mount components- active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, Flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.

UNIT III SOLDERING AND CLEANING

UNIT IV SURFACE MOUNT TECHNOLOGY
SMT Equipment and Material Handling Systems, Handling of Components and Assemblies - Moisture Sensitivity and ESD, Safety and Precautions Needed, IPC and Other Standards, Stencil Printing Process, solder paste storage and handling, stencils and squeegees, process parameters, quality control - Component Placement, Equipment Type, Chip shooter, IC placer, Flexibility, Accuracy of Placement, Throughput, reflow soldering, adhesive, underfill and encapsulation process, applications, storage and handling, process & parameters.

UNIT V INSPECTION, TEST AND REWORK FOR PCB:

OUTCOMES:
At the end of this course, the students shall be able to:
CO1: Realize wafer preparation and PCB fabrication.
CO2: Elaborate on through hole and surface mount technology components.
CO3: Discuss the steps involved in soldering post solder cleaning and its importance in PCB
manufacturing.
CO4: Improve knowledge on surface mount technology.
CO5: Locate the required inspections, testing and repair methods used in PCB.

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ED4079    QUALITY CONCEPTS IN DESIGN  L  T  P  C
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COURSE OBJECTIVES:
1. To impart knowledge on various concepts in engineering design, material selection and manufacturing methods.
2. To learn the principles of implementing quality in a product or services using different tools
3. To enhance the quality of product by use of failure mode effect analysis and implement methods to uphold the status of six sigma
4. To develop a robust product or service using various strategies of design of experiments
5. To maintain the quality of the product by use of statistical tools and enforce methods to improve the reliability of a product
UNIT – I DESIGN FUNDAMENTALS, METHODS AND MATERIAL SELECTION

UNIT – II DESIGN FOR QUALITY
Quality Function Deployment -House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments – design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design – testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

UNIT – III FAILURE MODE EFFECTS ANALYSIS AND DESIGN FOR SIX SIGMA

UNIT – IV DESIGN OF EXPERIMENTS
Importance of Experiments, Experimental Strategies, Basic principles of Design, Terminology, ANOVA, Steps in Experimentation, Sample size, Single Factor experiments – Completely Randomized design, Randomized Block design, Statistical Analysis, Multifactor experiments - Two and three factor full Factorial experiments, 2K factorial Experiments, Confounding and Blocking designs, Fractional factorial design, Taguchi’s approach - Steps in experimentation, Design using Orthogonal Arrays, Data Analysis, Robust Design- Control and Noise factors, S/N ratios

UNIT – V STATISTICAL CONSIDERATION AND RELIABILITY

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
1. Apply fundamentals of design process and material selection for developing a quality product
2. Apply the quality concepts to develop a robust product
3. Perform Failure Mode Effect Analysis on a product and use six sigma principles to enhance its quality
4. Apply different experimental design methods in product development
5. Implement various statistical tools to improve its quality and reliability
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MF4092

OBJECTIVES:
(1) To stress the importance of NDT in Engineering.
(2) To select the appropriate NDT Technique
(3) To familiarize with different NDT Technique
(4) To impart various knowledge to check the weld quality of various structures, pressure vessels
(5) Compare the merits of various NDT Techniques

UNIT I
NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING

UNIT II
EDDY CURRENT TESTING & ACOUSTIC EMISSION

UNIT III
MAGNETIC PARTICLE TESTING & THERMOGRAPHY
UNIT IV  ULTRASONIC TESTING
Principle, Ultrasonic transducers, Ultrasonic Flaw detection Equipment, Modes of display A- scan, B-Scan, C-Scan, Applications, Inspection Methods - Normal Incident Pulse-Echo Inspection, Normal Incident Through-transmission Testing, Angle Beam Pulse-Echo testing, TOFD Technique, Applications of Normal Beam Inspection in detecting fatigue cracks, Inclusions, Slag, Porosity and Intergranular cracks - Codes, standards, specification and procedures and case studies in ultrasonics test.

UNIT V  RADIOGRAPHY
Principle of Radiography, x-ray and gamma ray sources- safety procedures and standards, Effect of radiation on Film, Radiographic imaging, Inspection Techniques – Single wall single image, Double wall Penetration, Multiwall Penetration technique, Real Time Radiography - Codes, standards, specification and procedures and case studies in Radiography test.
Case studies on defects in cast, rolled, extruded, welded and heat-treated components - Comparison and selection of various NDT techniques

OUTCOMES:
At the end of this course the students
(1) Realize the importance of various NDT Techniques
(2) Are expected to have hands on experience on all types of NDT techniques
(3) Will choose appropriate technique for testing
(4) Will Compare the merits of various NDT Techniques
(5) Characterize the flaws and defects and provide solutions

REFERENCES:
4. www.ndt.net

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COURSE OBJECTIVES:
1. Fundamental concepts of electric and hybrid vehicle operation and architectures.
2. Understand the properties of batteries and its types.
3. Provide knowledge about design of series hybrid electric vehicles.
4. Provide knowledge about design of parallel hybrid electric vehicles.
5. Understand of electric vehicle drive train.

UNIT–I INTRODUCTION TO ELECTRIC VEHICLES

UNIT–II ENERGY SOURCE

UNIT–III SERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN

UNIT–IV PARALLEL HYBRID ELECTRIC DRIVE TRAIN DESIGN
Control Strategies of ParallelHybridDriveTrain-DriveTrainParameters-EnginePowerCapacity- Electric Motor Drive Power Capacity-Transmission Design- Energy Storage Design

UNIT–V ELECTRIC VEHICLE DRIVE TRAIN

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1 Explain how a hybrid vehicle works and describe its main components and their function.
CO2 Choose proper energy storage systems for vehicle applications
CO3 Design series hybrid electric vehicles.
CO4 Design parallel hybrid electric vehicles.
CO5 Describe the transmission components and their configurations for electric vehicles

TOTAL: 45 PERIODS

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ED4073 MATERIAL HANDLING SYSTEMS AND DESIGN
(Use of Approved Data Book is Permitted) 3 0 0 3

COURSE OBJECTIVES:
1. Fundamental concepts related to material handling.
2. Design of various hoisting gears for different material handling applications.
3. Development of conveyor systems for material flow in different industrial production systems.
4. Design of elevators for various manufacturing and service applications.
5. Integrated mechanical system design for machine tools, power transmission and engine parts.

UNIT– I INTRODUCTIONS AND DESIGN OF HOISTS

UNIT– II DRIVES OF HOISTING GEAR
Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes-slewing, jibandluffinggear-cogwheeldrive-selecting the motor ratings.

UNIT–III CONVEYORS
Types-description-design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors.

UNIT– IV ELEVATORS
Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices-Design of fork lift trucks.

UNIT– V INTEGRATED DESIGN
Integrated Design of systems - Valve Gear Mechanisms, Portable Air Compressor, Hay-Balelifter, Cam Testing Machine, Power Screws, Gear Box Design more than six speed.

TOTAL: 45 PERIODS
COURSE OUTCOMES:

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

- **CO1** Design hoists and brakes used in any handling applications.
- **CO2** Design drive mechanisms and hoisting gear for different handling applications.
- **CO3** Design different conveyor systems for material handling applications.
- **CO4** Design bucket, cage and fork lift elevators for to and fro transportation of materials in vertical direction.
- **CO5** Design of integrated mechanical system for machine tools, power transmission and engine parts

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PD4291 DESIGNING WITH ADVANCED MATERIALS

OBJECTIVES:

The main learning objective of this course is to prepare the students for:

1. Analyzing the different strengthening and failure mechanism of the metals
2. Applying the effects of metallurgical parameters in the materials design
3. Analyzing the relationship between the selection of materials and processing
4. Developing the novel material through understanding the properties of the existing metallic materials
5. Analyzing the different materials used in the engineering applications.
UNIT I  INTRODUCTION TO REVERSE ENGINEERING & GEOMETRIC FORM  9

UNIT II  MATERIAL CHARACTERISTICS, PART DURABILITY AND LIFE LIMITATION  9
Alloy Structure Equivalency – Phase Formation and Identification – Mechanical Strength – Hardness – Part Failure Analysis – Fatigue – Creep and Stress Rupture – Environmentally Induced Failure

UNIT III  MATERIAL IDENTIFICATION AND PROCESS VERIFICATION  9

UNIT IV  DATA PROCESSING, PART PERFORMANCE AND SYSTEM COMPATIBILITY  9

UNIT V  ACCEPTANCE, LEGALITY AND INDUSTRIAL APPLICATIONS OF RE  9

TOTAL : 45 PERIODS

OUTCOMES:
On Completion of the course the student will be able to
• Analyze the different strengthening and failure mechanism of the metals
• Apply the effects of metallurgical parameters in the materials design
• Analyze the relationship between the selection of materials and processing
• Develop the novel material through understanding the properties of the existing metallic materials
• Analyze the different materials used in the engineering applications

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8. www.astm.org/labs/pages/131350.htm
AUDIT COURSES

AX4091 ENGLISH FOR RESEARCH PAPER WRITING

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

REFERENCES

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
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
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

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

REFERENCES
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

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
- The Constitution of India, 1950 (Bare Act), Government Publication.

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**UNIT I**

1. தொழிலியர் தொழில் தொழி தொழியகப்பூச்சியை தொண்டெருவை, டே வருண டே வருண டே வருண
2. அடிகற்று (82)
   - இக்கற்று தொண்டெருவை அருணாசலம்
3. குல்லதியம் பண்டும் பல்லவகர்மம்
4. பழிவாய் (95, 195)
   - பழிவாய் கிளையியல் குழுமார்த்தம்

**UNIT II**

1. அருணாசலம் கீழ் கிளையியல்
   - இக்கற்று மறு கிளையியல், இக்கற்று மறு கிளையியல், கிளையியல், பகுதி
2. பெட்டியார்கேளம் - இக்கற்று பகுதி
   - இக்கற்று, இக்கற்று பகுதி, இக்கற்று, இக்கற்று பகுதி (கிளையியல் மறு கிளையியல் கிளையியல்)

**UNIT III**

1. குருகைகளியல் பகுதியம்
   - குருகைகளியல் பகுதியம் குழும குழு மறு குழு மறு குழு மறு குழு
   - குருகைகளியல் பகுதியம் குழு மறு குழு

**UNIT IV**

1. கிளையியல் பகுதியம்
   - கிளையியல் பகுதியம் (கிளையியல் பகுதியம், கிளையியல் பகுதியம், கிளையியல் பகுதியம், கிளையியல் பகுதியம்)
   - கிளையியல் பகுதியம்
2. அருணாசலம்
   - அருணாசலம் பார் கிளையியல்
3. குருகைகளியல் (617, 618)
   - குருகை குருகை குருகை
4. பெட்டியார்கேளம் - குருகை குருகை குருகை
5. பெட்டியார்கேளம் - குருகை குருகை குருகை
6. அகநொனூறு (4) - வணேணு
நற்றிகண (11) - காணேணு
கலித்ததொக (11) - பாணேணு, புறேணு
யொகன் 50 (27) - மேணு
அலிபோக பிரிவு தமிழியம்

UNIT V  நொட்டு தமிழ் தலைப்பிட்டம்
1. உரண்டைச் செய்யம்
- தமிழியம்
- தமிழியம்
- தமிழியம்
- தமிழியம்
- தமிழியம்
- தமிழியம்
2. மன்னர் நிகழ்த்துவம் பார்வை நொட்டு தலைப்பிட்டம்
3. புதுக்காற்று நிகழ்த்துவம் நொட்டு தலைப்பிட்டம்
4. விளக்கார நிகழ்த்துவம் தமிழ் தொடரமைப்பிட்டம் நொட்டு தலைப்பிட்டம்
5. அறிவியல் நொட்டு
6. தொடர்பு நொட்டு
7. கட்டுநொட்டு பொருளகம் நொட்டு தலைப்பிட்டம்.

TOTAL: 30 PERIODS

தமிழ் தலைப்பிட்ட வேலைப்படுத்துப்படுத்து / பதிவுக்கையிட
1. தமிழ் விளக்கார கட்டுநொட்டு (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விளக்காரப்பைப்பை (Tamil Wikipedia) -https://ta.wikipedia.org
3. தமிழ் விளக்காரா பதிவு இணைப்பு
4. விளக்காரம் கனவாரம் - தமிழ் பொருளகம் கனவாரம், தலைப்பு
5. மன்னர் கனவாரம் - தமிழ் பொருளகம் கனவாரம் (thamilvalarchithurai.com)
6. அறிவியல் கனவாரம் - தமிழ் பொருளகம், தலைப்பு