1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

| I. | To prepare students to know and utilize the modern manufacturing facility in order to improve productivity. |
| II. | To impart skills to use smart machines and apply latest technology in manufacturing field to innovate production process that will be useful to the Society |
| III. | To imbibe skills for integrated problem-solving techniques to optimize the Manufacturing resources for sustainable development |
| IV. | To develop research attitude, new product, and process to solve problems in the field of manufacturing and to prepare the necessary reports. |

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>2.</td>
<td>An ability to write and present a substantial technical report/document</td>
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<td>3.</td>
<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>4.</td>
<td>An ability to design systems, components, or processes meeting specified needs for the manufacturing industry and to improve its efficiency.</td>
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<tr>
<td>5.</td>
<td>To use modern equipment and problem-solving tools for improving the manufacturing systems and processes in all aspects including technical, financial and management</td>
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<td>6.</td>
<td>To pursue higher studies / pursue their career or entrepreneur in manufacturing and allied industries</td>
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3. PEO / PO Mapping:

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| **PRACTICALS** |             |                                                       |          |                  |                        |         |
| 8.      | MF4111      | CAD/CAM Laboratory                                    | PCC      | 0 0 4            | 4                      | 2       |
| 9.      | MF4112      | Technical Seminar                                     | EEC      | 0 0 2            | 2                      | 1       |
|          |              | **TOTAL**                                             |          | 19 1 6          | 26                     | 21      |

* Audit Course is optional

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| **PRACTICALS** |             |                                                       |          |                  |                        |         |
| 9.      | MF4211      | Automation and Metal Forming Laboratory                | PCC      | 0 0 3            | 3                      | 1.5     |
| 10.     | MF4212      | Advanced Manufacturing Processes Laboratory            | PCC      | 0 0 3            | 3                      | 1.5     |
|          |              | **TOTAL**                                             |          | 23 0 6          | 29                     | 24      |

* Audit Course is optional
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**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 75**
## FOUNDATION COURSES (FC)

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## PROFESSIONAL CORE COURSES (PCC)

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## RESEARCH METHODOLOGY AND IPR COURSES (RMC)

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**TOTAL CREDITS** 2
## PROFESSIONAL ELECTIVES FOR M.E. MANUFACTURING ENGINEERING

### SEMESTER II, ELECTIVES - I & II

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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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MA4155 APPLIED PROBABILITY AND STATISTICS FOR MANUFACTURING ENGINEERING

COURSE OBJECTIVES:
1. To understand the basics of random variables with emphasis on the standard discrete and continuous distributions.
2. To understand the basic probability concepts with respect to two dimensional random variables along with the relationship between the random variables.
3. To apply the small and large sample tests through test of hypothesis.
4. To understand the basic concepts of sampling distributions and statistical properties of point estimators.
5. To understand the concept of analysis of variance and use it to investigate factorial dependence.

UNIT I PROBABILITY AND RANDOM VARIABLES

UNIT II TWO DIMENSIONAL RANDOM VARIABLES
Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT III TESTING OF HYPOTHESIS
Sampling distributions - Type I and Type II errors - Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT IV ESTIMATION THEORY
Interval estimation for population mean - Standard deviation - Difference in means, proportion ratio of standard deviations and variances.

UNIT V DESIGN OF EXPERIMENTS
Completely randomized design – Randomized block design – Latin square design – $2^2$ Factorial design.

COURSE OUTCOMES:
At the end of the course, students will be able to
- Analyze the performance in terms of probabilities and distributions achieved by the determined solutions.
- Be familiar with some of the commonly encountered two dimensional random variables and be equipped for a possible extension to multivariate analysis.
- Apply the basic principles underlying statistical inference(hypothesis testing).
- Demonstrate knowledge of applicable large sample theory of estimators and tests.
- Obtain a better understanding of the importance of the methods in modern industrial processes.
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MF4101 ADVANCES IN MANUFACTURING PROCESSES  

OBJECTIVES:
1. To inculcate specialized knowledge and skill in advanced manufacturing processes using the principles and methods of engineering analysis and design.
2. To impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries and research organizations.
3. To impart knowledge about principles and criteria of yielding during forming of metals, analysis of different bulk metal forming processes following different analysis approach.
4. To give awareness of different techniques used in Micro and Nano manufacturing.
5. To introduce students the basics of rapid prototyping and its applications in various fields, reverse engineering techniques

UNIT I ENERGY ASSISTED MANUFACTURING PROCESSES  
Introduction – mechanism of materials removal and operating parameters of: Plasma Arc Machining – Laser Beam Machining – Electron Beam Machining – Electrical Discharge Machining – Ultrasonic Machining – Water Jet Machining – Abrasive water jet Machining – Abrasive jet Machining – Ion Beam Machining.

UNIT II PRECISION MACHINING  
UNIT III  ADVANCES IN METAL FORMING
Orbital forging, Isothermal forging, Warm forging, Overview of Powder Metal techniques –Hot and Cold isostatic pressing - high speed extrusion, rubber pad forming, Hydroforming, Superplastic forming, Peen forming-micro blanking –Powder rolling – Tooling and process parameters.

UNIT IV  MICRO MACHINING AND NANO FABRICATION

UNIT V  RAPID PROTOTYPING AND SURFACE MODIFICATION TECHNIQUES

TOTAL: 45 PERIODS

OUTCOMES:
At the end of the course, students will be able to
1. Analyze the processes and evaluate the role of each process parameter during machining of various advanced materials.
2. Understand requirements to achieve maximum material removal rate and best quality of machined surface while machining various industrial engineering materials.
3. Analyze the different bulk metal forming process mechanics using different analysis
4. Acquire the knowledge in mechanical micromachining processes.
5. Demonstrate the knowledge of Additive Manufacturing and Rapid Prototyping Technologies

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7
COURSE OBJECTIVES:
1. To study the metallurgical concepts and applications of casting and welding process.
2. To acquire knowledge in CAD of casting and automation of the welding process.
3. To know various solid state and special welding processes.
4. To introduce metallurgy of welding.
5. To design the weldments for various materials. To gain knowledge on various welding defects and inspection methods.

UNIT I CASTING DESIGN
Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and riser-Melting and casting quality

UNIT II CASTING METALLURGY

UNIT III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT
Shell moulding, precision investment casting, CO₂ moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes. Layout of mechanized foundry — sand reclamation — material handling in foundry pollution control in foundry — Computer aided design of casting.

UNIT IV WELDING METALLURGY AND DESIGN

UNIT V RECENT TRENDS IN WELDING

COURSE OUTCOMES:
● At the end of this course the students are expected to impart knowledge on basic concepts and advances in casting and welding processes.
● Know and perform solid state and special welding processes.
● Understand and analyze the material structures after welding.
● Design the weldments for various materials.
● Attain the knowledge about various welding defects and inspection methods.

TOTAL: 45 PERIODS
REFERENCES:
1. ASM Handbook vol.6, welding Brazing & Soldering, 2010

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MF4103 THEORY OF METAL CUTTING

COURSE OBJECTIVES:
1. To make the students to familiar with the basic principles of metal cutting
2. To familiarise the students various cutting tool materials and its wear mechanisms during the machining operation.
3. Differentiate between single point and multi point cutting tools
4. To study the heat generation during machining and the necessity for cutting fluid
5. To study the effect of vibrations during machining

UNIT I INTRODUCTION
Need for rational approach to the problem of cutting materials-observation made in the cutting of metals-basic mechanism of chip formation-thin and thick zone modes-types of chips-chip breaker-orthogonal Vs oblique cutting-force velocity relationship for shear plane angle in orthogonal cutting-energy consideration in machining-review of Merchant, Lee and Shafter theories-critical comparison.

UNIT II SYSTEM OF TOOL NOMENCLATURE
Nomenclature of single point cutting tool and nomenclature of multi point cutting tools – Twist Drill – milling cutter -System of tool nomenclature and conversion of rake angles-nomenclature of multi point tools like drills, milling-conventional Vs climb milling, mean cross sectional area of chip in milling-specific cutting pressure.
UNIT III THERMAL ASPECTS OF MACHINING
Heat distribution in machining-effects of various parameters on temperature-methods of temperature measurement in machining-hot machining- Cutting fluid – properties – types of cutting fluids – Selection of cutting fluids.

UNIT IV TOOL MATERIALS, TOOL LIFE AND TOOL WEAR

UNIT V WEAR MECHANISMS AND CHATTER IN MACHINING

COURSE OUTCOMES:
At the end of the course students will be familiar with
- Basics of orthogonal cutting, oblique cutting and chip formation
- Different tool materials, tool life and tool wear mechanisms
- Necessity for a cutting fluid and cutting efficiency
- Single and Multipoint cutting tools
- Effect of vibrations and surface roughness during machining

TOTAL: 45 PERIODS

REFERENCES

CM4151 COMPUTER AIDED MANUFACTURING

COURSE OBJECTIVES:
1. To introduce the evolution of CAD, CAM, CIM, engineering product specification and interpreting geometric specifications.
2. To train the candidates on the integration of Computer Aided Design and Computer Aided Manufacturing.
3. To impart knowledge on manual part program and generation of CNC part program using Computer Aided Manufacturing packages.
4. To introduce with the implementation of CAD and CAM in manufacturing process.
5. To introduce the importance of Internet of Things in Computer Aided Manufacturing.
UNIT I  INTRODUCTION TO CAM  9
Introduction CAD, CAM, CAE, CIM, system configuration for CAM including hardware and software, evolution of product realization, historical development, engineering product specification. Geometric Tolerancing - ASME standard, interpreting geometric specifications, multiple part features and datum.

UNIT II  CAD AND CAM INTEGRATION  9

UNIT III  PROGRAMMING OF CNC MACHINES  9
Structure of CNC program, Coordinate system, G & M codes, cutter radius compensation, tool nose radius compensation, tool wear compensation, canned cycles, mirroring features, Manual part programming for CNC turning, machining center, wire electric discharge machining, abrasive water jet cutting machine, bulk and sheet metal forming, generation of CNC program using CAM softwares.

UNIT IV  CAD AND CAM FOR MANUFACTURING PROCESSES  9
Classification of Manufacturing process, construction and operations, Integration of CAD and CAM in CNC turning center, machining center, electric discharge machining, wire electric discharge machining, abrasive water jet cutting machine, bulk forming, sheet metal forming.

UNIT V  IOT IN CAM  9
Introduction, overview of IOT enabled manufacturing system, Real-time and multi-source manufacturing information sensing system, IOT enabled smart assembly station, cloud computing based manufacturing resources configuration method, Real-time key production performances analysis method, Real-time information driven production scheduling system.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students shall be able to:
CO1: Recognize the importance of CAD, CAM, CIM, Engineering product specification and interpreting geometric specifications.
CO2: Improve knowledge on the integration of CAD and CAM.
CO3: Exhibit competency in manual part program and generation of CNC part program using CAM packages.
CO4: Describe the implementation of CAD and CAM in manufacturing processes.
CO5: Explain applications of IOT in computer aided manufacturing.

REFERENCES:
6. Yingfeng Zhang and Fei Tao, “Optimization of Manufacturing Systems Using the Internet of
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RM4151 RESEARCH METHODOLOGY AND IPR

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UNIT I RESEARCH DESIGN
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
Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III DATA ANALYSIS AND REPORTING
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

UNIT V PATENTS

TOTAL :30 PERIODS

REFERENCES
MF4111 CAD / CAM LABORATORY

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COURSE OBJECTIVES:
1. To introduce components and assemblies used in machines and use of 3D parametric CAD, CAM software for mechanical design.
2. To provide an experiential learning environment using projects done by student groups, while applying CAD, CAE software tools to design mechanisms and structures for mechanical design evaluation, optimization of mass properties, static-stresses, deformations, etc. with experimental validation of simulation models.
3. To do some exercises in tool pre-setting and work piece referencing on CNC machine tools, manual part programming for CNC turning and milling centres.
4. Use of software for simulation of turned and milled parts and simple surfaces, Automatic Cutter location data generation from CAD Models in APT format and post-processing for machining on CNC machines using standard CAD/CAM software
5. To produce an industrial component and measure to verify its conformity with the design

CAM LABORATORY
1. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving canned cycle
3. Standards, types, applications and working of following components and assemblies, Machine Components: Screw fasteners, Riveted joints, Keys, Cotters and joints, Shaft couplings, Pipe joints and fittings. Assemblies: Bearings, Hangers and brackets, Steam and IC engine parts, Valves, Some important machine assemblies.
4. Mechanical Drawing: Machining and surface finish symbols and tolerances in dimensioning.
5. CAD: Introduction to CAD, CAM, software in product life cycle.
7. Productivity Enhancement Tools in CAD Software: Feature patterns, duplication, grouping, suppression. Top-down vs. bottom-up design

CAD LABORATORY

2D modelling and 3D modelling of components such as
1. Bearing
2. Couplings
3. Gears
4. Sheet metal components
5. Jigs, Fixtures and Die assemblies.

TOTAL: 60 PERIODS

COURSE OUTCOMES:
At the end of this course the students are expected to;
1. Interpret mechanical drawings for components, assemblies and use parametric 3D CAD software tools in the correct manner for creating their geometric part models, assemblies and automated drawings.
2. Apply the concepts of machining for the purpose of selection of appropriate machining centres, machining parameters, select appropriate cutting tools for CNC milling and turning equipment, set-up, program, and operate CNC milling and turning equipment.
3. Create and validate NC part program data using manual data input (MDI) and automatically using standard commercial CAM package for manufacturing of required component using CNC milling or turning applications.

4. Produce an industrial component by interpreting 3D part model/part drawings using Computer Aided Manufacturing technology through programming, setup, and ensuring safe operation of Computer Numerical Control (CNC) machine tools.

5. Create and demonstrate the technical documentation for design/selection of suitable drive technologies, precision components and an overall CNC machine tool system for automation of machining operations using appropriate multi-axis CNC technology.

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**MF4112 TECHNICAL SEMINAR**

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**OBJECTIVES:**

(1) To enrich the communication skills of the student through presentation of topics in recent advances in engineering/technology

(2) To ensure that students possess a comprehensive understanding of the latest development in his chosen area

(3) To ensure that students are getting updated with latest technology

A group of 2 students have to choose a problem and carry out scientific systematic investigation experimentally/theoretically in suggesting a viable solution. At the end of the semester, each group of students have to submit a report for evaluation.

Depth of understanding, coverage, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

**OUTCOMES:**

At the end of this course the students are expected;

(1) To develop skills to search, read, write, comprehend and present research papers in the areas of manufacturing engineering.

(2) Updated with the latest technology in the field of Manufacturing Engineering

(3) Able to plot graph, sketch, bring out the visual about his understanding on various topics

**TOTAL: 30 PERIODS**
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OBJECTIVES:
1) To make use of the optimization techniques while modelling and solving the engineering problems of different fields.
2) To apply Linear Programming and Dynamic Programming to provide solutions for different problems.
3) Learn classical optimization techniques and numerical methods of optimization.
4) Know the basics of different evolutionary algorithms.
5) To understand and differentiate traditional and non-traditional methods of Optimization.

UNIT I INTRODUCTION

UNIT II CLASSIC OPTIMIZATION TECHNIQUES

UNIT III NON-LINEAR PROGRAMMING
Introduction – Lagrangeon Method – Kuhn-Tucker conditions – Quadratic programming – Separable programming – Stochastic programming – Geometric programming

UNIT IV INTEGER PROGRAMMING AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES

UNIT V ADVANCES IN SIMULATION
Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems

TOTAL: 45 PERIODS
OUTCOMES:
1) At the end of this course the students will be expected to introduce the various optimization techniques and their advancements.
2) Ability to go in research by applying optimization techniques in problems of Engineering and Technology
3) Use classical optimization techniques and numerical methods of optimization.
4) Describe the basics of different evolutionary algorithms
5) Ability to solve the mathematical results and numerical techniques of optimization theory to concrete Engineering problems by using computer software

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MF4202 ADVANCES IN METROLOGY AND INSPECTION

OBJECTIVES:
1) To teach the students basic concepts in various methods of engineering measurement techniques and applications
2) To make them understand the importance of measurement and inspection in manufacturing industries.
3) To understand the use of Light rays and Laser beams for measurement and their merits
4) To make the students capable of learning to operate and use advanced metrological devices with ease in industrial environments.
5) To teach the use of computer for measuring and processing of measured quantity

UNIT I CONCEPTS OF METROLOGY
Terminologies – Standards of measurement – Errors in measurement – Interchangeability and Selective assembly – Accuracy and Precision – Calibration of instruments – Basics of Dimensional metrology and Form metrology
UNIT II  MEASUREMENT OF SURFACE ROUGHNESS  

UNIT III  INTERFEROMETRY  

UNIT IV  MEASURING MACHINES AND LASER METROLOGY  

UNIT V  IMAGE PROCESSING FOR METROLOGY  
Overview, Computer imaging systems, Image Analysis, Pre-processing, Human vision system, Image model, Image enhancement, grey scale models, histogram models, Image Transforms - Examples.

OUTCOMES:
At the end of this course the students are expected to
1. Understand the advanced measurement principles with ease.
2. Operate sophisticated and accurate measuring instruments.
3. Understand the various inspection methods and tools
4. Design and develop new measuring methods.
5. Apply computers in Measurement

TOTAL: 45 PERIODS

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17
OBJECTIVES:
1) To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
2) To study the thermo mechanical regimes and its requirements of metal forming.
3) To learn the art of processing and making of powder metallurgy components.
4) To learn the effect of friction and lubrication in metal forming.
5) To study the various surface treatment processes.

UNIT I  THEORY OF PLASTICITY  9

UNIT II  THEORY AND PRACTICE OF BULK FORMING PROCESSES  9

UNIT III  SHEET METAL FORMING  9

UNIT IV  POWDER METALLURGY AND SPECIAL FORMING PROCESSES  9

UNIT V  SURFACE TREATMENT AND METAL FORMING APPLICATIONS  9

OUTCOMES:
1) At the end of this course the students are expected to upgrade their knowledge on various metal forming techniques and formability.
2) Apply the theory of plasticity for various types of metal forming process.
3) Apply the concept of powder metallurgy to make prismatic components.
4) Understand Non-traditional forming processes.
5) Understand the purpose of surface treatment in metal forming applications.

TOTAL: 45 PERIODS
REFERENCES:
10. Surender Kumar, Technology of Metal Forming Processes, Prentice Hall India Publishers, 2010

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MF4204 ADDITIVE MANUFACTURING

OBJECTIVES:
1) To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology
2) Gain insights on the need, advantages and limitations of additive manufacturing (AM) versus traditional manufacturing
3) Find out the various applications of AM, Deployment levels, Innovative and optimized product design
4) To explore the potential of additive manufacturing in different industrial sectors.
5) To apply 3D printing technology for additive manufacturing.

UNIT I INTRODUCTION
UNIT II  REVERSE ENGINEERING AND CAD MODELLING  9

UNIT III  LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS  9
Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications.

UNIT IV  POWDER BASED ADDITIVE MANUFACTURING SYSTEMS  9

UNIT V  OTHER ADDITIVE MANUFACTURING SYSTEMS  9
Three-dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based and powder based 3DP systems, strength and weakness, Applications and case studies. Shape Deposition Manufacturing (SDM), Ballistic Particle Manufacturing (BPM), Selective Laser Melting, Electron Beam Melting.

TOTAL: 45 PERIODS

OUTCOMES:
1) The students are expected to learn about a variety of Additive Manufacturing (AM) technologies.
2) Describe additive manufacturing and explain its advantages and disadvantages
3) Explain the processes used in additive manufacturing for a range of materials and applications
4) understand the role of additive manufacturing in the design process and their potential to support Design and manufacturing,
5) Case studies relevant to mass customized manufacturing, and some of the important research challenges associated with AM and its data processing tools

REFERENCES:
MF4205 FLUID POWER AUTOMATION L T P C
3 0 0 3

OBJECTIVES:
1) To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
2) To train the students in designing the hydraulic and pneumatic circuits using various design procedures.
3) To understand the concept and principle operation of automation systems and their controls.
4) To provide knowledge levels needed for PLC programming and operating
5) Ability to implement automation systems in Industry

UNIT I INTRODUCTION

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 underlapped spool valves-operating characteristics-electro hydraulic servo valves, Digital valves -Different types-characteristics and performance.

UNIT IV CIRCUIT DESIGN

UNIT V ELECTRO PNEUMATICS & ELECTRONIC 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, PLC ladder diagram for various circuits, motion controllers, use of field busses in circuits. Electronic drive circuits for various Motors.

TOTAL: 45 PERIODS
OUTCOMES:
1) At the end of this course the students are familiarized in the area of hydraulics, pneumatic and fluid power components and its functions.
2) Recognize the standard symbols used in fluid power circuits and assess the suitable component for a particular application
3) Construct the hydraulic circuits for an industrial application.
4) Build a pneumatic circuit and apply them to real life problems.
5) Design and develop a PLC controlled pneumatic circuit for industrial application

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MF4211 AUTOMATION AND METAL FORMING LABORATORY

OBJECTIVES
1) To train the students on the basic concepts of metal forming processes
2) To determine metal forming parameters for a given shape.
3) To learn the automation systems using fluid power control systems
4) To learn and use automation studio software
5) To learn PLC and its importance in Fluid power applications

EXPERIMENTS
1. Determination of strain hardening exponent
2. Determination of strain rate sensitivity index
3. Construction of formability limit diagram
4. Determination of efficiency in water hammer forming
5. Determination of interface friction factor
6. Determination of extrusion load
7. Study on two high rolling process
AUTOMATION LAB
1. Simulation of single and double acting cylinder circuits
2. Simulation of Hydraulic circuits
3. Simulation of electro pneumatic circuits
4. Simulation of electro hydraulic circuits
5. Simulation of PLC circuits

TOTAL: 60 PERIODS

OUTCOMES:
At the end of this course the students are expected
1) To impart practical knowledge on bulk metal forming processes
2) Know various symbols used in Hydraulic and Pneumatic circuits
3) Conduct few sheet metals forming processes and analyse the parameters
4) Design hydraulic circuits for industrial applications
5) Learnt how to use automation studio

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MF4212 ADVANCED MANUFACTURING PROCESSES LABORATORY
(Students can do any three sets for this lab out of the given four i.e. I, II, III, IV)

COURSE OBJECTIVES
(1) To analyses the forces in machining
(2) To perform modelling and simulation of manufacturing processes
(3) To develop product using rapid prototyping
(4) To program a robot for an autonomous movement
(5) To analyze product Life cycle

I ADVANCED MACHINING PROCESS
(1) Analysis of cutting forces during turning/drilling process.
(2) Analysis of temperature during turning/drilling process.
(3) Study on the effect of process parameters in Electro-Chemical/Electric-Discharge Machining

II PROCESS MODELLING
1. Analysis of stress strain distribution in a structural loading of composite bar using MATLAB codes.
2. Transient heat transfer analysis of a rectangular slab using a FEA package.
III RAPID PROTOTYPING
(1) Selection of Rapid Prototyping Technology.
(2) Product development activity – Concept design and Detailed design.
(3) Product development activity – Engineering analysis and Prototype development.

IV ROBOTICS
(1) Determination of maximum and minimum position of links.
(2) Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
(3) Estimation of accuracy, repeatability and resolution.
(4) Robot programming and simulation for pick and place
(5) Robot programming and simulation for Color identification
(6) Robot programming and simulation for Shape identification

COURSE OUTCOMES:
1. Perform modelling and simulation of manufacturing processes
2. Analyze the process using an FEA package
2. Competence to execute product development phases
3. Simple programming for robotic applications
4. Use EDM/ECM for machining different materials

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MF4311 PROJECT WORK I

OBJECTIVES:
(1) To develop knowledge to formulate a real-world problem.
(2) To break up the goal and evolve procedures
(3) To use different tools and techniques to arrive at a solution
(4) To validate the results analytically and experimentally
(5) To prepare a report and give a presentation

Student shall identify a minor problem related to the field of Manufacturing and carry out a literature survey/case studies/data collection. Student is supposed to formulate Engineering solutions to the problem, methodology to test their hypothesis/solutions and validate it theoretically/practically, planned and executed within the stipulated time

Observations, results and inference should be documented and presented as report in the prescribed format.

TOTAL: 180 PERIODS
OUTCOMES
After successful completion of this course, the students should be able to
(1) Design and analyze, an identified problem using scientific tools
(2) Simulation/ Theoretical analysis of a physical system
(3) Integrate various domain knowledge for a sustainable solution.
(4) Set Goals, Targets, timeline, plan and execute activities of the project
(5) Disseminate work both in oral and written format.

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MF4411 PROJECT WORK II

OBJECTIVES:
(1) To develop knowledge to formulate a real-world problem.
(2) To break up the goal and evolve procedures
(3) To use different tools and techniques to arrive at a solution
(4) To validate the results analytically and experimentally
(5) To prepare a report and give a presentation

Student shall identify a major/critical problem related to the field of Manufacturing and carry out a literature survey/case studies/data collection. Student supposed to formulate Engineering solutions to set objectives, methodology to test their hypothesis/solutions and validate it theoretically/practically, planned and executed within the stipulated time. Observations, results and inferences should be documented and presented as report in the prescribed format.

TOTAL: 360 PERIODS

OUTCOMES
After successful completion of this course, the students should be able to
(1) Design and analyze, an identified problem using scientific tools and research
(2) simulation/ Theoretical analysis of a physical system
(3) Integrate various domain knowledge in carrying out experimental work and provide a sustainable solution.
(4) Set Goals, Targets, timeline, plan and execute activities of the project
(5) Disseminate work both in oral and written format.
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**MF4071 DESIGN FOR MANUFACTURE AND ASSEMBLY**

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**OBJECTIVES:**

1. To apply various design rules in manufacturing processes
2. To evaluate the process by design guidelines for optimum design
3. To analyze the rules of concepts of GD&T
4. To make the students to learn about tolerance analysis and allocation, geometrical tolerances
5. Guidelines for design for manufacturing and assembly with suitable examples.

**UNIT I TOLERANCE ANALYSIS**


**UNIT II TOLERANCE ALLOCATION**


**UNIT III GD&T**


**UNIT IV TOLERANCE CHARTING**


**UNIT V MANUFACTURING GUIDELINES**


**TOTAL: 45 PERIODS**
OUTCOMES:
At the end of this course the students are expected
(1) To impart the knowledge about the significance of design for manufacturing and assembly
(2) To apply the principle of tolerancing in design
(3) Evaluate the process of GD & T using design guidelines
(4) Apply tolerance allocation and tolerance charting in design
(5) Apply guidelines for manufacturing and assembly

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MF4001 MICRO MANUFACTURING

OBJECTIVES:
(1) The objective of the course is to acquaint the students with the principles of micro manufacturing
(2) To learn basic machine tools used in micro manufacturing and developments in the micro manufacturing process
(3) To familiarize with the research trends in the area of micro manufacturing process.
(4) To learn various polishing techniques
(5) To study the various measuring techniques used for micro/nano components

UNIT I MECHANICAL MICRO MACHINING

UNIT II BEAM ENERGY BASED MICRO MACHINING
UNIT III NANO POLISHING

UNIT IV MICRO FORMING AND WELDING

UNIT V RECENT TRENDS AND APPLICATIONS

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are well experienced
(1) To impart the principles of various basic micro manufacturing process
(2) To know and perform micro machining
(3) Research various micro machining process to optimize the process variables
(4) Attain knowledge about polishing techniques
(5) Measure and analyse the various parameters of micro machined components

REFERENCES:
8. www.cmxr.com/industrial/

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OBJECTIVES:
To make the students construct the various quality control charts for variables and attributes
To study the various sampling plans
To make the students design for reliability
To learn different methods of improving reliability
To learn the basics of maintainability.

UNIT I QUALITY & STATISTICAL PROCESS CONTROL

UNIT II ACCEPTANCE SAMPLING

UNIT III EXPERIMENTAL DESIGN AND TAGUCHI METHOD

UNIT IV CONCEPT OF RELIABILITY
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 – Markov analysis, load sharing systems, standby systems, covariant models, static models, dynamic models.

UNIT V DESIGN FOR RELIABILITY AND MAINTAINABILITY
Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are exposed to the various quality control techniques, to understand the importance and concept of reliability and maintainability in industries.
(1) Apply control chart techniques in production process
(2) Understand inspection by sampling techniques
(3) Able to do reliable design
(4) Improve the availability of equipment through proper maintenance
(5) Know how to improve the reliability

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**MF4003 FINITE ELEMENT METHODS FOR MANUFACTURING ENGINEERING**

**OBJECTIVES:**
1. To familiarize the students with fundamentals of finite element method,
2. To study the fundamentals of one dimensional and two dimensional problems using FEA in manufacturing.
3. Acquaint students with finite element formulations and theories
4. Develop the ability to perform finite element analyses and evaluate the results of a select set of manufacturing processes.
5. Provide exposure to practical problems and their solutions, through simulations using the finite element software

**UNIT I INTRODUCTION**
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**
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**
Shape functions for one and two dimensional elements- Three nodded triangular and four nodded quadrilateral element Global and natural co-ordinates—Nonlinear analysis – Isoparametric elements – Jacobian matrices and transformations – Basics of two dimensional, plane stress, plane strain and axisymmetric analysis.
UNIT IV  COMPUTER IMPLEMENTATION  9
Pre Processing, mesh generation, elements connecting, boundary conditions, input of material and processing characteristics – Solution and post processing – Overview of application packages – Development of code for one dimensional analysis and validation

UNIT V  ANALYSIS OF PRODUCTION PROCESSES  9

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are highly confident in
(1) Fundamentals of Finite Element Methods.
(2) Perform one dimensional and Two-dimensional analysis using FEA
(3) Perform finite element formulations to solve problems
(4) perform finite element analyses and evaluate the results of a select set of manufacturing processes,
(5) Provide simulations through FE Software

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7. www.pollockeng.com
8. www.tbook.com

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OBJECTIVES:
To introduce the students
(1) the various concepts of materials management
(2) familiarize them with vendor development and rating
(3) the various aspects of Logistics and storage
(4) Planning and Forecasting of the need
(5) Various aspects of Inventory management

UNIT I  INTRODUCTION
Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT II  MANAGEMENT OF PURCHASE

UNIT III  MANAGEMENT OF STORES AND LOGISTICS

UNIT IV  MATERIALS PLANNING

UNIT V  INVENTORY MANAGEMENT
ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are
(1) Familiarized with the various concepts and functions of material management
(2) Able to handle the purchase and stores Independently
(3) Understand Logistics and inventory pricing
(4) Materials planning and periodic replenishment of material
(5) Just in time techniques and inventory management

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**MF4005**  
**INDUSTRIAL ERGONOMICS**

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**OBJECTIVES:**
1. To introduce the concepts of Ergonomics and to indicate the areas of Applications.
2. Identify ergonomic principles
3. to increase awareness of the need and role of ergonomics in occupational health
4. To inculcate analysing skills among the students with respect to work place design, working postures and lifting tasks.
5. To provide thorough knowledge about assessment about occupational exposure to heat stress, noise, vibrations

**UNIT I**  
**INTRODUCTION**  

**UNIT II**  
**ANTHROPOMETRY**  
Physical dimensions of the human body as a working machine – Motion size relationships – Static and dynamic anthropometry – Anthropometric aids – Design principles – Using anthropometric measures for industrial design – Procedure for anthropometric design.

**UNIT III**  
**DESIGN OF SYSTEMS**  

**UNIT IV**  
**ENVIRONMENTAL FACTORS IN DESIGN**  

**UNIT V**  
**WORK PHYSIOLOGY**  
Provision of energy for muscular work – Role of oxygen physical exertion – Measurement of energy expenditure Respiration – Pulse rate and blood pressure during physical work – Physical work capacity and its evaluation.

**TOTAL: 45 PERIODS**
OUTCOMES:
At the end of this course the students are
(1) updated with various concepts of Ergonomics
(2) able to provide appropriate allowances for the jobs under analysis.
(3) Students will be able to analyse and calculate the level of risk in a job causing stress, fatigue and musculoskeletal disorders and design appropriate work systems.
(4) Students will be able to assess the occupational environmental factors like heat stress, noise, and vibration and RSPM level in the industry.
(5) Maintain a comfortable environment in the work place

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MF4006 POLYMERS AND COMPOSITE MATERIALS

OBJECTIVES:
(1) To impart knowledge on various polymer processing techniques
(2) To learn about various fibre, Matrix materials and their properties
(3) To learn the methods by which Polymer matrix composites are made
(4) To study about the composites used for High temperature applications
(5) To study the behaviour of reinforcements in MMC and PMC

UNIT I PROCESSING OF POLYMERS

UNIT II FIBERS 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:
At the end of this course the students are expected
• To study matrix material, reinforcements of polymer matrix composites, MMC and ceramic matrix composites.
• To develop knowledge on processing, interfacial properties and application of composites.
• To have ability to develop new fibre or reinforcement materials
• To differentiate between the composites used in room temperature and High temperature applications

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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
Introduction to various non-destructive methods, Comparison of Destructive and Non-destructive Tests, Visual Inspection, Optical aids used for visual inspection, Applications.
Physical principles, procedure for penetrant testing, Penetrant testing materials, Penetrant testing methods-water washable, Post – Emulsification methods, Applications

UNIT II   EDDY CURRENT TESTING & ACOUSTIC EMISSION
Principles, Instrumentation for ECT, Absolute, differential probes, Techniques – High sensitivity techniques, Multi frequency, Phased array ECT, Applications.
Principle of AET, Instrumentation, Applications - testing of metal pressure vessels, Fatigue crack detection in aerospace structures.

UNIT III  MAGNETIC PARTICLE TESTING & THERMOGRAPHY
Principle of MPT, procedure used for testing a component, Equipment used for MPT, Magnetizing techniques, Applications.
Principle of Thermography, Infrared Radiometry, Active thermography measurements, Applications – Imaging entrapped water under an epoxy coating, Detection of carbon fiber contaminants.

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
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4. www.ndt.net

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MF4007 LEAN MANUFACTURING

OBJECTIVE:
(1) To implement lean manufacturing concepts in the factories.
(2) Understand the distinction between mass and lean production and to be able to assess the difference in a manufacturing environment
(3) Understand the various elements of Lean systems
(4) Learn the importance of JIT
(5) Understand the various Inspection systems and effectively plan for a Lean system

UNIT I INTRODUCTION:
The mass production system – Origin of lean production system – Necessity – Lean revolution in Toyota – Systems and systems thinking – Basic image of lean production – Customer focus – Muda (waste).

UNIT II STABILITY OF LEAN SYSTEM:
Standards in the lean system – 5S system – Total Productive Maintenance – standardized work – Elements of standardized work – Charts to define standardized work – Man power reduction – Overall efficiency - standardized work and Kaizen – Common layouts.

UNIT III JUST IN TIME

UNIT IV JIDOCA (AUTOMATION WITH A HUMAN TOUCH)
UNIT V            WORKER INVOLVEMENT AND SYSTEMATIC PLANNING METHODOLOGY

Involvement – Activities to support involvement – Quality circle activity – Kaizen training - Suggestion Programmes – Hoshin Planning System (systematic planning methodology) – Phases of Hoshin Planning – Lean culture

OUTCOMES:
The student will be competent
(1) To know the necessity for a Lean Manufacturing system
(2) To Differentiate between the conventional Mass production system with Lean system
(3) In effectively implement the principles of JIT
(4) To apply the Inspection tools effectively in the Lean systems
(5) To apply Hoshin planning system to create a Lean culture in Industry

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MF4008            ROBOT DESIGN AND PROGRAMMING

OBJECTIVES:
(1) To impart knowledge about different types of robots and configuration
(2) To gain fundamental knowledge on robot manipulators.
(3) To provide a brief knowledge on geometry, kinematics, dynamics, motion planning and control
(4) To impart knowledge in Robot designing and programming
(5) To familiarize with sensors and actuators used in robots
UNIT I  INTRODUCTION  9
Definition, Need Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors – types, selection applications.

UNIT III  ROBOT KINEMATICS  9

UNIT III  ROBOT DYNAMICS AND TRAJECTORY PLANNING  9
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, Machine Vision

UNIT IV  ROBOT PROGRAMMING & AI TECHNIQUES  9
Types of Programming – Teach Pendant programming – Basic concepts in A1 techniques – Concept of knowledge representations – Expert system and its components.

UNIT V  ROBOT SENSORS AND ACTUATORS  9
Design of Robots – characteristics of actuating systems, comparison, microprocessors control of electric motors, magnetostrictive actuators, shape memory type metals, sensors, position, velocity, force, temperature, pressure sensors – Contact and non-contact sensors, infrared sensors, RCC, vision sensors.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected
(1) Classify and configure robots
(2) Apply the kinematic arrangement of robots and its applications in the area of manufacturing sectors
(3) To select sensors for different application
(4) To build a robot for any type of application
(5) To develop and Expert system

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MF4009 MEMS AND NANOTECHNOLOGY

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OBJECTIVES:
(1) To inspire the students to expect to the trends in manufacturing of micro components
(2) Familiarise the students with various fabrication techniques for micro components.
(3) Acquaint them with various sensors and actuators
(4) Introduce them the various methods of developing nano materials
(5) Make them understand characterization tools

UNIT I OVERVIEW 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 CHARACTERIZATION OF NANO MATERIALS

OUTCOMES:
At the end of this course the students are expected
(1) Realise the need of micro electromechanical systems.
(2) Develop a knowledge to select a sensor for an application
(3) Develop a nano material
(4) characterize the Nano material
(5) Develop an Electromechanical systems

TOTAL: 45 PERIODS
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CM4091  GREEN MANUFACTURING  L  T  P  C  3 0 0 3

COURSE OBJECTIVES
1. To expose the students to the basics of environmental sustainability and impact assessment objectives.
2. To incorporate knowledge about the environmental based improvements towards lean manufacturing systems.
3. To analyze various machineries with intent to conserve energy.
4. To analyze hazardous and solid wastees with intent to point out areas of adverse environmental impact and how this impact could be minimized or prevented.
5. To impart the knowledge about the need, procedure and benefits of Green-Co rating.

UNIT – I  ENVIRONMENTAL SUSTAINABILITY AND IMPACT ASSESSMENT  9
Environmental impact assessment objectives – Legislative development – European community directive – Hungarian directive. Strategic environmental assessment and sustainability appraisal. Regional spatial planning and environmental policy.

UNIT – II  LEAN MANUFACTURING AND GREEN ENERGY SYSTEM  9

UNIT – III  ENERGY SAVING MACHINERY AND COMPONENTS  9
UNIT – IV  HAZARDOUS AND SOLID WASTE MANAGEMENT  

UNIT – V  GREEN CO-RATING  

TOTAL: 45 PERIODS

COURSE OUTCOMES:
Upon completion of this course, the students will be able to:
CO1: Understand the Concepts of environmental sustainability and environmental impact assessment objectives
CO2: Apply suitable schemes towards design of green manufacturing requirements.
CO3: Analyze manufacturing processes towards conservation of energy.
CO4: Analyze manufacturing processes towards minimization or prevention of hazardous and solid wastes.
CO5: Acquire Knowledge of green co-rating and its benefits are well known to the students.

CO-PO MAPPING:

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REFERENCES:
4. World Commission on Environment and Development (WCED), Our Common Future, Oxford
MF4010  COMPUTER AIDED PRODUCT DESIGN  L T P C  
3 0 0 3

OBJECTIVES:
(1) To Learn the basic concepts of Designing and Drafting.
(2) To Learn the computer aided modeling and various concepts of product design.
(3) Integrating CAE, CAD, CAM tools in product design and assess the quality and performance of products.
(4) To learn reliability and Maintainability concepts.
(5) To learn the failure analysis tools for improvement

UNIT I  INTRODUCTION  9
Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware & Peripherals – software packages for design and drafting.

UNIT II  COMPUTER GRAPHICS FUNDAMENTALS AND GEOMETRIC MODEL  9

UNIT III  PRODUCT DESIGN CONCEPTS AND PRODUCT DATA MANAGEMENT  9

UNIT IV  PRODUCT DESIGN TOOLS & TECHNIQUES  9

UNIT V  PRODUCT DESIGN TECHNIQUES  9

OUTCOMES:
At the end of this course the students are expected
(1) To model a product using CAD software.
(2) Assess the data for the need for a new product
(3) To apply the various design concepts and design tools and techniques while designing a product.
(4) To know the challenges in the product development
(5) To apply the failure analysis in the product design

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MF4011 PROCESS PLANNING AND COST ESTIMATION L T P C 3 0 0 3

OBJECTIVES:
(1) To introduce the process planning concepts and its necessity
(2) Economical planning of tools and equipment requirement
(3) Differentiate between cost accounting and cost estimation
(4) Cost Estimation and analysis
(4) To estimate time for various machining operations

UNIT I INTRODUCTION TO PROCESS PLANNING 9
Introduction- methods of process planning- Drawing Interpretation-Material evaluation – steps in process selection, Production equipment and tooling selection

UNIT II PROCESS PLANNING ACTIVITIES 9
Process parameters calculation for various production processes-Selection jigs and fixtures election of quality assurance methods – Set of documents for process planning- Economics of process planning- case studies

UNIT III INTRODUCTION TO COST ESTIMATION 9

UNIT IV PRODUCTION COST ESTIMATION 9
Estimation of Different Types of Jobs – Estimation of Forging Shop, Estimation of Welding Shop, Estimation of Foundry Shop

UNIT V MACHINING TIME CALCULATION 9
Estimation of Machining Time – Importance of Machine Time Calculation- Calculation of Machining Time for Different Lathe Operations, Drilling and Boring – Machining Time Calculation for Milling, Shaping and Planning -Machining Time Calculation for Grinding

TOTAL: 45 PERIODS
OUTCOMES:
(1) Explain the concept of selection and steps in process planning, tooling, equipment selection and material evaluation
(2) Calculate process parameters and select Jig, Fixtures and quality assurance methods
(3) Apply the methods of costing and to explain the concept of estimation.
(4) Compute the cost of the product in various shops of production.
(5) Calculate the machining time for various operation

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MF4091 MANUFACTURING MANAGEMENT

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
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
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.

COURSE 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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MF4012  NANOTECHNOLOGY  L T P C
3 0 0 3

OBJECTIVES:
The course is aimed to
(1) Offer an overview on properties of Nanomaterials in their design and fabrication.
(2) Inculcate insight of the nano defects and doping effects of Nanomaterials in their design fabrication.
(3) Educate them on various nano structuring processes and recent trends
(4) Provide them with knowledge of nanostructure classification and various synthetic approaches.
(5) Make them understand various Nanomaterial characterization techniques

UNIT I  OVER VIEW OF NANOTECHNOLOGY
Definition – historical development – properties, design and fabrication Nanosystems, working principle, applications and advantages of nano system. Nanomaterials – ordered oxides – Nano arrays – potential health effects

UNIT II  NANODEFECTS, NANO PARTICLES AND NANOLAYERS

UNIT III  NANOSTRUCTURING
UNIT IV  SCIENCE AND SYNTHESIS OF NANO MATERIALS

UNIT V  CHARACTERIZATION OF NANO MATERIALS

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected
(1) Obtain the knowledge on Nano systems and its applications.
(2) Gain the fundamentals of nano defects and properties.
(3) Acquire knowledge about nano structuring and fabrication techniques
(4) Apply the concepts and techniques to design various nanomaterial-based devices
(5) Aware of various morphological techniques and selecting appropriate tools for their future research.

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MF4013 MATERIALS TESTING AND CHARACTERIZATION TECHNIQUES  L T P C  3 0 0 3

OBJECTIVE:
(1) Make them acquainted with microscopic techniques to analyse crystal structures
(2) Acquire an understanding on the electron microscopic techniques for characterization
(3) Gain a fundamental on chemical and thermal analysis
(4) Provide the knowledge on various static methods to characterize materials
(5) Study the failure of materials under stress

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:
1) At the end of this course the students are expected
2) to be knowledgeable in microstructure evaluation, crystal structure analysis,
3) to take images in electron microscopy and process those images,
4) to do Chemical Thermal Analysis,
5) Analyse the results of static and dynamic mechanical testing.

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OBJECTIVES:
(1) Understand key elements of Mechatronics system, representation into block diagram
(2) It gives the frame work of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.
(3) Understand principles of sensors, its characteristics, interfacing with DAQ microcontroller
(4) Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial application
(5) Understand the PLC used in home appliances

UNIT I INTRODUCTION

UNIT II SENSORS AND TRANSDUCERS

UNIT III MICROPROCESSORS AND MICROCONTROLLERS
Introduction – Architectures of 8-bit microcontrollers (8051) series, PIC Microcontrollers (16f xxx) series – Assembly language programming instruction format, addressing modes, instruction sets, Basic program examples interface of keypads, LEDs, A/D and D/A Converters, RS 232 serial communication interface, classification of memories.

UNIT IV ACTUATORS

UNIT V MECHATRONIC SYSTEMS
Design process-stages of design process – Traditional and Mechatronics design concepts – Case studies – Engine management system, Automatic camera, Automatic wishing machine, Pick and place robots.

TOTAL: 45 PERIODS
OUTCOMES:
The student will be able to
1. Identify the key elements of mechatronics system and its representation in terms of block diagram.
2. Understand the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O
3. Interfacing of Sensors, Actuators using appropriate DAQ micro-controller
4. Differentiate between traditional design and Mechatronics design
5. Apply the mechatronics concepts in home appliances

REFERENCES:
2. M.A. Mazidi & J.G. Mazidi, 8051 Micrcontroller and embedded systems, 2002

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MR4071  INTERNET OF THINGS FOR MANUFACTURING

COURSE OBJECTIVES:
1. To understand the basics of IoT, Opportunities and challenges in IoT
2. To design a IoT solution
3. To develop an IoT prototype
4. To explain the various protocols used in IoT and Localization
5. To examine the applications of IoT in Manufacturing

UNIT I  INTRODUCTION
UNIT II  DESIGN OF IoT
Design challenges in IoT - Standardization, Security and privacy, Infrastructure, Analytics. Design steps for implementing IoT.

UNIT III  PROTOTYPING OF IoT

UNIT IV  PREREQUISITES FOR IoT
IoT Technologies Wireless protocols low-power design (Bluetooth Low Energy), range extension techniques (data mining and mesh networking), and data-intensive IoT for continuous recognition applications. Data storage and analysis algorithms. Localization for mobile systems.

UNIT V  APPLICATION IN MANUFACTURING
Applications HCI and IoT world - Multilingual interactions. Robotics and Autonomous Vehicles. Sensing and data processing - Simultaneous mapping and localization - Levels of autonomy, Smart factories, Future research challenges.

TOTAL : 45 PERIODS

COURSE OUTCOME:
On completion of the course, the students will be able to
CO1: Identify the Opportunities and challenges in IoT
CO2: Propose a suitable IoT design
CO3: Develop an optimized IoT prototype
CO4: Understand the various protocols used in IoT and Localization
CO5: Understand the applications of IoT in Manufacturing

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COURSE OBJECTIVES:
1. Recognize the importance of data analytics
2. Exhibit competence on data analytics packages
3. Apply solution methodologies for industrial problems.

UNIT I INTRODUCTION

UNIT II MULTIPLE REGRESSION
Multiple Regression- Linear and Nonlinear techniques- Backward-Forward-Stepwise Hierarchical regression-Testing interactions (2way interaction) - Analysis of Variance and Covariance (ANOVA & ANCOVA) - Multivariate Analysis of Variance and Covariance (MANOVA & MANCOVA).

UNIT III LOGISTIC REGRESSION
Regression with binary dependent variable -Simple Discriminant Analysis Multiple Discriminant analysis-Assessing classification accuracy- Conjoint analysis (Full profile method).

UNIT IV PRINCIPAL COMPONENT ANALYSIS
Principal Component Analysis -Factor Analysis- Orthogonal and Oblique Rotation-Factor Score Estimation-Multidimensional Scaling-Perceptual Map-Cluster Analysis (Hierarchical Vs Nonhierarchical Clustering).

UNIT V LATENT VARIABLE MODELS
Latent Variable Models an Introduction to Factor, Path, and Structural Equation Analysis-Time series data analysis (ARIMA model) – Decision tree analysis (CHAID, CART) - Introduction to Big Data Management.

TOTAL: 45 PERIODS

COURSE OUTCOMES:
On completion of the course, the student will be able to:
- To recognize the importance of data analytics
- To Exhibit competence on data analytics packages
- To apply solution methodologies for industrial problems.

REFERENCES:
OBJECTIVES:
• To discuss the importance and advantages of applying simulation and modelling techniques
• To teach various random number generation techniques, its use in simulation
• To explain the applications of random probability distributions in real time environments.
• To train students to solve discrete event problems using software.
• To train students on Simulation models using a simulation software.

UNIT I INTRODUCTION
Systems and its types, Types of Modelling, Principles used in Modeling, simulation as a decision making tool, types of simulation, Advantages and disadvantages of simulation, Steps in simulation model building - statistical models in simulation - discrete and continuous system

UNIT II RANDOM NUMBERS

UNIT III RANDOM VARIATES

UNIT IV ANALYSIS OF SIMULATION DATA
Input modelling - Fitness tests – verification and validation of simulation models – output analysis for a single model, Comparison and evaluation of alternate system design, Optimization using simulation.

UNIT V SIMULATION LANGUAGES AND CASE STUDIES
Simulation languages and packages - Case studies in WITNESS; FLEXSIM, ARENA, SIMQUICK - Simulation based optimization - Modelling and Simulation with Petrinets - Case studies in manufacturing and material handling system- Monte Carlo Simulation. Simulation of Single Server Queuing System. Simulation of manufacturing shop Simulation of Inventory System

TOTAL: 45 PERIODS

OUTCOMES
CO1: Explain the Manufacturing Models of Discrete event systems
CO2: Develop the Uncertainty using Random numbers and Random Variates
CO3: Analyze the verification & valediction of Models and Optimization
CO4: Demonstrate the concepts of modeling layers of society’s critical infrastructure networks
CO5: Make use of tools to view and control simulations

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PD4391 PRODUCT LIFECYCLE MANAGEMENT 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

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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OBJECTIVE:
(1) Learn to know the necessity for a New Product by analysing the market trend
(2) Select methodology and process for development
(3) Generate detailed specifications for the given architecture
(4) Integrating CAE, CAD, CAM tools in product design and asses the quality and performance of products
(5) Make a prototype of a problem adhering to design principles to enhance manufacturability

UNIT I PRODUCT DEVELOPMENT AND CONCEPT SELECTION

UNIT II PRODUCT ARCHITECTURE
Product architecture – Implication of the architecture – Establishing the architecture – Related system level design issues.

UNIT III INDUSTRIAL AND MANUFACTURING DESIGN
Need for industrial design – Impact of industrial design – Industrial design process. Assessing the quality of industrial design- Human Engineering consideration - Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors

UNIT IV PROTOTYPING AND ECONOMIC ANALYSIS
Principles of prototyping – Planning for prototypes - Elements of economic analysis – Base case financial model – Sensitivity analysis – Influence of the quantitative factors

UNIT V MANAGING PRODUCT DEVELOPMENT PROJECTS
Sequential, parallel and coupled tasks - Baseline project planning – Project Budget Project execution – Project evaluation- patents- patent search-patent laws International code for patents.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected to
(1) Identify the need for a New Product
(2) design and develop various products
(3) Work out the cost of developing a product
(4) Will be able to prototype the product
(5) Know how to patent the new design or the product
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MF4016 ENTREPRENEURSHIP DEVELOPMENT L T P C
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OBJECTIVE:
(1) To develop and strengthen entrepreneurial quality and motivation in students.
(2) To impart knowledge on the competencies necessary to establish new ventures
(3) To inculcate strategic thinking, budgeting and ethical behaviour which are vital to enhance entrepreneurial skills
(4) To establish start-ups and small businesses
(5) To evaluate the business and monitor

UNIT I ENTREPRENEURIAL COMPETENCE

UNIT II ENTREPRENEURIAL ENVIRONMENT

UNIT III BUSINESS PLAN PREPARATION

UNIT IV LAUNCHING OF SMALL BUSINESS

UNIT V MANAGEMENT OF SMALL BUSINESS
Monitoring and Evaluation of Business - Preventing Sickness and Rehabilitation of Business Units- Effective Management of small Business.

TOTAL: 45 PERIODS
COURSE OUTCOME:
Students will
(1) Gain knowledge and skills needed to run a business.
(2) Innovate and solve challenges in business
(3) Determine risks in the trade and respond effectively
(4) Utilize tools and develop strategies to manage business
(5) Establish start-ups and Evaluate the business

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MF4020 INDUSTRIAL SAFETY

OBJECTIVES:
(1) To develop and strengthen the safety ideas and motivate the students to impart basic safety skills
(2) To know about Industrial safety programs, Industrial laws, regulations and source models
(3) To understand about fire and explosion, preventive methods, relief and its sizing methods
(4) To assess the safety of human beings from toxic substances
(5) To analyse industrial hazards and its risk assessment.
UNIT I  OPERATIONAL SAFETY  9
Hot metal operation, boiler, pressure vessels – heat treatment shop – gas furnace operation –
electroplating – hot bending pipes – safety in welding and cutting, Cold – metal operation –
safety in machine shop – cold bending and chamfering of pipes metal cutting – shot blasting,
grinding, painting – power press and other machines. Management of toxic gases and
chemicals – industrial fires and prevention – road safety – highway and urban safety – safety
of sewage disposal and cleaning – control of environmental pollution – managing emergencies
in industries – planning security and risk assessments, on – site and off site. Control of major
industrial hazards.

UNIT II  SAFETY APPRAISAL AND ANALYSIS  9
Human side of safety – personal protective equipment – causes and cost of accidents.
Accidents prevention program – specific hazard control strategies – HAZOP training and
development of employees – first aid – fire fight devices – accident reporting, investigation.
Measurement of safety performance, accident reporting and investigation – plant safety
inspection, job safety analysis – safety permit procedures. Product safety – plant safety rules
and procedures – safety sampling – safety inventory systems. Determining the cost
effectiveness of safety measurement.

UNIT III  OCCUPATIONAL HEALTH  9
Concept and spectrum of health functional units and activities of operational health service –
occupational and related disease – levels of prevention of diseases – notifiable occupational
diseases Toxicology Lead – Nickel, chromium and manganese toxicity – gas poisoning (such
as CO, Ammonia Chlorise, So2, H2s.) their effects and prevention – effects of ultra violet
radiation and infrared radiation on human system.

UNIT IV  SAFETY AND HEALTH REGULATIONS  9
Safety and health standards – industrial hygiene – occupational diseases prevention welfare
facilities. The object of factories act 1948 with special reference to safety provisions, model
rules 123a, history of legislations related to safety – pressure vessel act – Indian boiler act –
the environmental protection act – electricity act – explosive act.

UNIT V  SAFETY MANAGEMENT  9
Evaluation of modern safety concepts – safety management functions – safety organization,
safety department- safety committee, safety audit – performance measurements and
motivation – employee participation in safety - safety and productivity.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are
(1) Expected to gain knowledge and skills needed to run an industry with utmost safety
precautions.
(2) Understand the industrial laws, regulations and source models.
(3) Apply the methods of prevention of fire and explosions.
(4) Analyse the effect of release of toxic substances
(5) Understand the methods of hazard identification and preventive measures.

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**MF4017 ADVANCES IN MATERIALS**

**COURSE OBJECTIVES**

1. Understand major types of special steels such as HSLA, TRIP, Dual and Tool steels and cast-irons.
2. To study the polymer behaviour and develop polymer composites.
3. To study energy conversion materials.
4. To learn about various materials used for bio implants.
5. To understand the advantage of materials at Nano scale.

**UNIT I METALLIC MATERIALS**


**UNIT II POLYMERS AND COMPOSITES**

Structure of polymers, characterization and applications of polymers: mechanical behavior of polymers, strengthening of polymers, crystallization and glass transition phenomenon and types of polymers.

Composites: Particle reinforced composites, fiber reinforced composites – influence of fiber length, orientation and concentration. Fiber phase, matrix phase, metal matrix composites, polymer matrix composites, ceramic matrix composites, carbon – carbon composites, hybrid composites and structural composites.

**UNIT III ENERGY MATERIALS**

Need for high performance energy materials - carbon nanostructure based energy conversion and storage materials - nanomaterials for solar cell applications - next generation energy storage materials – Li and Ni based batteries, fuel cells.
UNIT IV  BIO MATERIALS
Introduction to biomaterials; need for biomaterials; Salient properties of important material classes; Property requirement of biomaterials; Metallic implant materials, ceramic implant materials, polymeric implant materials, composites as biomaterials; Orthopedic, dental and other applications.

Biomaterials preparation and characterization; Processing and properties of different bio ceramic materials; Mechanical and physical properties evaluation of biomaterials; New and novel materials for biomedical applications. Design concept of developing new materials for bio-implant applications; Nanomaterials and nanocomposites for medical applications

UNIT V  NANO MATERIALS
Concept of nano materials – scale / dimensional aspects, Top-down and bottom-up approaches for preparing nano materials Advantages and limitations at the nano level – thermodynamic aspects at the nano level, health and environmental issues.

TOTAL : 45 PERIODS

COURSE OUTCOMES:
At the end of this course, the students would be able to:
(1) Understand the various ferrous alloys and their applications
(2) Understand different types of composite materials and polymers
(3) Understand Solar materials
(4) Understand the properties of different biomaterials
(5) Understand the structure and behavior of Nano materials

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COPO Mapping
OBJECTIVES:
The objective of this course is to enable the students to
(1) Understand the basic concepts of intelligent agents
(2) Develop general-purpose problem-solving agents, logical reasoning agents, and agents that reason under uncertainty
(3) To learn to represent knowledge in solving AI problems
(4) To understand the different ways of designing software agents
(5) Employ AI techniques to solve some of today’s real-world problems.

UNIT I  INTELLIGENT AGENTS  9
Introduction to AI – Agents and Environments – Concept of rationality – Nature of environments – Structure of agents
Problem solving agents – search algorithms – uninformed search strategies

UNIT II  PROBLEM SOLVING  9
Heuristic search strategies – heuristic functions
Local search and optimization problems – local search in continuous space – search with non-deterministic actions – search in partially observable environments – online search agents and unknown environments

UNIT III  GAME PLAYING AND CSP  9
Constraint satisfaction problems – constraint propagation – backtracking search for CSP – local search for CSP – structure of CSP

UNIT IV  LOGICAL AGENTS  9
Knowledge-based agents – propositional logic – propositional theorem proving – propositional model checking – agents based on propositional logic
First-order logic – syntax and semantics – knowledge representation and engineering – inferences in first-order logic – forward chaining – backward chaining – resolution

UNIT V  KNOWLEDGE REPRESENTATION AND PLANNING  9
Ontological engineering – categories and objects – events – mental objects and modal logic – reasoning systems for categories – reasoning with default information
Classical planning – algorithms for classical planning – heuristics for planning – hierarchical planning – non deterministic domains – time, schedule, and resources – analysis

TOTAL : 45 PERIODS

COURSE OUTCOMES:
On successful completion of this course, the students will be able to
1. Explain autonomous agents that make effective decisions in fully informed, partially observable, and adversarial settings
2. Choose appropriate algorithms for solving given AI problems
3. Design and implement logical reasoning agents
4. Design and implement agents that can reason under uncertainty
5. Apply AI for real world problems
TEXT BOOKS:

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MF4019 SMART MANUFACTURING L T P C
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COURSE OBJECTIVES
(1) To introduce students to fundamentals of Manufacturing
(2) To familiarize with selection of sensors for various application
(3) To learn the basics of agent-based manufacturing
(4) Understand Cyber physical systems
(5) Provide brief understanding about industry 4.0 concepts in Manufacturing systems

UNIT I SENSORS SMART MANUFACTURING

UNIT II DATA ANALYTICS
Introduction to Data and Analytics in a Digital Context (Internet of Things), Product Data Management for Design and Manufacturing (PLM Tools), Typical data challenges (data quality, enrichment, integration of ERP & PLM data), Preparing data for analytics (techniques to improve data quality, integration - ETL)
Advances in data visualization & related tools - Statistical Techniques for Analytics, Descriptive Statistics Inferential statistics, Regression and ANOVA

UNIT II CYBER PHYSICAL SYSTEMS
Concept of Cyber Physical Systems (CPS) and Cyber Physical Production System (CPPS), System Architecture for implementation of CPPS, Components for CPPS, Communication for CPPS

UNIT IV E-MANUFACTURING

UNIT V INDUSTRY 4.0
Evaluation of industries, Introduction to Industry 4.0, Challenges in industry 4.0, Impact of Industry 4.0, Case studies on industry 4.0, Introduction to Internet of Things (IoT) and its applications, Smart supply chain and Case studies.

TOTAL : 45 PERIODS

COURSE OUTCOMES
The students are expected to appreciate:
(1) Appreciate concepts and basic framework necessary for smart manufacturing
(2) current trends at system level in manufacturing organizations
(3) Use of Sensors and Selection of sensors for various applications
(4) IoT based manufacturing systems
(5) The importance of industry 4.0 concepts at manufacturing systems

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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

Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

UNIT III  DISASTER PRONE AREAS IN INDIA

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

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

REFERENCES

AX4093 CONSTITUTION OF INDIA L T P C 2 0 0 0

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 nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

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.
UNIT IV
அதிசயிலிக் தமிழ்
6
1. கின்றும்பரும்பெறும்
- பார்க் முன்னோட்டம் ஒன்று நாள்களின், பட்டி
  பெருக்கு பெருக்கு நூற்றாண்டு, அதிசயிலிக்
  சாதாரண பொருளிலியரின் நாள்களின், உயர் பண்டுப்படை
2. திருமலை
- அதிசயிலிக் புனேகழ் கிளமை
3. கின்றும்பரும் (617, 618)
- தொடர் தொடர் திலகின
4. தர்மாண்டலம் தினியில மூலத்தோர்
5. புறநூறு
- கின்றும்பரும் மூறாக்காலம்
6. கதார்த்தம் (4) - கர்நாடகத்
  தேசியகம் (11) - தொடர்
  கதார்த்தம் (11) - பாடல், புபா
  கேள்விகேள் 50 (27) - பாடல்
  புறப்படுத்தும் பரிமாரில்

UNIT V
நவீன தமிழ் இலக்கியம்
6
1. நடப்புள்ள சொற்கு
- கூறில் முதல் பரிமாரி,
- கூறில் முதல் விளக்கம்,
- வழிகாட்டு திலகின
- வழிகாட்டு திலகின
- பலகை
2. நூற்றாண்டு விளக்கம் மூலாக்காலம் தமிழ் இலக்கியமை
3. செய்தி விளக்கம் தமிழ் இலக்கியமை
4. பாடல் விளக்கம் விளக்கம் தொடக்க விளக்கமை
  ஆட்சமை தமிழ் இலக்கியமை
5. அளிப்பிட்டு சொற்கு
6. தேசியநாட்டில் சொற்கு
7. கதார்த்தம் ஆட்சமை தமிழ் இலக்கியமை

TOTAL: 30 PERIODS
1. தமிழ் விருத்தலம் கல்விக்கழகம் (Tamil Virtual University) - www.tamilvu.org
2. தமிழ் விக்கிப்பீட்டை (Tamil Wikipedia) - https://ta.wikipedia.org
3. தமிழ் ஓரிஷை அலுவலன்
4. தமிழ் சேவை கல்விக்கழக (Tamil Nadu) - தமிழ் வாழக்குறிக்குழல், கொழுங்கை
5. தமிழ் மற்றும் தமிழ் சேவை கல்விக்கழக - தமிழ் வாழக்குறிக்குழல்
   (thamilvalarchithurai.com)
6. அறிவியல் கல்விக்கழக - தமிழ் பல்கலைக்கழகம், கொழுங்கை