# ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
REGULATIONS 2017
M.E. MANUFACTURING ENGINEERING
CHOICE BASED CREDIT SYSTEM

I TO IV SEMESTERS (FULL TIME) CURRICULUM AND SYLLABUS

## SEMESTER I

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- **Semester II:** 28 L, 19 T, 2 P, 23 C
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**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 72**
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**EMPLOYABILITY ENHANCEMENT COURSES (EEC)**

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OBJECTIVES:
This course is designed to provide the solid foundation on topics in applied probability and various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis and multivariate analysis.

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 ESTIMATION THEORY

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

UNIT V MULTIVARIATE ANALYSIS
Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components – Principal components from standardized variables

TOTAL : 60 PERIODS

OUTCOMES:
After completing this course, students should demonstrate competency in the following topics:

- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.
- The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

REFERENCES:
MF5101 ADVANCES IN MANUFACTURING TECHNOLOGY

OBJECTIVE:

The students are expected to understand special machining processes, unconventional machining processes, micro machining process, nano fabrication processes and rapid prototyping.

UNIT I
UNCONVENTIONAL MACHINING

10
Introduction-Bulk processes - surface processes- Plasma Arc Machining- Laser Beam Machining-Electron Beam Machining-Electrical Discharge Machining – Electro chemical Machining-Ultrasonic Machining- Water Jet Machining-Electro Gel Machining-Anisotropic machining-Isotropic machining-Elastic Emission machining – Ion Beam Machining.

UNIT II
PRECISION MACHINING:

10
Ultra Precision turning and grinding: Chemical Mechanical Polishing (CMP) - ELID process – Partial ductile mode grinding-Ultra precision grinding- Binderless wheel – Free form optics. aspherical surface generation
Grinding wheel- Design and selection of grinding wheel-High-speed grinding-High-speed milling- Diamond turning.

UNIT III
ADVANCES IN METAL FORMING

7
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

10

UNIT V
RAPID PROTOTYPING AND SURFACE MODIFICATION TECHNIQUES

8

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the students are expected
1. to produce useful research output in machining of various materials
2. use this knowledge to develop hybrid machining techniques
3. Application of this knowledge to manage shop floor problems
REFERENCES

MF5102 COMPUTER INTEGRATED MANUFACTURING SYSTEMS LTPC

OBJECTIVES:
This course will enable the Student

☐ To gain knowledge about the basic fundamental of CAD.
☐ To gain knowledge on how computers are integrated at various levels of planning and manufacturing understand computer aided planning and control and computer monitoring.

UNIT I COMPUTER AIDED DESIGN
Concept of CAD as drafting and designing facility, desirable features of CAD package, drawing features in CAD – Scaling, rotation, translation, editing, dimensioning, labeling, Zoom, pan, redraw and regenerate, typical CAD command structure, wire frame modeling, surface modeling and solid modeling (concepts only) in relation to popular CAD packages.

UNIT II COMPONENTS OF CIM
CIM as a concept and a technology, CASA/Sme model of CIM, CIM II, benefits of CIM, communication matrix in CIM, fundamentals of computer communication in CIM – CIM data transmission methods – seriel, parallel, asynchronous, synchronous, modulation, demodulation, simplex and duplex. Types of communication in CIM – point to point (PTP), star and multiplexing. Computer networking in CIM – the seven layer OSI model, LAN model, MAP model, network topologies – star, ring and bus, advantages of networks in CIM

UNIT III GROUP TECHNOLOGY AND COMPUTER AIDED PROCESS PLANNING

UNIT IV SHOP FLOOR CONTROL AND INTRODUCTION TO FMS

UNIT V COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING
OUTCOMES:
At the end of this course the students are expected
1. to produce useful research output in computer integrated manufacturing
2. use this knowledge to develop computer techniques
3. Application of this knowledge to functionalise computer aided planning.

TOTAL: 45 PERIODS

REFERENCES:

MF5103 ADVANCES IN CASTING AND WELDING LTPC
3 0 0 3

OBJECTIVES:
☐ To study the metallurgical concepts and applications of casting and welding process.
☐ To acquire knowledge in CAD of casting and automation of welding process.

UNIT I CASTING DESIGN 8
Heat transfer between metal and mould — Design considerations in casting – Designing for directional solidification and minimum stresses - principles and design of gating and risering

UNIT II CASTING METALLURGY 8

UNIT III RECENT TRENDS IN CASTING AND FOUNDRY LAYOUT 8
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 10
UNIT V    RECENT TRENDS IN WELDING

OUTCOMES:
At the end of this course the students are expected to impart knowledge on basic concepts and advances in casting and welding processes.

REFERENCES:
1. ASM Handbook vol.6, welding Brazing & Soldering, 2003

MF5104    METAL CUTTING THEORY AND PRACTICE
L T P C
4 0 0 4

OBJECTIVES:
☐ To make the students familiar with the various principles of metal cutting, cutting tool materials and its wear mechanisms during the machining operation.

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-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 fluids.
UNIT IV TOOL MATERIALS, TOOL LIFE AND TOOL WEAR

12


UNIT V WEAR MECHANISMS AND CHATTER IN MACHINING

12

Processing and Machining – Measuring Techniques – Reasons for failure of cutting tools and forms of wear-mechanisms of wear-chatter in machining-factors effecting chatter in machining-types of chatter-mechanism of chatter.

OUTCOMES:
At the end of this course the students are expected to impart the knowledge and train the students in the area of metal cutting theory and its importance.

TOTAL: 60 PERIODS

REFERENCES

MF5111 CAD / CAM LABORATORY

L T P C
0 0 4 2

OBJECTIVES:
☐ To teach the students about the drafting of 3D components and analyzing the same using various CAD packages and programming of CNC machines
☐ To train them to use the various sensors

CAM LABORATORY
1. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving canned cycle

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

TOTAL: 60 PERIODS

OUTCOMES:
At the end of this course the students are expected
☐ To impart the knowledge on training the students in the area of CAD/CAM
OBJECTIVES:
- To make use of the above techniques while modeling and solving the engineering problems of different fields.

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 12

UNIT V ADVANCES IN SIMULATION 9
Genetic algorithms – simulated annealing – Neural Network and Fuzzy systems

TOTAL: 75 PERIODS

OUTCOME:
At the end of this course the students will be expected to introduce the various optimization techniques and their advancements.

REFERENCES:

CM5251 ADVANCES IN METROLOGY AND INSPECTION L T P C
3 0 0 3

OBJECTIVES:
☐ To teach the students basic concepts in various methods of engineering measurement techniques and applications, understand the importance of measurement and inspection in manufacturing industries.
☐ To make the students capable of learning to operate and use advanced metrological devices with ease in industrial environments.

UNIT I CONCEPTS OF METROLOGY: 8
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: 9

UNIT III INTERFEROMETRY: 8

UNIT IV MEASURING MACHINES AND LASER METROLOGY: 10
UNIT V
IMAGE PROCESSING FOR METROLOGY:
Overview, Computer imaging systems, Image Analysis, Preprocessing, Human vision system, Image model, Image enhancement, gray scale models, histogram models, Image Transforms - Examples.

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected to
1. Understand the advanced measurement principles with ease.
2. Operate sophisticated measurement and inspection facilities.
3. Design and develop new measuring methods.

REFERENCES

MF5202
THEORY OF METAL FORMING
L T P C
30 03

OBJECTIVES:
☐ To study the basic concepts of metal forming techniques and to develop force calculation in metal forming process.
☐ To study the thermo mechanical regimes and its requirements of metal forming

UNIT I
THEORY OF PLASTICITY
9

UNIT II
THEORY AND PRACTICE OF BULK FORMING PROCESSES
8
Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming.

UNIT III
SHEET METAL FORMING
8
Formability studies – Conventional processes – H E R F techniques – Superplastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantage, Limitations and application

UNIT IV
POWDER METALLURGY AND SPECIAL FORMING PROCESSES
9
UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS


OUTCOMES:
At the end of this course the students are expected to upgrade their knowledge on plasticity, surface treatment for forming of various types of metal forming process.

TOTAL: 45 PERIODS

REFERENCES:

MF5203 TOOLING FOR MANUFACTURING L T P C 4 004

OBJECTIVES:
☐ To study the various design considerations for tooling.
☐ Develop knowledge in tooling and work holding devices

UNIT I INTRODUCTION

UNIT II TOOLING FOR METAL REMOVAL PROCESSES
Traditional machining processes -work and tool holding devices-tool nomenclatures-Mechanism of machining-force temperature and tool life of single point tool-multipoint tools -tool design-tool wear-special processes-capstan and turret lathe-tooling layout of automats-tooling in NC and CNC machines-tooling for machining centres-CAD in tool design-Jigs and fixtures-design-Non-traditional material removal processes-mechanical, electrical thermal and chemical energy processes-principles-operation-equipment-tooling parameters and limitations
UNIT III  TOOLING FOR METAL FORMING PROCESSES  12
Classification of Forming processes-Types of presses-design of -blanking and piercing dies-simple, compound,
combination and progressive dies-Drawing dies-Bending dies-forging dies-plastic moulding dies

UNIT IV  TOOLING FOR METAL CASTING AND METAL JOINING PROCESSES  12
Tools and Equipment for moulding-patterns –pattern allowances – pattern construction-die casting tools-
mechanization of foundries. Tooling for Physical joining processes Design of welding fixtures – Arc welding,
Gas welding, Resistance welding, laser welding fixtures-Tooling for Soldering and Brazing Tooling for
Mechanical joining processes

UNIT V  TOOLING FOR INSPECTION AND GAUGING  12
Survey of linear and angular measurements-standards of measurement-design and manufacturing of gauges-
measurement of form-Inspection bench centre-co-ordinate measuring machine-tooling in CMM.

OUTCOMES:
At the end of this course the students are well versed in
1.  State of Art in Tooling in Manufacturing and Inspection
2.  Design and Develop tooling for Flexible Manufacturing

REFERENCES:
4. L E Doyle Tool Engineering Prentice Hall 1950
5. Wellar, J Non-Traditional Machining Processes, SME, 1984

MF5211  AUTOMATION AND METAL FORMING LABORATORY  L T P C
0 04 2

OBJECTIVE
□ To train the students to have an hands on having the basic concepts of metal forming processes and to
determine some metal forming parameters for a given shape.

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
☐ To impart practical knowledge on bulk metal forming and sheet metal forming processes

MF5212
TECHNICAL SEMINAR
LTPC
0 0 2 1

OBJECTIVE:
☐ To enrich the communication skills of the student through presentation of topics in recent advances in engineering/technology

OUTCOME:
Students will develop skills to read, write, comprehend and present research papers.
Students shall give presentations on recent areas of research in manufacturing engineering in two cycles. Depth of understanding, coverage, quality of presentation material (PPT/OHP) and communication skill of the student will be taken as measures for evaluation.

TOTAL: 30 PERIODS

MF5001
FLUID POWER AUTOMATION
LTPC
3 0 0 3

OBJECTIVES:
☐ To make the students to learn the basic concepts of hydraulics and pneumatics and their controlling elements in the area of manufacturing process.
☐ To train the students in designing the hydraulics and pneumatic circuits using various design procedures.

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-Different types-characteristics and performance.

UNIT IV CIRCUIT DESIGN
UNIT V  
**ELECTRO PNEUMATICS & ELECTRONIC CONTROL OF HYDRAULIC AND PNEUMATIC CIRCUITS** 7  
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.  

**OUTCOMES:**  
At the end of this course the students are familiarized in the area of hydraulics, pneumatic and fluid power components and its functions.  

**REFERENCES:**  

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**MF5002**  
**DESIGN FOR MANUFACTURE AND ASSEMBLY**  

**OBJECTIVES:**  
- To make the students learn about tolerance analysis, allocation and geometrical tolerances.  
- Guidelines for design for manufacturing and assembly with examples.  

**UNIT I  
TOLERANCE ANALYSIS**  
8  

**UNIT II  
TOLERANCE ALLOCATION**  
8  

**UNIT III  
GD&T**  
10  

**UNIT IV  
TOLERANCE CHARTING**  
9  
UNIT V MANUFACTURING GUIDELINES 10

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected
d To impart the knowledge about the significance of design for manufacturing and assembly

REFERENCES:

MF5003 MICRO MANUFACTURING L T P C
3 003

OBJECTIVE:
do The objective of the course is to acquaint the students with the principles, basic machine tools, and developments in the micro manufacturing process and research trends in the area of micro manufacturing process.

UNIT I MICRO MACHINING I 10

UNIT II MICRO MACHINING II 10

UNIT III NANO POLISHING 9

UNIT IV MICRO FORMING AND WELDING 9

UNIT V RECENT TRENDS AND APPLICATIONS 7

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are well experienced
do To impart the principles of various basic micro manufacturing process
# MF5004 QUALITY AND RELIABILITY ENGINEERING

## OBJECTIVES:
To make the students to understand the various quality control techniques and to construct the various quality control charts for variables and attributes and also the design concepts for reliable system and maintenance aspects in industries.

## 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 – Markove 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.

REFERENCES:

MF5005 FINITE ELEMENT METHODS FOR MANUFACTURING
ENGINEERING

OBJECTIVE:
☐ To study the fundamentals of one dimensional and two dimensional problems using FEA in manufacturing.

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 noded triangular and four noded quadrilateral element Global and natural co-ordinates—Non linear analysis – Isoparametric elements
– Jacobian matrices and transformations – Basics of two dimensional, plane stress, plane strain and axisymmetric analysis.

UNIT IV COMPUTER IMPLEMENTATION
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

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are highly confident in
☐ Finite element methods and its application in manufacturing.
OBJECTIVE:
To introduce to the students the various concepts of materials 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
☐ Familiarized with the various concepts and functions of material management, so that the students will be in a position to manage the materials management department independently.

REFERENCES
OBJECTIVES:
To introduce the concepts of Ergonomics and to indicate the areas of Applications.

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.

OUTCOMES:
At the end of this course the students are updated with various concepts of Ergonomics, so that students will able to apply the concepts of ergonomics to Design of man – machine system

REFERENCES:
UNIT II  FIBERS AND MATRIX MATERIALS  9

UNIT III  PROCESSING OF POLYMER MATRIX COMPOSITES  9

UNIT IV  PROCESSING OF METAL MATRIX COMPOSITES  9

UNIT V  PROCESSING OF CERAMIC MATRIX COMPOSITES AND CARBON-CARBON COMPOSITES  9
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.

REFERENCES:
OBJECTIVES:
To stress the importance of NDT in engineering.

UNIT I  NON-DESTRUCTIVE TESTING: AN INTRODUCTION, VISUAL INSPECTION & LIQUID PENETRANT TESTING 6 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 III  MAGNETIC PARTICLE TESTING & THERMOGRAPHY 10 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 10 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 9 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

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected to have hands on experience on all types of NDT and their applications in Engineering.

REFERENCES:
4. www.ndt.net
OBJECTIVE:
To implement lean manufacturing concepts in the factories.

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 JIDOKA (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

OUTCOME:
The student will be able to practice the principles of lean manufacturing like customer focus, reduction of MUDA, just in time, Jidoka and Hoshin planning.

REFERENCES
OBJECTIVES:
☐ To impart knowledge in the area of Robot designing and programming in Robotic languages.

UNIT I INTRODUCTION
Definition, Need Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors – types, selection applications.

UNIT III ROBOT KINEMATICS

UNIT III ROBOT DYNAMICS AND TRAJECTORY PLANNING
Lagrangian mechanics, dynamic equations for sing, double and multiple DOF robots – static force analysis of robots, Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning

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

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

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected
☐ To introduce the kinematic arrangement of robots and its applications in the area of manufacturing sectors
☐ To expose to build a robot for any type of application

REFERENCES
OBJECTIVES:

- To inspire the students to expect to the trends in manufacturing of micro components and measuring systems to nano scale.

UNIT I OVER VIEW OF MEMS AND MICROSYSTEMS 6
Definition – historical development – properties, design and fabrication micro-system, microelectronics, working principle applications and advantages of micro system. Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds - silicon piezo resistors, Galium arsenide, quartz, polymers for MEMS, conductive polymers.

UNIT II FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING 10
Photolithography, photo resist applications, light sources, ion implantation, diffusion–Oxidation - thermal oxidation, silicon dioxide, chemical vapour deposition, sputtering - deposition by epitaxy – etching – bulk and surface machining – LIGA process – LASER, Electron beam ,Ion beam processes
– Mask less lithography. Micro system packaging –packaging design– levels of micro system packaging -die level, device level and system level – interfaces in packaging – packaging technologies- Assembly of Microsystems

UNIT III MICRO DEVICES 8

UNIT IV SCIENCE AND SYNTHESIS OF NANO MATERIALS 10
Classification of nano structures – Effects of nano scale dimensions on various properties – structural, thermal, chemical, magnetic, optical and electronic properties fluid dynamics –Effect of nano scale dimensions on mechanical properties - vibration, bending, fracture

UNIT V CHARACTERIZATION OF NANO MATERIALS 11

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected
- To expose the evolution of micro electromechanical systems, to the various fabrication techniques and to make students to be aware of micro actuators. Also to impart knowledge to nano materials and various nano measurements techniques.

REFERENCES:
MF5012 COMPUTER AIDED PRODUCT DESIGN  L T P C  3 0 0 3

OBJECTIVES:
To introduce the computer aided modeling and various concepts of product design.

UNIT I INTRODUCTION  8
Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware & Peripherals – software packages for design and drafting.

UNIT II COMPUTER GRAPHICS FUNDAMENTALS AND GEOMETRIC MODEL  8

UNIT III PRODUCT DESIGN CONCEPTS AND PRODUCT DATA MANAGEMENT  10

UNIT IV PRODUCT DESIGN TOOLS & TECHNIQUES  10

UNIT V PRODUCT DESIGN TECHNIQUES  9

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected
☐ To model a product using CAD software.
☐ To apply the various design concepts and design tools and techniques while designing a product.

REFERENCES:
OBJECTIVES:
To introduce the process planning concepts to make cost estimation for various products after process planning.

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

UNIT II  PROCESS PLANNING ACTIVITIES  
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  
Importance of costing and estimation – methods of costing- elements of cost estimation – Types of estimates – Estimating procedure- Estimation labor cost, material cost- allocation of over head charges- Calculation of depreciation cost

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

UNIT V  MACHINING TIME CALCULATION  
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:
At the end of this course the students are expected to use the concepts of process planning and cost estimation for various products.

REFERENCES:
OBJECTIVES:
To introduce the concepts of manufacturing management and various manufacturing management functions to the students.

UNIT I  PLANT ENGINEERING

UNIT II  WORK STUDY

UNIT III  PROCESS PLANNING AND FORECASTING
Process planning – Aims of process planning – steps to prepare the detailed work sheets for manufacturing a given component – Break even analysis – Forecasting – Purpose of forecasting – Methods of forecasting – Time series – Regression and Correlation – Exponential smoothing.

UNIT IV  SCHEDULING AND PROJECT MANAGEMENT

UNIT V  PERSONNEL AND MARKETING MANAGEMENT

OUTCOMES:
At the end of this course the students are trained in the various functions of manufacturing management so that the students will be able to take up these functions as they get in to senior managerial positions.

REFERENCES
2. Dr. R. Kesavan, C.Elanchezian and B.Vijayaramnath, Production Planning and Control, Anuratha Publications, Chennai – 2008

TOTAL: 45 PERIODS
OBJECTIVES

To impart scientific, statistical and analytical knowledge for carrying out research work effectively.

UNIT I  INTRODUCTION TO RESEARCH

The hallmarks of scientific research – Building blocks of science in research – Concept of Applied and Basic research – Quantitative and Qualitative Research Techniques – Need for theoretical frame work – Hypothesis development – Hypothesis testing with quantitative data. Research design – Purpose of the study: Exploratory, Descriptive, Hypothesis Testing.

UNIT II  EXPERIMENTAL DESIGN


UNIT III  DATA COLLECTION METHODS


UNIT IV  MULTIVARIATE STATISTICAL TECHNIQUES

Data Analysis – Factor Analysis – Cluster Analysis -Discriminant Analysis – Multiple Regression and Correlation – Canonical Correlation – Application of Statistical(SPSS) Software Package in Research.

UNIT V  RESEARCH REPORT

Purpose of the written report – Concept of audience – Basics of written reports. Integral parts of a report – Title of a report, Table of contents, Abstract, Synopsis, Introduction, Body of a report – Experimental, Results and Discussion – Recommendations and Implementation section – Conclusions and Scope for future work.

TOTAL = 45 PERIODS

OUTCOME

After completion of the syllabus students will able to get knowledge about the different research techniques and research report.

REFERENCES

OBJECTIVES:
To inspire the students to expect to the trends in development and synthesizing of nano systems and measuring systems to nano scale.

UNIT I  OVER VIEW OF NANOTECHNOLOGY  6
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 NANO LAYERS  8

UNIT III  NANOSTRUCTURING  8

UNIT IV  SCIENCE AND SYNTHESIS OF NANO MATERIALS  12

UNIT V  CHARACTERIZATION OF NANO MATERIALS  11

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected
☐ To evaluate Nano systems, to the various fabrication techniques.
☐ Also to have deep knowledge in nano materials and various nano measurements techniques.

REFERENCES:
OBJECTIVE:
This course aims to impart knowledge on various techniques of material characterization.

UNIT I  MICRO AND CRYSTAL STRUCTURE ANALYSIS  10

UNIT II  ELECTRON MICROSCOPY  9

UNIT III  CHEMICAL AND THERMAL ANALYSIS  9

UNIT IV  MECHANICAL TESTING – STATIC TESTS  8

UNIT V  MECHANICAL TESTING – DYNAMIC TESTS  9

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected to be knowledgeable in microstructure evaluation, crystal structure analysis, electron microscopy, Chemical Thermal Analysis, static and dynamic mechanical testing methods.

REFERENCES:
OBJECTIVES:
This syllabus is formed to create knowledge in Mechatronics systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives the frame work of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

UNIT I INTRODUCTION
Introduction to Mechatronics-systems – Mechatronics approach to modern engineering and design –
Need of Mechatronics – Emerging areas of Mechatronics – Classification of Mechatronics –
Mechatronics elements.

UNIT II SENSORS AND TRANSDUCERS
Hall effect sensor – Capacitance sensors – Digital transducers – Temperature sensors – Optical sensors –
Piezo electric sensor-ultrasonic sensors – Proximity sensors – Signal processing techniques.

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

UNIT IV ACTUATORS
Switching Devices, Classification of actuators – Electrical actuators – Solid state relays, solenoids,
D.C. motors, Servo motors, Stepper motors – Interfacing with microcontroller through H-bridge
Circuits – Piezoelectric actuators.

UNIT V MECHATRONIC 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.

OUTCOMES:
At the end of this course the students are experts in designing Mechatronics components.

REFERENCES:
2. M.A. Mazidi & J.G. Mazidi, 8051 Micrcontroller and embedded systems, 2002
OBJECTIVES:
- To discover key IoT concepts including identification, sensors, localization, wireless protocols
- To explore IoT technologies, architectures, standards, and regulation
- To realize the value created by collecting, communicating, coordinating, and leveraging data
- To examine developments that will likely shape the industrial landscape in the future;

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 Localization 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

OUTCOMES:
- At the end of this course the students are expected to
- Utilizing sensors to gain greater visibility and real-time situational awareness
- Vertical applications that provide a clear business case and a pressing opportunity
- Emerging technologies to address IoT challenges

REFERENCES:
OBJECTIVES:
The Student should be made to:
- Be exposed to big data
- Learn the different ways of Data Analysis
- Be familiar with data streams
- Learn the mining and clustering
- Be familiar with the visualization

UNIT I INTRODUCTION TO BIG DATA
8

UNIT II DATA ANALYSIS
12

UNIT III MINING DATA STREAMS
8

UNIT IV FREQUENT ITEMSETS AND CLUSTERING
9

UNIT V FRAMEWORKS AND VISUALIZATION
8
MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases – S3 – Hadoop Distributed file systems – Visualizations – Visual data analysis techniques, interaction techniques; Systems and applications:

TOTAL : 45 PERIODS

OUTCOMES:
At the end of this course the students are expected to
- Apply the statistical analysis methods.
- Compare and contrast various soft computing frameworks.
- Design distributed file systems.
- Apply Stream data model.
- Use Visualisation techniques.
REFERENCES:

MANUFACTURING SYSTEM SIMULATION L T P C 3003

OBJECTIVES:
- Introduce computer simulation technologies and techniques
- Introduce concepts of modeling layers of society’s critical infrastructure networks
- Build tools to view and control simulations and their results

UNIT I INTRODUCTION

UNIT II RANDOM NUMBERS

UNIT III RANDOM VARIATES

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

UNIT V SIMULATION LANGUAGES
Simulation languages and packages-Case studies in WITNESS; FLEXSIM, ARENA, SIMQUICK-Simulation based optimization-Modelling and Simulation with Petrinets – Case studies in manufacturing and material handling system.

TOTAL : 45 PERIODS

OUTCOMES:
- At the end of this course the students are expected to
- Develop Manufacturing Models of Discrete event systems
- Generation of Uncertainty using Random numbers and Random Variates
- Input, Output Analysis: Verification & Valediction of Models and Optimization

REFERENCES:
OBJECTIVE:
To understand history, concepts and terminology of PLM
To understand functions and features of PLM/PDM
To understand different modules offered in commercial PLM/PDM tools
To understand PLM/PDM implementation approaches
To understand integration of PLM/PDM with other applications

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 A PDM/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, organisation, 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. Understand history, concepts and terminology of PLM.
2. Apply the functions and features of PLM/PDM.
3. Understand different modules offered in commercial PLM/PDM tools.
4. Understand PLM/PDM implementation approaches.
5. Integrate PLM/PDM with other applications.
6. Analyse the case studies.

REFERENCES
OBJECTIVE:
To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology and the associated Aerospace, Architecture, Art, Medical and industrial applications.

UNIT I INTRODUCTION:

UNIT II REVERSE ENGINEERING AND CAD MODELING:

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

UNIT IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS:

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

TOTAL: 45 PERIODS

OUTCOMES:
On completion of this course the students are expected to learn about a variety of Additive Manufacturing (AM) technologies, their potential to support design and manufacturing, case studies relevant to mass customized manufacturing, and some of the important research challenges associated with AM and its data processing tools

REFERENCES:
MF5018  PRODUCT DESIGN AND DEVELOPMENT  L T P C  3 0 0 3

OBJECTIVES:
Understand the application of product design methods to develop a product

UNIT I  PRODUCT DEVELOPMENT AND CONCEPT SELECTION  10

UNIT II  PRODUCT ARCHITECTURE  7
Product architecture – Implication of the architecture – Establishing the architecture – Related system level design issues.

UNIT III  INDUSTRIAL AND MANUFACTURING DESIGN  10
Need for industrial design – Impact of industrial design – Industrial design process. Assessing the quality of industrial design- Human Engineering consideration - Estimate the manufacturing cost – Reduce the component cost – Reduce the assembly cost – Reduce the support cost – Impact of DFM decisions on other factors

UNIT IV  PROTOTYPING AND ECONOMIC ANALYSIS  9
Principles of prototyping – Planning for prototypes - Elements of economic analysis – Base case financial model – Sensitivity analysis – Influence of the quantitative factors

UNIT V  MANAGING PRODUCT DEVELOPMENT PROJECTS  9
Sequential, parallel and coupled tasks - Baseline project planning – Project Budget Project execution – Project evaluation- patents- patent search-patent laws International code for patents

TOTAL: 45 PERIODS

OUTCOMES:
At the end of this course the students are expected to design and develop various products

REFERENCES:

MF5074  ENTREPRENEURSHIP DEVELOPMENT  L T P C  300 3

OBJECTIVE:
To develop and strengthen entrepreneurial quality and motivation in students. To impart basic entrepreneurial skills and understandings to run a business efficiently and effectively.

UNIT I  ENTREPRENEURIAL COMPETENCE  6

UNIT II  ENTREPRENEURIAL ENVIRONMENT  12
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.

OUTCOME:
☐ Students will gain knowledge and skills needed to run a business.

REFERENCES:

MF5075 INDUSTRIAL SAFETY LTPC
OBJECTIVE:
To develop and strengthen the safety ideas and motivate the students to impart basic safety skills and understandings to run an industry efficiently and effectively

UNIT I OPERATIONAL SAFETY

UNIT II SAFETY APPRAISAL AND ANALYSIS
UNIT III  OCCUPATIONAL HEALTH
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

UNIT V  SAFETY MANAGEMENT

TOTAL: 45 PERIODS

OUTCOME:
At the end of this course the students are expected to gain knowledge and skills needed to run an industry with utmost safety precautions.

REFERENCES: