REGULATIONS - 2015

DEPARTMENT OF
MECHANICAL ENGINEERING

CURRICULUM AND SYLLABI OF
M.E. – MANUFACTURING ENGINEERING
### SEMESTER I

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Total Minimum Credits to be earned for the Award of the Degree: 71
## PROGRAMME ELECTIVE COURSES

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FORMAT FOR COURSE CODE

1 5 M F 2 3 C

Compulsory Course
Course Sequence Number
Semester Number
Specialization Name
Year of Regulation

1 5 M F 0 1 E

Elective Course
Course Sequence Number
Specialization Name
Year of Regulation
COURSE OUTCOMES
Upon completion of this course, the students will be able to
- CO1: compute probabilities based on practical situations using the binomial, poisson and normal distributions (K5)
- CO2: describe the sampling distributions and practical applications (K2)
- CO3: determine an appropriate interval for estimating an unknown population mean and standard deviation (K5)
- CO4: conduct hypothesis tests for population proportions and means (K4, A3)
- CO5: choose an appropriate analysis procedure for forecasting the demand of products (K4)

UNIT I PROBABILITY THEORY
Random variables – probability density and distribution functions - moment generating and characteristic functions – Binomial, Poisson, Normal distributions and their applications.

UNIT II SAMPLING THEORY
Sampling distributions – Standard error – t, F, Chi square distributions – applications.

UNIT III ESTIMATION THEORY
Interval estimation for population mean, standard deviation, difference in means, ratio of standard deviations – point estimation.

UNIT IV TESTING OF HYPOTHESIS AND ANOVA
Hypothesis testing – Small samples – Tests concerning proportion, means, standard deviations – Tests based on chi square – Non parametric methods – Sign test – Rank sum test One, two factor models-Design of experiments

UNIT V CORRELATION, REGRESSION AND TIME SERIES ANALYSIS

L:45 T:30 TOTAL: 75 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: acquire the knowledge of fundamental concepts of the basic mechanism of the plastic deformation and the mechanics of metal working (K2,A1)

CO2: analyze the forming processes, physical phenomenon constituting forming operation and force calculations (K4)

CO3: describe the various sheet metal forming process, advantages, limitations and application (K2)

CO4: describe the preparation of powder performs (P/M) and special forming processes and its applications (K2, S1)

CO5: describe the suitable surface treatment process for any metal forming process (K2)

UNIT I THEORY OF PLASTICITY 9

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

UNIT III SHEET METAL FORMING 9

UNIT IV POWDER METALLURGY AND SPECIAL FORMING PROCESSES 9

UNIT V SURFACE TREATMENT AND METAL FORMING APPLICATIONS 9


L:45 TOTAL: 45 PERIODS

REFERENCES
15MF13C ADVANCED MATERIALS TECHNOLOGY

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe the basic mechanical properties of materials and various strengthening Mechanisms (K2)
CO2: explain the fundamentals of fracture of metals (K2)
CO3: select suitable material for specific application based on requirements and cost (K5,A3)
CO4: describe the properties and the suitability of modern metallic Materials for specific applications (K2)
CO5: describe processing, properties and applications of Non-metallic materials (K2)

UNIT I ELASTIC AND PLASTIC BEHAVIOR
Elasticity in metals and polymers Anelastic and visco-elastic behaviour – Mechanism of plastic deformation and nonmetallic shear strength of perfect and real crystals – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity – Deformation of non crystalline materials.

UNIT II FRACTURE BEHAVIOUR

UNIT III SELECTION OF MATERIALS
Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

UNIT IV MODERN METALLIC MATERIALS

UNIT V NON METALLIC MATERIALS
Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TIC, TaC, Al2O3, SiC, Si3N4 CBN and diamond – properties, processing and applications.

L:45 TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe the basic concepts of CIM systems (K2)
CO2: identify the automation strategies in production operations (K2)
CO3: develop machining programs for CNC equipment and study the concept of FMS (K6,A2)
CO4: select an appropriate automated inspection systems for quality control in manufacturing (K5,A3)
CO5: develop a control system for manufacturing cells (K6)

UNIT I COMPUTER INTEGRATED MANUFACTURING 8
Introduction, nature, evolution, development of CIM, fundamentals of CAD/CAM, computerized networks for manufacturing, future trends in CIM.

UNIT II FUNDAMENTALS OF MANUFACTURING AND AUTOMATION 8
Production operations and automation strategies, production economics.

UNIT III NUMERICAL CONTROL PRODUCTION SYSTEMS 8
Numerical Control, computer numerical control, part programming, flexible manufacturing system.

UNIT IV COMPUTER AIDED QUALITY CONTROL AND INSPECTION 13
Automated inspection and testing, QC and CIM, computer aided inspection using robots, integrated computer aided inspection system, flexible inspection system. Group Technology and Computer aided process planning, DNC and integration requirements, FMS design.

UNIT V CONTROL SYSTEMS 8
Introduction to control systems, linear control systems, linear feedback control systems, optimal control, sequence control and programmable controllers, process control.

L:45 TOTAL: 45 PERIODS

REFERENCES
15MF15C ADVANCED MACHINING SCIENCES

COURSE OUTCOMES

Upon completion of this course, the student will be able to

CO1: describe the fundamentals of mechanics of metal cutting and calculate the cutting forces (K2)

CO2: define the mechanisms of tool wear and machinability of tool materials (K1)

CO3: identify the methods of manufacturing the gears and gear finishing operations (K2,S3)

CO4: identify the role of computers in machining systems (K2)

CO5: develop part programming for machining operations in lathe & milling machines (K6, A2)

UNIT I MECHANICS OF METAL CUTTING


UNIT II TOOL MATERIAL, TOOL WEAR AND TOOL LIFE


UNIT III GEAR MANUFACTURE


UNIT IV CNC MACHINES


UNIT V CNC PROGRAMMING


L:45 TOTAL: 45 PERIODS

REFERENCES

15MF16C ADVANCED METROLOGY AND QUALITY  L T P C
ENGINEERING  3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
- CO1: demonstrate the usage of laser principles in manufacturing metrology (K3)
- CO2: analyze the role of laser based precision instruments in metrology (K4)
- CO3: critically analyze the factors which causes the uncertainty in CMM measurement (K4,A3)
- CO4: identify the applications of optoelectronic devices and machine vision techniques in production monitoring (K2)
- CO5: analyze the tools for controlling the quality in manufacturing (K4,A3)

UNIT I LASER METROLOGY  8

UNIT II PRECISION INSTRUMENTS BASED ON LASER  9

UNIT III CO-ORDINATE MEASURING MACHINE  10

UNIT IV OPTO ELECTRONICS AND VISION SYSTEM  9

UNIT V QUALITY IN MANUFACTURING ENGINEERING  9
Importance of manufacturing planning for quality – concepts of controllability – need for quality management system and models – quality engineering tools and techniques – statistical process control – six sigma concepts – Poka Yoke – Computer controlled systems used in inspection.

L:45 TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: create a 2D & 3D Model of simple machines (K6, S1)
CO2: generate CNC programs for simulating lathe and milling machine operations (K5, S2)
CO3: analyze a simple structures like beam, column, etc. (K4, A1, S2)

2D AND 3D GEOMETRIC MODELING
1. Exercise on 3D geometric modeling and assembly of Tail Stock.
2. Exercise on 3D geometric modeling and assembly of Screw Jack.
3. Exercise on 3D geometric modeling and assembly of Plummer Block.
4. Exercise on 3D geometric modeling and assembly of Machine Vice.
5. Exercise on 3D geometric modeling and assembly of Lathe Chuck.
6. Exercise on 3D geometric modeling and assembly of Flange Coupling.
7. Exercise on 2D geometric modeling of Sheet Metal Components.

COMPUTER AIDED MANUFACTURING
8. Exercise on CNC Lathe: Plain Turning, Step turning, Taper turning, Threading, Grooving & canned cycle

DESIGN AND ANALYSIS
10. Exercises on analysis of Beams with different loading conditions.
11. Exercise on buckling analysis of beams.
12. Exercise on structural analysis with contact options.

P:60 TOTAL: 60 PERIODS
15MF21C APPLIED HYDRAULICS AND PNEUMATICS  

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

CO1: explain the function and the purpose of various elements of pneumatic and hydraulic systems (K2)
CO2: design multiple actuator sequential circuits with suitable fringe modules (K6)
CO3: design pneumatic circuit to automate any simple machine (K6, S3)
CO4: read and understand Electro-Pneumatic circuit diagrams (K1)
CO5: construct a detailed hydraulic circuit diagram for any Industrial application (K6,A2)

UNIT I ELEMENTS OF PNEUMATIC SYSTEMS 9

UNIT II PNEUMATIC SYSTEMS DESIGN 9
General approach, travel step diagram. Sequential circuit design, step counter method. K.V. Mapping for minimization of logic equation, fringe condition modules, sizing of components in pneumatic systems.

UNIT III TYPICAL INDUSTRIAL APPLICATIONS OF PNEUMATIC SYSTEMS 9
Metal working, handling, clamping, application with counters.

UNIT IV ADVANCED TOPICS IN PNEUMATICS 9
Electro pneumatics, ladder diagram. Servo and proportional valves - types, operation, application, hydro-mechanical servo systems. PLC-construction, types, operation, programming.

UNIT V DESIGN OF TYPICAL HYDRAULIC SYSTEMS 9
Total design of a fluid power system for an industrial application. Specifications of the circuit, circuit design, selection of elements based on force, speed, travel and time, sizing of pipes, design of power packs/selection of compressor, piping layout and accessories.

L:45 TOTAL: 45 PERIODS

REFERENCES
15MF22C PRODUCTION AND OPERATIONS MANAGEMENT  L  T  P  C
3  2  0  4

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: explore the role of forecasting as a basis for supply chain planning and
choose an appropriate method of forecasting for the given situation (K3)
CO2: analyze the different inventory systems and models (K4)
CO3: solve the sequencing and scheduling problems and minimize the
make span (K5,A2)
CO4: construct a network model using PERT and CPM techniques for the given
project (K6)
CO5: analyze the importance of materials requirement planning and master
production scheduling in industries (K4,A4)

UNIT I FORECASTING 15
Introduction, types of forecasting, qualitative forecasting techniques, Time series
analysis – Simple and weighted moving average, Exponential smoothing, seasonal
and cyclic forecasting, measures of forecasting accuracy, decomposition of time
series, limitations of time series.

UNIT II INVENTORY ANALYSIS AND CONTROL 15
Need for inventory, Definitions, EOQ model, EMQ model, continuous and periodic review
policies, lot sizing techniques, inventory models with uncertain demand and lead times, risk
pooling, ABC inventory system, vendor managed inventory, simulation of inventory systems.

UNIT III SEQUENCING AND SCHEDULING 15
Objectives in scheduling, single machine models – SPT and EDD sequences, mean flow
time, weighted mean flow time, number of tardy jobs and mean tardiness, Parallel machine
models – minimizing makespan and weighted mean flow time, Flow shop models –
Johnson’s algorithm, Jobshop models – branch and bound approach.

UNIT IV PROJECT MANAGEMENT 15
PERT, Network stochastic considerations, CPM, time-cost trade off. Project
monitoring, Line of balance.

UNIT V AGGREGATE PLANNING AND MASTER PRODUCTION
SCHEDULING 15
Approaches to aggregate planning-graphical, empirical, optimization and parametric.
Development of a master production schedule, Make-to-stock, assemble-to-order, make-to-
order/engineer-to-order, materials requirement planning (MRP-I) manufacturing resource
planning (MRP-II) and ERP.

L:45 T:30 TOTAL: 75 PERIODS

REFERENCES
Planning, Scheduling, and Inventory Control”, John Wiley & Sons, 1974.
2. Bedworth D D, "Integrated Production Control Systems Management, Analysis,
3. Richard B Chase, Nicholas J Aquilano and F Robert Jacobs, “Production and
Operations Management – Manufacturing and Services, 8th Edition, Tata
15MF23C ADVANCED WELDING AND CASTING  L T P C
3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the student will be able to
CO1: summarize the fundamental concepts of weld joint design and its characteristics (K2)
CO2: gain the knowledge about the recent trends in welding (K1,A1)
CO3: attain skill to use design principles in casting (K1,A1)
CO4: get aware on the solidification of various metals and alloys (K2)
CO5: gain the knowledge about the various methods of casting and specific products fabrication (K1,A1)

UNIT I   WELDING METALLURGY AND DESIGN  8

UNIT II   RECENT TRENDS IN WELDING  8

UNIT III 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 IV CASTING METALLURGY  10

UNIT V CASTING PROCESSES  11
Shell moulding, precision investment casting, CO₂ moulding, centrifugal casting, Die casting, Continuous casting, Counter gravity low pressure casting, Squeeze casting and semisolid processes.

REFERENCES
15MF24C RESEARCH PAPER AND PATENT REVIEW - SEMINAR

The student will make at least two technical presentations on current topics related to the specialization. The same will be assessed by a committee appointed by the department. The students are expected to submit a report at the end of the semester covering the various aspects of his/her presentation together with the observation in industry visits.

P:60; TOTAL: 60 PERIODS
15MF25C METROLOGY AND MATERIALS TESTING LABORATORY

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

CO1: choose an appropriate device/sensor to measure the linear & angular dimensions, speed, vibration and surface roughness(K3,S1,A1)
CO2: write programs to control the motion in AC, DC, servo & stepper motor and encoders(K5,S1)
CO3: predict and justify the mechanical properties of any ferrous or non-ferrous Materials(K5,S1)

METROLOGY
2. Study of various types of gauges.
3. Exercises on linear, angular and speed measurements
4. Exercises on Vibration measurements
5. Exercises on Motion controller using AC motor, DC motor, Servo motor and encoder.
7. Exercises on microprocessor based data acquisition system.
8. Exercise on measurements of surface finish parameters.
9. Experiment using pneumatic gauges.

MATERIALS TESTING
10. Study on various standards for testing.
11. Comparison of mechanical properties of any two materials (Metal or non-metal).
12. Exercise on preparation of samples for microstructure study.

P:60; TOTAL: 60 PERIODS
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe the working of unconventional machining processes (K2)
CO2: discuss about the fabrication of micro devices (K2)
CO3: discuss the technology about the fabrications and techniques used in micro
fabrications (K2,A2)

UNIT I NEWER MACHINING PROCESSES - I 9
(Non thermal energy) – Abrasive machining – water jet machining – ultrasonic
machining – chemical machining – electro chemical machining – construction working
principle – steps – types – process parameters – derivations – problems, merits,
demerits and applications .

UNIT II NEWER MACHINING PROCESS – II 9
Wire cut EDM - Electro chemical machining – ECG - Electric discharge machining –
applications.

UNIT III NEWER MACHINING PROCESS – III 9
Laser beam machining – Electron beam machining – Plasma arc machining – Ion beam
machining – construction working principle types – process parameter – derivations –
problems, merits, demerits and applications.

UNIT IV FABRICATION OF MICRO DEVICES 9
Semiconductors – films and film de purification – Oxidation - diffusion – ion implantation
Solid free form fabrication.

UNIT V MICRO FABRICATION TECHNOLOGY 9
Wafer preparation – monolithic processing – moulding – PCB board hybrid & mcm
technology – programmable devices & ASIC – electronic material and processing –
stereo lithography SAW devices, Surface Mount Technology.

L:45; TOTAL: 45 PERIODS

REFERENCES
1. Pandey P.C. & Shan HS,” Modern Machining Processes”, Standard
Publishing Co.,1980
2. Jaeger R.C., “Introduction to microelectronic fabrication”, Addison Wesley,
15MF02E  ADVANCED METAL CUTTING THEORY AND PRACTICE  
L  T  P  C  3  0  0  3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe the basic mechanisms of chip formation and cutting force analysis in orthogonal cutting (K2)
CO2: describe the nomenclature of different cutting tools (K2, A1)
CO3: describe the measurement of temperature and heat distribution in machining (K2)
CO4: perform economics of machining and tool life estimation (K5)
CO5: analyze the different mechanisms of tool wear and chattering (K4, A2)

UNIT I  INTRODUCTION  
9
Need for rational approach to the problem of cutting materials-observation made in the cutting of metals-basic mechanism of chip formation-thin and thick zone modes-types of chips-chip breaker-orthogonal Vs oblique cutting-force velocity relationship for shear plane angle in orthogonal cutting-energy consideration in machining-review of Merchant, Lee and Shafter theories-critical comparison.

UNIT II  SYSTEM OF TOOL NOMENCLATURE  
9
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  
9
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  
9

UNIT V  WEAR MECHANISMS AND CHATTER IN MACHINING  
9
Processing and Machining – Measuring Techniques – Reasons for failure of cutting tools and forms of wear-mechanisms of wear-chatter in machining-factors effecting chatter in machining-types of chatter-mechanism of chatter.

L:45; TOTAL: 45 PERIODS

REFERENCES
15MF03E ADVANCED TOOL DESIGN

L T P C
3 2 0 4

COURSE OUTCOMES
Upon completion of this course, the student will be able to
CO1: appropriate knowledge about the selection of tool and tool material for
machining any type of material (K2)
CO2: describe different type of multipoint cutting tools used in conventional
and CNC machines (K2)
CO3: design JIG and fixture fixtures for Machining simple components (K6)
CO4: design and manufacture tools for press work in addition to selection
of the presses (K6)
CO5: describe the mould design concepts (K2)

UNIT I DESIGN OF SINGLE POINT TOOLS 15
Design of form tools, Selection of tool materials for different application, ISO standard
for Inserts, tool holders, Selection of inserts and tool holders for specific examples.

UNIT II DESIGN OF MULTI POINT TOOLS 15
Design of Drills, Reamers, Milling cutters, Tapes and dies, Broaching tools, Gear cutting
tools, Thread milling tools for CNC Machining Centers.

UNIT III DESIGN OF CHUCKING SYSTEMS 15
For CNC turning applications.
DESIGN OF JIGS AND FIXTURES: Design of drill jigs and milling fixtures. Welding
fixtures, modular fixtures.

UNIT IV DESIGN OF TOOLS FOR PRESS WORK 15
Design of simple, compound and progressive tools, study of power presses and
accessories, Application of EDM for tool making.

UNIT V DESIGN OF PLASTIC MOLD DESIGN 15
Design of Thermo plastic tools, two and three plate, design of runner, gate, cooling line,
ejection.
DESIGN OF GAUGES: Plug, Ring, Snap, thread gauges, Application of Sine bar, Slip
gauges and Air gauges, Toolings for Casting.

L:45; T:30: TOTAL: 75 PERIODS

REFERENCES
15MF04E   ARTIFICIAL INTELLIGENCE

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe fuzzy logic principles (K2)
CO2: apply the concepts of fuzzy logic in industrial problems (K3,A2)
CO3: discuss the fundamental concepts of ANN (K2)
CO4: use various heuristic algorithms for simple and complex problems (K3,A3)

UNIT I   INTRODUCTION TO FUZZY LOGIC
Basic concepts in Fuzzy Set theory – Operations of Fuzzy sets – Fuzzy
relational equations – Propositional, Predicate Logic – Inference – Fuzzy Logic
Principles – Fuzzy inference – Fuzzy Rule based systems – Fuzzification and
defuzzification – Types.

UNIT II   FUZZY LOGIC APPLICATIONS
Fuzzy logic controllers – Principles – Various industrial Applications of Fuzzy
logic control – Adaptive Fuzzy systems – Fuzzy Decision making – Fuzzy
classification – Fuzzy pattern Recognition – Image Processing applications – Fuzzy
optimization.

UNIT III   INTRODUCTION TO ARTIFICIAL NEURAL NETWORKS
Fundamentals of Neural networks – Neural network architectures – Learning methods –
Taxonomy of Neural Network Architectures – Standard back propagation Algorithms –
Selection of various parameters – Variations.

UNIT IV   OTHER ANN ARCHITECTURES
Associative memory – Exponential Bidirectional Associative Memory – Adaptive
Resonance Theory – Introduction – Adaptive Resonance Theory 1 – Adaptive
Resonance Theory 2 – Applications – Kohonen Self organizing maps – counter
propagation networks – Industrial Applications.

UNIT V   RECENT ADVANCES
Fundamentals of Genetic Algorithms – Hybrid systems – Meta heuristic techniques like
simulated Annealing, Tabu Search, Ant colony optimization, Perpetual self organizing,
Artificial immune systems – Applications in Design and Manufacturing.

L:45; TOTAL: 45 PERIODS

REFERENCES
   House, 1994
2. Laurene Fausett, “Fundamentals of Neural Networks, Architectures, Algorithms
4. Simon Haykin, ‘Neural Networks A comprehensive foundation”, Prentice Hall, 2nd
5. S. Rajasekaran, GA Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe the properties of fibers, matrices and smart materials. (K2)
CO2: analyze the characteristics of different fibers. (K4, A3)
CO3: select any of techniques to process metal matrix composites. (K2)
CO4: prepare the design procedure composite materials. (K3, A3)
CO5: perform various analysis of Composite Beams, Plates and Shells. (K4, A1)

UNIT I INTRODUCTION
Definition - Need - General characteristics, Applications, Fibers - Glass, Carbon, Ceramic and Aramid fibers. Matrices - Polymer, Graphite, Ceramic and Metal Matrices - Characteristics of fibers and matrices. Smart materials - Types and characteristics.

UNIT II MECHANICS AND PERFORMANCE
Characteristics of fibre - reinforced Lamina - Laminates - Interlaminar stresses - Static Mechanical Properties fatigue and Impact properties - Environmental effects - Fracture Behaviour and Damage Tolerance.

UNIT III MANUFACTURING
Bag Moulding - Compression Moulding - Pultrusion - Filament Winding - Other Manufacturing Processes, Quality Inspection methods, Processing of MMC's.

UNIT IV DESIGN
Failure Predictions - Laminate Design Consideration - Bolted and Bonded Joints Design Examples.

UNIT V ANALYSIS

L:45; T:30; TOTAL: 75 PERIODS

REFERENCES
15MF06E COMPUTER AIDED PRODUCT DESIGN

COURSE OUTCOMES
Upon completion of this course, the students will be able to
- CO1: identify the basics of engineering design and design software packages. (K2)
- CO2: discuss about the fundamentals of computer graphics and geometric modeling. (K2)
- CO3: describe the concepts of product design and its functions. (K2)
- CO4: analyze various product design tools and techniques. (K4)
- CO5: illustrate the important functions of product data management. (K3)

UNIT I INTRODUCTION
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

UNIT III PRODUCT DESIGN CONCEPTS

UNIT IV PRODUCT DESIGN TOOLS & TECHNIQUES

UNIT V PRODUCT DATA MANAGEMENT

L:45; TOTAL: 45 PERIODS

REFERENCES
15MF07E DESIGN FOR MANUFACTURING AND ASSEMBLY  L  T  P  C
3  2  0  4

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe various approaches for tolerance design (K2)
CO2: synthesis the assembly tolerance and allocate it to the components of assembly (K5)
CO3: understand the fundamentals of geometric dimensioning and tolerancing (K2)
CO4: prepare tolerance chart for the given application (K6,A2)
CO5: discuss the statistical methods of tolerance analysis (K2)

UNIT I TOLERANCE ANALYSIS 15

UNIT II TOLERANCE ALLOCATION 15

UNIT III GD & T 15

UNIT IV TOLERANCE CHARTING 15

UNIT V MANUFACTURING GUIDELINES 15

REFERENCES
15MF08E FINANCIAL MANAGEMENT  
L T P C  3 2 0 4

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: prepare a balance sheet based on profit and loss statement (K3,S2)
CO2: estimate the cost of manufacturing of a product and allocation of overhead cost (K2)
CO3: estimate the working capital requirements and inventory valuation(K2)
CO4: calculate the return on investment by different methods(K4,A2)
CO5: analyze the costing and profit planning methodologies for decision making(K4)

UNIT I FINANCIAL ACCOUNTING  15
Accounting principles - Basic records - Preparation and interpretation of profit and loss statement - balance sheet - Fixed assets - Current assets.

UNIT II COST ACCOUNTING  15

UNIT III MANAGEMENT OF WORKING CAPITAL  15
Current assets - Estimation of working capital requirements - Management of accounts receivable - Inventory - Cash - Inventory valuation methods.

UNIT IV CAPITAL BUDGETING  15
Significance of capital budgeting - payback period - present value method - accounting rate of return method - Internal rate of return method.

UNIT V PROFIT PLANNING AND ANALYSIS  15
Cost - Volume profit relationship Relevant costs in decision making profit management analysis - Break even analysis.

L:45; T:30 ;TOTAL: 75PERIODS

REFERENCES
15MF09E

FINITE ELEMENT APPLICATION IN MANUFACTURING

L T P C
3 2 0 4

COURSE OUTCOMES
Upon completion of this course, the student will be able to

CO1: understand the fundamental concepts of FEM (K2)
CO2: perform one dimensional analysis in solid mechanics and heat transfer (K3,A4)
CO3: solve structural and non-structural problem using FEM (K5,A2)
CO4: develop code for one dimensional analysis and validation using computer system (K6,A1)
CO5: perform finite element analysis of various production processes (K3,A2)

UNIT I  INTRODUCTION  15

UNIT II  ONE DIMENSIONAL ANALYSIS  15
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  15
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  15
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  15

L:45; T:30 ;TOTAL: 75 PERIODS

REFERENCES
15MF10E INDUSTRIAL ERGONOMICS L T P C 3 0 0 3

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe the concepts of human factor engineering.(K2)
CO2: analyze the human motions using anthropometry principle.(K4,S1)
CO3: design the workplace and process.(K6)
CO4: analyze the environmental factors in working location.(K4,A2)
CO5: discuss about the work physiology and its evaluation.(K2)

UNIT I INTRODUCTION
Concepts of human factors engineering and ergonomics – Man – machine system and
design philosophy – Physical work – Heat stress – manual lifting – work posture –
repetitive motion.

UNIT II ANTHROPOMETRY
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
Displays – Controls – Workplace – Seating – Work process – Duration and rest
periods– Hand tool design – Design of visual displays – Design for shift work.

UNIT IV ENVIRONMENTAL FACTORS IN DESIGN
Temperature – Humidity – Noise – Illumination – Vibration – Measurement of
illumination and contrast – use of photometers – Recommended illumination levels.
The ageing eye– Use of indirect (reflected) lighting – cost efficiency of illumination –
special purpose lighting for inspection and quality control – Measurement of sound –
Noise exposure and hearing loss – Hearing protectors – analysis and reduction of noise
– Effects of Noise on performance – annoyance of noise and interference with
communication – sources of vibration discomfort.

UNIT V WORK PHYSIOLOGY
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.

L:45; TOTAL: 45 PERIODS

REFERENCES
4. Martin Helander, “A guide to the ergonomics of manufacturing”, East West press,
1996
Publishers, 2003
15MF11E LEAN MANUFACTURING SYSTEM AND IMPLEMENTATION  

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COURSE OUTCOMES
Upon completion of this course, the student will be able to
CO1: discuss the Principles and basic elements of lean manufacturing.(K2)
CO2: identify the importance of cellular manufacturing, JIT, TPM and its implementations.(K2)
CO3: describe the concepts of set up time reduction, TQM, 5S and VSM.(K2)
CO4: analyze the factors for the implementation of six sigma concepts.(K4)
CO5: illustrate the case studies about implementation of lean manufacturing at industries.(K3)

UNIT I INTRODUCTION 7

UNIT II CELLULAR MANUFACTURING, JIT, TPM 9
Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT III SET UP TIME REDUCTION, TQM, 5S, VSM 10
Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

UNIT IV SIX SIGMA 9
Six Sigma – Definition, statistical considerations, variability reduction, design of experiments – Six Sigma implementation

UNIT V CASE STUDIES 10
Various case studies of implementation of lean manufacturing at industries

L:45; TOTAL: 45 PERIODS

REFERENCES
15MF12E MANUFACTURING MANAGEMENT

COURSE OUTCOMES
Upon completion of this course, the student will be able to

CO1: analyze the available plant layout types in practice and select the proper one for specific application (K4)

CO2: select an efficient methodology from alternatives by comparing their standard time for processing a specific product (K2)

CO3: prepare the route sheet for processing a product and use different tools and methods for estimating the future demand of products (K3)

CO4: apply machine scheduling and job sequencing methods to minimize the manufacturing lead time and increase the production rate of products (K3)

CO5: describe the managerial functions as they get in to senior managerial positions in industry (K2, A1)

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 – Forecast errors.

UNIT IV SCHEDULING AND PROJECT MANAGEMENT

UNIT V PERSONNEL AND MARKETING MANAGEMENT

L:45; TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to

CO1: recognize the important characteristics, key words, phrases, and concepts of simulation(K2)
CO2: generate random numbers based on discrete & continuous distribution and testing its randomness(K6)
CO3: describe the principles of experimental simulation design and apply the concepts in engineering industries(K2)
CO4: use computer simulation software to solve and interpret the results(K3)
CO5: develop simulation models for the defined cases(K6)

UNIT I INTRODUCTION 8
Basic concepts of system – elements of manufacturing system - concept of simulation – simulation as a decision making tool – types of simulation – Monte-Carlo simulation - system modeling – types of modeling – Limitations and Areas of application of simulation.

UNIT II RANDOM NUMBERS 10
Probability and statistical concepts of simulation – Pseudo random numbers – methods of generating random numbers – discrete and continuous distribution – testing of random numbers – kolmogorov-Smirnov test, the Chi-Square test - sampling - simple, random and simulated.

UNIT III DESIGN OF SIMULATION EXPERIMENTS 9

UNIT IV SIMULATION LANGUAGE 9
Comparison and selection of simulation languages - Study of GPSS (Basic blocks only) Generate, Queue, Depart, Size, Release, Advance, Terminate, Transfer, Enter and Leave.

UNIT V CASE STUDIES 9
Development of simulation models using GPSS for queuing, production, inventory, maintenance and replacement systems – case studies.

REFERENCES
5. Jeffrey L.Written, Lonnie D, Bentley and V.M. Barice, “System analysis and Design Methods”, Galgotia publication, 1999
15MF14E MATERIALS MANAGEMENT AND LOGISTICS L T P C
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COURSE OUTCOMES
Upon completion of this course, the student will be able to
CO1: discuss the concept of materials management and its functions.(K2)
CO2: analyze the method of purchase, source of supply and buyer-seller relationship.(K4)
CO3: discuss the importance of management of stores & logistics and its functions.(K2)
CO4: use various tools for materials planning.(K3)
CO5: analyze various tools of inventory management.(K4)

UNIT I INTRODUCTION 6
Introduction to materials management – Objectives – Functions – Operating Cycle – Value analysis – Make or buy decisions.

UNIT II MANAGEMENT OF PURCHASE 7

UNIT III MANAGEMENT OF STORES AND LOGISTICS 12

UNIT IV MATERIALS PLANNING 10

UNIT V INVENTORY MANAGEMENT 10
ABC analysis – Aggregate planning – Lot size under constraints – Just in Time (JIT) system.

L:45; TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe elastic and plastic behaviour of engineering materials(K2,A1)
CO2: explain the concepts of fatigue failure analysis(K2)
CO3: choose an appropriate material for the specific applications(K3,A2)
CO4: characterize the modern metallic materials(K5)
CO5: understand the properties, processing and applications of non-metallic materials(K2)

UNIT I BASIC CONCEPTS OF MATERIAL BEHAVIOR

UNIT II BEHAVIOUR UNDER DYNAMIC LOADS AND DESIGN APPROACHES
Stress intensity factor and fracture toughness – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law - Safe life, Stress-life, strain-life and fail - safe design approaches -Effect of surface and metallurgical parameters on fatigue – Fracture of non metallic materials – Failure analysis, sources of failure, procedure of failure analysis.

UNIT III SELECTION OF MATERIALS
Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection.

UNIT IV MODERN METALLIC MATERIALS

UNIT V NON METALLIC MATERIALS
Polymeric materials – Formation of polymer structure – Production techniques of fibers, foams, adhesives and coating – structure, properties and applications of engineering polymers – Advanced structural ceramics, WC, TiC, TaC, Al2O3, SiC, Si3N4, CBN and diamond – properties, processing and applications.

REFERENCES
15MF16E  MECHANICAL PROCESSING AND PROPERTIES OF NANOSTRUCTURE MATERIALS  

COURSE OUTCOMES
Upon completion of this course, the student will be able to

CO1: describe the mechanics and processes of rolling, forging, extrusion, wire drawing and sheet metal forming (K2)
CO2: describe the techniques for processing polymers (K2, S1)
CO3: analyze various processing methods in powder metallurgy (K4)
CO4: discuss about the properties and processing of structural and functional nanocrystalline materials (K2, A3)
CO5: analyze the microstructure of nanostructure materials (K4)

UNIT I  PROCESSING OF METALS AND ALLOYS  6
Understanding the following processes from the viewpoints of mechanics and processes: rolling, forging, extrusion, wire drawing, sheet metal forming.

UNIT II  PROCESSING OF POLYMERS  7
Special techniques like injection moulding, thermoforming, vacuum and pressure assisted forming.

UNIT III  PROCESSING OF POWDERS OF METALS AND CERAMICS  12
Selection and characterization of powders, compacting and sintering; mechanical working. Production of Porous and Dense Composite Components: Metal-polymer- and ceramic-based composites.

UNIT IV  PROCESSING OF STRUCTURAL AND FUNCTIONAL NANOCRYSTALLINE MATERIALS  10
Properties required of nanocrystalline materials used for structural, hydrogen storage, magnetic and catalytic applications; processing techniques; techniques for retaining the nanocrystalline structure in service.

UNIT V  MICROSTRUCTURE AND PROPERTIES  10
Properties slightly dependent on temperature and grain size; properties strongly dependent on temperature and grain size; strengthening mechanisms; enhancement of available plasticity; grain size evolution and grain size control; Hall-Petch relation, microstructure – dislocation interactions at low and high temperatures; effects of diffusion on strength and flow of materials; methods of enhancing or retarding diffusion; grain boundary sliding and grain boundary migration; current limitations on approaches based on dislocation theory; possibilities for predictive design.

L:45; TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: discuss the concepts of microelectronics and its applications. (K2)
CO2: describe the fabrication processes of different materials. (K2)
CO3: grasp ideas about various sensors. (K2, S1)
CO4: describe the fundamentals and properties of nanomaterials. (K2, A2)
CO5: analyze various microscopic techniques and its evaluation. (K4)

UNIT I OVERVIEW OF MEMS AND MICROSYSTEMS
Definition – historical development – fundamentals – properties, micro fluidics, design and fabrication micro-system, microelectronics, working principle and applications of micro system.

UNIT II MATERIALS, FABRICATION PROCESSES AND MICRO SYSTEM PACKAGING
Substrates and wafers, silicon as substrate material, mechanical properties of Si, Silicon Compounds silicon piezo resistors, Galium arsenide, quartz, polymers for MEMS, conductive polymers. Photolithography, photo resist applications, light sources, implantation, diffusion process exudation – thermal oxidation, silicon diode, chemical vapour deposition, sputtering - deposition by epitaxy – etching – bulk and surface machining – LIGA process Micro system packaging – considerations packaging – levels of micro system packaging die level, device level and system level.

UNIT III MICRO DEVICES AND MATERIALS

UNIT IV SCIENCE OF NANO MATERIALS
Classification of nano structures – effect of the nanometer length scale effects of nano scale dimensions on various properties – structural, thermal, chemical, mechanical, magnetic, optical and electronic properties – effect of nanoscale dimensions on biological systems. Fabrication methods – Top down processes – bottom up process.

UNIT V CHARACTERIZATION OF NANO MATERIALS

L:45; TOTAL: 45 PERIODS

REFERENCES
COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: discuss the preparation techniques of metal-ceramic composites. (K2, S1)
CO2: identify the characteristics and properties of metal based nanocomposites. (K2)
CO3: design and improve the mechanical properties of super hard nanocomposites. (K6, A2)
CO4: design, dimension analysis and electrical properties of fractal based nanocomposites. (K6)
CO5: describe the properties of polymer based nanocomposites. (K2, A3)

UNIT I  NANO CERAMICS  9
Metal-Ceramic composites, Different aspects of their preparation techniques and their final properties and functionality.

UNIT II  METAL BASED NANO COMPOSITES  9
Metal-metal nanocomposites, some simple preparation techniques and their new electrical and magnetic properties.

UNIT III  DESIGN OF SUPER HARD MATERIALS  9
Super hard nanocomposites, its designing and improvements of mechanical properties.

UNIT IV  NEW KIND OF NANO COMPOSITES  9
Fractal based glass-metal nanocomposites, its designing and fractal dimension analysis. Electrical property of fractal based nanocomposites. Core-Shell structured nanocomposites.

UNIT V  POLYMER BASED NANOCOMPOSITES  9
Preparation and characterization of diblock Copolymer based nanocomposites; Polymercarbon nanotubes based composites, their mechanical properties, and industrial possibilities.

L:45; TOTAL: 45 PERIODS

REFERENCES
2. The search for novel, superhard materials- Stan Veprjek (Review Article) JVST A, 1999
15MF19E  OPTIMIZATION TECHNIQUES IN ENGINEERING  

L T P C  
3 2 0 4

COURSE OUTCOMES
Upon completion of this course, the student will be able to

CO1: describe the need and practical applications of engineering optimization(K2)
CO2: solve linear programming problems by different methods(K3,A1)
CO3: solve non linear programming problems by various methods(K3)
CO4: work out the problems on integer & dynamic programming and construct the network for maximal flow & shortest path identification(K5)
CO5: define the concepts of non-traditional optimization techniques(K1,A2)

UNIT I  INTRODUCTION  

UNIT II  CLASSIC OPTIMIZATION TECHNIQUES  

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

UNIT IV  INTEGER AND DYNAMIC PROGRAMMING AND NETWORK TECHNIQUES  

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

L:45; T:30 ;TOTAL: 75 PERIODS

REFERENCES
15MF20E POLYMERS AND COMPOSITE MATERIALS

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe structure, processing and property relationship of polymers.(K2)
CO2: apply the various processing techniques of Polymers.(K3)
CO3: explain the mechanical properties of various fibers.(K2)
CO4: signify the processing techniques of polymer matrix composites.(K2,S2)
CO5: discuss the fabrication techniques of metal and ceramic matrix composites.(K2,S3)

UNIT I PROPERTIES OF POLYMERS 8
Chemistry and Classification of Polymers – Properties of Thermo plastics – Properties of Thermosetting Plastics – Applications – Merits and Disadvantages.

UNIT II PROCESSING OF POLYMERS 9

UNIT III INTRODUCTION TO FIBRES AND COMPOSITE MATERIALS 9
Fibres – Fabrication, Structure, properties and applications - Glass, Boron, carbon, organic, ceramic and metallic fibers whiskers – Matrix materials structure – polymers, – metals and ceramics – Physical and chemical properties

UNIT IV PROCESSING OF POLYMER MATRIX COMPOSITES 9

UNIT V PROCESSING OF METAL MATRIX COMPOSITES AND CERAMIC MATRIX COMPOSITES 10

L:45; TOTAL: 45 PERIODS

REFERENCES
15MF21E RAPID MANUFACTURING

COURSE OUTCOMES
Upon completion of this course, the students will be able to
- CO1: understand the AI concepts and expert systems.(K2)
- CO2: apply the concurrent engineering design in real time applications.(K3)
- CO3: describe various advanced manufacturing concepts.(K2)
- CO4: attain knowledge on product development.(K2)
- CO5: define the principles of modular and rapid tooling.(K1)

UNIT I INTRODUCTION TO CONCURRENT ENGINEERING 9
Extensive definition of CE – CE design methodologies organizing for CE – CE tool box
- collaborative product development – IT support – Solid modeling – Product data
- management – collaborative product – Artificial intelligence – Expert systems –
software hardware co – design.

UNIT II DESIGN STATE 9
Life cycle design of products – opportunity for manufacturing enterprises – modality of
concurrent engineering design – Automated Analysis Idealization control – concurrent
Engineering in optimal structural design – Real time constraints.

UNIT III MANUFACTURING CONCEPTS AND ANALYSIS 9
Manufacturing competitiveness – checking design process – conceptual design
mechanism – qualitative physical approach – An intelligent design for manufacturing
system – JIT system – low inventory – modular fixtures modeling and Reasoning for
computer based Assembly planning – Design of Automated Manufacturing systems.

UNIT IV RAPID PROTOTYPE TOOLING PROCESSES 9
Ed for coessiomn in product development classification of RP systems – Fused
deposition modeling selective laser sintering – stereo lithography systems – laminated
object manufacturing. Solid ground curing – laser engineered net shaping (LENS).

UNIT V MODULAR AND RAPID TOOLING 9
Principle – Thermojet printer, Sander’s model 3D printer, Genisys Xs printer, JP
system object yudra system – In direct rapid tooling , silicon rubber tooling –
aluminium fitted epoxy tooling – spray metal tooling, direct rapid tooling – quick cast
process – copper polyamide, rapid tools sand casting tooling laminated tooling soft
tooling Vs hard tooling.

L:45; TOTAL: 45 PERIODS

REFERENCES
Ver Log 1987.
2. Cleetus. J.,“Design for concurrent Engineering”, Concurrent Engineering
3. Andrew Kusaik, “Concurrent Engineering Automation tools and technology”,
Development”, 1996.
5. Paul P. Jacob, Stereo Lithography and other Rapid Prototyping
COURSE OUTCOMES

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

CO1: discuss the basic concepts of reliability and the aspects of the reliability optimization of systems subjected to failure (K2)
CO2: design for reliability process by taking into account the maintainability considerations that arise at each phase in the life cycle of the system (K6)
CO3: discuss the considerations and requirements for designing equipment and systems to facilitate maintenance (K2)
CO4: describe the various techniques used to optimize the system reliability (K2)
CO5: discuss objectives of packaging, transportation and subsequent storage and the reliability management (K2)

UNIT I CONCEPTS OF RELIABILITY 15

Definition of reliability, reliability Vs quality, reliability function, MTTF, hazard rate function, bathtub curve, derivation of the reliability function, constant failure rate model, time dependent failure models, Weibull distribution, normal distribution- the lognormal distribution.

RELIABILITY OF SYSTEM AND MODELS:
Serial configuration, parallel configuration, combined series parallel systems, system structure function, minimal cuts and minimal paths, Markov analysis, load sharing systems, standby system, degraded systems, three state devices, covariate models, static models, dynamic models, physics of failure models.

UNIT II DESIGN FOR RELIABILITY & MAINTAINABILITY 15

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, optimal, Arinc, Agree, design methods, parts and material selection, derating, stress-strength analysis, failure analysis, identification of failure mode, determination of causes, assessment of effects, classification of severity, computation of criticality index, corrective action, system safety and FTA.

UNIT III DESIGN FOR MAINTAINABILITY 15

Analysis of downtime- the repair time distribution, stochastic point processes, system repair time, reliability under preventive maintenance, state dependent systems with repair, MTTR-mean system downtime, MTR-MH/OH, cost model, fault isolation and self diagnostics, repair Vs replacement, replacement model, proactive, preventive, predictive maintenance, maintenance and spares provisioning, maintainability prediction and demonstration, concepts and definition of availability.

UNIT IV OPTIMIZATION OF SYSTEM RELIABILITY 15

Optimization techniques for system reliability with redundancy, heuristic methods applied to optimal system reliability, redundancy allocation by dynamic programming, reliability optimization by non linear programming.

THE ANALYSIS OF FAILURE DATA AND RELIABILITY TESTING:
Data collection, empirical methods, ungrouped and grouped complete, censored data, static life estimation, test time calculation, burn in testing, acceptance, sequential, binomial testing, accelerated life testing, other acceleration models, experimental design, reliability growth process, idealized growth curve, various growth models, identifying failure and repair distributions.

UNIT V PACKAGING AND TRANSPORTATION FOR RELIABILITY 15

Objectives, preservation-packaging, transportation and subsequent storage, reliability and the customer. Purchase of equipment, installation, commissioning a new system, reliability prediction and control, reliability management, the people concerned with reliability, coordination, training.
REFERENCES
15MF23E ROBOT DESIGN AND PROGRAMMING

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COURSE OUTCOMES
Upon completion of this course, the student will be able to

CO1: discuss the working principle, characteristics and applications of robots.(K2)

CO2: discuss various robot kinematic principles.(K2)

CO3: understand the robot dynamics, static force analysis of robots and trajectory planning.(K2)

CO4: understand the basics of robot programming and AI techniques.(K2)

CO5: illustrate the various functions and applications of robot sensors and actuators.(K3)

UNIT I INTRODUCTION 9
Definition, Need Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors – types, selection applications.

UNIT II ROBOT KINEMATICS 9

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

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.

L:45; TOTAL: 45 PERIODS

REFERENCES
15MF24E  STATISTICAL QUALITY CONTROL  L  T  P  C
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COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe the principles underlying sampling as a means of making inferences about a population(K2)
CO2: construct a control chart to identify the capability of manufacturing process(K6)
CO3: choose proper sampling plan to accept or reject a product lot (K3)
CO4: use statistical tools to characterize the reliability of an item(K3,A1)
CO5: suggest a suitable experimental design to identify the contribution of parameters any process (K6)

UNIT I  SAMPLING THEORY AND TESTING OF HYPOTHESIS  15

UNIT II  STATISTICAL PROCESS CONTROL  15

UNIT III  ACCEPTANCE SAMPLING  15
Lot by lot sampling types – probability of acceptance in single, double, multiple sampling plans – OC curves – Producer’s risk and consumer’s risk. AQL, LTPD, AOQL, Concepts Design of single sampling plan – standard sampling plans for AQL end LTPD – use of standard sampling plans – Sequential sampling plan.

UNIT IV  RELIABILITY AND QUALITY  15

UNIT V  EXPERIMENTAL DESIGN AND TAGUCHI METHOD  15

L:45; T:30; TOTAL: 75 PERIODS

REFERENCES
15MF25E SYNTHESIS AND APPLICATIONS OF NANOMATERIALS

COURSE OUTCOMES
Upon completion of this course, the students will be able to
CO1: describe the synthesis methods of bulk and nano composite materials. (K2,S1)
CO2: analyze various chemical approaches in synthesizing of bulk and nano composite materials(K4)
CO3: discuss various physical approaches in synthesizing of bulk and nano composite materials(K2)
CO4: explain the fundamentals of nano porous materials(K2)
CO5: apply nano materials in various engineering fields(K3,A2)

UNIT I BULK SYNTHESIS
Synthesis of bulk nano-structured materials – sol gel processing – Mechanical alloying and mechanical milling- Inert gas condensation technique – Nano polymers – Bulk and nano composite materials.

UNIT II CHEMICAL APPROACHES
Self-assembly, self-assembled mono layers (SAMs). Langmuir-Blodgett (LB) films, clusters, colloids, zeolites, organic block copolymers, emulsion polymerization, templated synthesis, and confined nucleation and/or growth. Biomimetic Approaches: polymer matrix isolation, and surface-templated nucleation and/or crystallization. Electrochemical Approaches: anodic oxidation of alumina films, porous silicon, and pulsed electrochemical deposition.

UNIT III PHYSICAL APPROACHES
Vapor deposition and different types of epitaxial growth techniques- pulsed laser deposition, Magnetron sputtering - Micro lithography (photolithography, soft lithography, micromachining, e-beam writing, and scanning probe patterning).

UNIT IV NANOPOROUS MATERIALS

UNIT V APPLICATION OF NANOMATERIALS

L:45; TOTAL: 45 PERIODS

REFERENCES