ME 8101 DESIGN OF EXPERIMENTS

L T P **Credits:4**
3 1 0

Unit-I

Introduction: Strategy of experimentation, Some typical applications of experimental design, Basic principles, Guidelines for designing experiments, A brief history of statistical design, Using statistical design in experimentation

Simple Comparative Experiments: Introduction, Basic statistical concepts, Sampling and sampling Distribution, Inferences about the Differences in means, randomized designs, Paired comparison Designs, Inferences about the Variances of Normal Distributions

(12 hrs)

Unit-II

Introduction To Factorial Design: Basic definition and principles, Advantages of factorials, The two factor factorial design, General factorial design, Fitting response curves and Surfaces, Blocking in a factorial design

(12 Hrs)

Unit-III

Fitting Regression Models: Introduction, Linear regression models, Estimate of parameters in linear regression models, Hypothesis testing in multiple regression, Confidence intervals in multiple regression, Prediction of new response observations, Regression model diagnostics, Testing for lack of fit

(12 Hrs)

Unit-IV

Taguchi Method Of Design Of Experiments: Concept design, Parameter design, Tolerance design, Quality loss function, Signal-to- Noise ratio, Orthogonal array experiments, Analysis of Mean (ANOM), Quality characteristics, Selection and testing of noise factors, Selection of control factors, Parameter optimization experiment, Parameter design case study

Analysis of Variance (Anova): Introduction, Example of ANOVA process, Degrees of freedom, Error variance and pooling, Error variance and application, Error variance and utilizing empty columns, the F-test

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Design and Analysis of Experiments	Douglas C Montgomery	John Wiley
Statistical Design and Analysis of Experiments	John P.W.M.	John Wiley
Introduction to Linear Regression Analysis	Montgomery D.C., Runger G. C.,	John Wiley
Response Surface Methodology Process and Product Optimization Using Designed Experiments	Myres R.H. and Montgomery D. C.	Wiley
Introduction to Quality Engineering	Taguchi , G	UNIPUB, White Plains, New York

ME 8102 ADVANCED MANUFACTURING SCIENCE

L T P **Credits:4**
3 1 0

Unit-I

Engineering Materials: Applications and Important Properties of ferrous materials-cast iron, steels and alloy steels, non-ferrous materials-Cu, Al and their alloys. New industrial materials and their properties with special emphasis to composites, Selection of materials

(12 Hrs)

Unit-II

Metal Machining: Tool Geometry, different system of representation, mechanics of orthogonal and oblique cutting, shear angle relation in orthogonal cutting, shear angle & chip flow direction in oblique cutting, chip control methods, analysis of cutting process like turning, drilling, milling. Temp. Distribution at the tool chip interface

(12 Hrs)

Unit-III

Casting Processes: Introduction, Mould and cores, Coating for moulds and cores, Melting of metals, furnaces, cooling and solidifications of metals, mechanism of solidifications, rate of solidification, continuous casting process, Riser Design and its placement, defects in casting, inspection of casting process

(12 Hrs)

Unit-IV

Welding: Introduction, Principle of solid state welding, Heat source, Metal Transfer in Arc Welding, Heat flow characteristics, Gas Metal Reactions, Cooling of fusion weld, weld defects and inspection, Advance welding process, Ultrasonic Welding, Electronic beam welding, Laser beam welding, Explosive Welding, Plasma welding, Development in welding Technology, Some research trends in welding, quality control of weldments

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Manufacturing Science	Ghosh and Malik	EWP
Welding Processes and Technology	R.S. Parmar,	Khanna Publishers
Production Technology	Frnk Kreith	HMT

ME 8103 IT IN MANUFACTURING

L T P **Credits:4**
3 1 0

Unit I

Computer Aided Design: Interaction device and technique, viewing in three dimensions, Geometrical transformations, Modeling and object hierarchy, Raster algorithms display, representation of 3D shapes, Hidden lines, edge and surface removal, Introduction to shading & rendering of surfaces and solids

Computer aided manufacturing: Introduction to conventional and modern manufacturing systems. NC, CNC, DNC systems, functions, their components advantages and disadvantages, Industrial automation, Special purpose machines, Concept of CIM

APT part programming: Fundamentals, geometry, tool motion, post processor and auxiliary statements, application to simple jobs

(12 Hrs)

Unit-II

Adaptive control system: Introduction, types, ACC, ACO area of application, advantages

Group technology: Introduction, part families, various systems of part classification and coding, production flow analysis, Cellular manufacturing, Composite part concept, Machine cell design, application and benefits

Conveyor System: Types of conveyors, Conveyor operation and features

Automated storage and retrieval system AS/RS: Storage system performance, Storage location strategies, Automated storage systems, Automated storage and retrieval system

(12 Hrs)

Unit-III

Robotics: Introduction, History, Definition, Classification, Description of manipulators, Basic motions, Precision of movements, PTP and CP robots, Types of drives, Introduction to robot programming, Robot programming languages, End of arm tooling, Sensors used in robots, Robot safety and economic analysis

(12 Hrs)

Unit-iV

Automated Inspection Quality Control: Inspection fundamentals, Automated inspection, Contact and non contact inspection techniques, Coordinate measuring machines, construction, operation, software, applications and benefits, Surface measurements, machine vision, other optical inspection techniques, non contact non optical inspection techniques

Computer Integrated Manufacturing System: Introduction, Types, machine tool and related equipment, material handling system, Computer control system, Human labor in manufacturing system, role of computers in CIMS, Introduction to CIM software, Benefits of CIMS

ERP, FOF: Computer managing system, Enterprise Resource Planning (ERP), factory of future

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Automation, production systems and computer integrated manufacturing	Groover, M. P	PHI
CAD/CAM Theory & Practice	Zeid, Ibraheim	TMH
Computer Numerical control of machine Tools	Thyer, G.E.	Heinemann
CAD/CAM	Mcmahon & Browne	Adison Wesley

ME 8104 METAL FORMING ANALYSIS & TECHNOLOGY

L T P **Credits:4**
3 1 0

Unit-I

Introduction: Stress-strain relations in elastic and plastic deformations, yield criteria for ductile metals, work hardening and anisotropy in yielding. Flow curves, elements of theory of plasticity, application of theory of plasticity for solving metal forming problems using slab method, upper and lower bound methods, slip line field theory, extremism principles, and effect of temperature and strain rate in metal working

Drawing: Drawing of a flat strip and round bar, determination of drawing load, drawing with wedge shaped dies, cylindrical dies, cylindrical rod drawing with a conical die analysis of the processes and maximum possible reduction

(12 Hrs)

Unit-II

Tube making: Tube making and deep drawing: introduction, plug drawing with a conical die, load determination, tandem drawing of tubes on a mandrel, tube sinking, concept of tube production by rolling and extrusion methods

Exclusion: Extrusion: round bar extrusion through a conical die, flat strip extrusion through dies of constant angles, impact extrusion, and hot extrusion of steels

(12 Hrs)

Unit-III

Rolling: Rolling of flat slabs and strip: Cold rolling and hot rolling, roll-pressure determination, rolling with no external tensions, rolling with front and back tensions

Forging: Forging: Introduction, determination of plain strain compression load, weight friction condition, inclined platen, thin strip, load evaluation for forging a flat circular disc

(12 Hrs)

Unit-IV

Frictions lubrication: Friction and lubrication in metal working, introduction, influences of friction in metalworking processes, lubricants used for different metalworking processes

Unconventional Forming: Introduction to unconventional forming processes like hydrostatic extrusion, hydro-forming of sheets and tubes, powder forming

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Principles of Industrial Metal working Processes.	G. B. Rowe	CBS
Manufacturing Science	Ghosh & Malik	East West
Foundry, forming and welding	P.N. Rao	TMH

ME-8105A ROBOTICS

L T P **Credits:4**
3 1 0

Unit-I

Introduction: Evolution of robot and robotics, laws of robotics, robot anatomy: Links, joints, Degrees of freedom (DOF), Arm configuration, wrist configuration, end-effector
Coordinate Frame, Mapping and Transforms: Coordinate frames, description of objects in space, transformation of vectors, inverting a homogeneous transform, fundamental rotation matrices

(12 Hrs)

Unit-II

Kinematics: Denavit- Hartenberg Notation, kinematic relationship between adjacent links, Manipulator transformation matrix, Inverse kinematics, Linear and angular velocity of a rigid body, velocity propagation along links, manipulator jacobian

(12 Hrs)

Unit-III

Dynamics: Lagrange-Euler Formulation, Newton-Euler Formulation

(12 Hrs)

Unit-IV

Control of manipulators: Position control, Force control: Applications of standard control strategies

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Robotics and Control	Mittal and Nagrath	TMH
Introduction to Robotics	J.J. Craig	Pearson Education
Vector mechanics	Beer and Johnston	TMH
Control System Engineering	Nise	Wiley
Simulation Modeling & Analysis	David Kelton	Tata McGraw Hill

ME-8105B QUALITY ENGINEERING AND MANAGEMENT

L T P **Credits:4**
3 1 0

Unit-I

Introduction: Statistical concepts in quality control, Graphical representation of ground data, Continuous & discrete probability distributions, central limit theorem, Chi-square test, Introduction to quality control, process control and product control, chance and assignable causes of quality variation, advantages of Shewart control charts, process control charts for variables, Fixation of control limits, Type I and Type II errors, Theory of runs, interpretation of out of control points, Probability limits, initiation of control charts, trial control limits, determination of aimed-at value of process setting, rational Method of sub grouping, control chart parameters, control limits and specifications limits, natural tolerance limits, relationship of process in control to upper and lower specifications limits, process capability studies

(12 Hrs)

Unit-II

Control charts: Special control charts for variables, Group control charts, Arithmetic moving X ad R charts, Geometric Moving charts, X control charts with reject limits, Steady trend in process average with cost dispersion, trend chart with sloping limits, variable subgroup size CUSUM or cumulative sum control chart

(12 Hrs)

Unit-III

Sampling plans: Probability theory, hyper-geometric, Binomial and Poisson distributions, Acceptance inspection 100% inspection, no Inspection and sampling inspection, Operating characteristic curve, effect of sample size and acceptance number. Type a and Type B O.C curves, single, Double and multiple sampling plans, Sequential sampling plans Acceptance/rejection ad acceptance/rectification plans, procedure's risk ad consumer's risk, difference quality level, Average outgoing quality curve, average outgoing quality limit, quality protection offered by a sampling plan. average sample number, Design of single, double and sequential plans

(12 Hrs)

Unit-IV

Quality systems: Economics of product inspection. real point, selection of economic sampling plans, Product quality ad reliability, failure data analysis ad life testing, elements of total quality control quality assurance, ISO9000 quality system

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Statistical Quality Control	Grant & Leaveworth	McGraw Hill
Quality Control & Industrial Statistics	Duncan	Irwin Press
Quality Control Handbook	Juran	McGraw Hill
Quality Control	Hansen	Prentice Hall
An Introduction to reliability & control	Thomason	Machinery Publishing
Total Quality Control	A.V. Taylor	McGraw-Hill
Quality Control Systems	J.R. Taylor	McGraw-Hill
TQM	Arora	S.Chand & Co,

ME – 8105C DIAGNOSTIC MAINTENANCE AND MONITORING

L T P **Credits:4**
3 1 0

Unit-I

Introduction: Introduction to maintenance techniques, maintenance Strategies, Classifications (Plant maintenance, Running Maintenance, Shut Down, Emergency corrective, curative, Breakdown, preventive predictive, Reliability, Total productive Maintenance, Guidelines for selecting best strategy

(12 Hrs)

Unit-II

Fault Tree analysis: Fault Tree analysis, Methodology for tree development, Family tree definitions in symbols. Fault Tree construction, fault tree simplification, fault tree evaluation, common cause failure, Probability evaluation in fault trees, Simulation approach

Wear analysis: Wear analysis through Thermo-graphy and Ferro-graphy

(12 Hrs)

Unit-III

Condition Monitoring: Various Techniques of condition Monitoring, condition based Maintenance, visual monitoring, performance monitoring, vibration monitoring, war debris monitoring, Decision elements in condition based maintenance detection, diagnosis, Prescription, Benefits of condition maintenance

(12 Hrs)

Unit-IV

Diagnostic maintenance: Application of diagnostic maintenance to Industrial Machine & plants. Case studies

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Diagnostic maintenance & condition Monitoring	Kelly	Butterworth & Co.
Maintenance and spare parts management	Krishan G	Prentice Hall
Maintenance Engineering Handbook	Higgins	McGraw Hill
RAM in manufacturing	Gandhi & Chawla	Proceedings of SERC, IIT
Engineering Maintenance Management	Nielsel Benjamin	Maries

ME-8105D FINITE ELEMENT METHODS

L T P **Credits:4**
3 1 0

Unit-I

Introduction: Historical Background, Stresses and equilibrium, Boundary Conditions, Strain-Displacement Relations, Stress-Strain Relations, Temperature Effects, Vectors and Matrices

Introduction & Fundamental Concepts: Classification of Differential Equations, Rayleigh-Ritz Method, Galerkin's Method, Point Collocation Method, Least Square Method, Weighted Residual Method, Variational Formulation

(12 Hrs)

Unit-II

1-D FE Modeling: Finite Element Modeling, Coordinates and Shape Functions, Generalized Coordinates, Natural Coordinates in 1D, 2D and 3D, Coordinate Transformation, Assembly of Global Stiffness matrix and Load vector, Properties of Stiffness Matrix, Treatment of Boundary Conditions and Temperature Effects. Truss and Beam Elements

2-D FE Modeling: Finite Element Modeling, Constant Strain Triangle (CST)

(12 Hrs)

Unit-III

2-D FE Modeling: The Four Node Quadrilateral, Numerical Integration, Higher Order Elements; Nine Node Quadrilateral, Eight Node Quadrilaterals, Six Node Triangle

Truss: Introduction, Plane Trusses, Assembly of Global Stiffness Matrix and load vector

Higher-Order Elements: Plate Bending, C^0 and C^1 Elements, Non-conforming Elements and Patch Test

(12 Hrs)

Unit-IV

Scalar Field Problems: Introduction, Steady-state heat transfer, Potential Flow, Fluid Flow in Ducts

Dynamic Considerations: Element Mass Matrices, Evaluation of Eigen Values and Eigen Vectors. (Introduction only)

Computer Implementation: Introduction; Computer Program Organization for Calculation of System Matrices

(12 Hrs)

Recommended Books:

Title	Author(s)	Publisher
Introduction to Finite Elements in Engineering	Chandrupatla and Belegundu	PHI
Finite Element Procedures	Bathe	PHI
An Introduction to Finite Element Method	Reddy	TMH
The Finite Element Methods for Engineers	Huebner	John Wiley
The Finite Element Method	Zienkiewicz	TMH
Finite Element Analysis	Buchanan	McGraw Hill

ME-8201 MECHATRONICS

L T P **Credits:4**
3 1 0

Unit-1

Introduction: The Mechatronics approach: A methodology for integrated design of Mechanical, Electronics, Electrical, Control, computer and Instrumentation

Fundamentals of Electronics and digital circuits: Number systems: Binary, Octal, Hexadecimal, Conversion from Binary to Decimal, Octal and Hexadecimal and vice – versa, Binary arithmetic: Addition, subtraction, Multiplication and division, Boolean Algebra: Laws, De-Morgan's laws, Logic Gates, Truth tables, Karnaugh maps and logic circuits. Generation of Boolean function from truth tables and simplification, Review of semiconductor devices, operational amplifier, Configurations: Inverting, summing, integrating and differentiating, Concepts of digital and analog systems, Digital to analog conversion (DAC): R-2R and summing Op-amp circuit, Analog to digital conversion (ADC): successive approximation method, Programs for DI, DO, DA and AD for PCL 208 card

(12 Hrs)

Unit-II

Sensors and Actuators: Strain Gauge, Potentiometer, Optical encoders: incremental and absolute encoders, Linear variable differential transformer(LVDT), Piezoelectric, Proximity sensor, Resistance Temperature Detector, (RTD), Thermistors, Thermocouple, Hall effect sensor, Permanent Magnet DC motor, Stepper motor

(12 Hrs)

Unit-III

Control systems: Mathematical modeling of physical systems, system equations, controllability and observability, pole placement, PID controller

(12 Hrs)

Unit-IV

Microprocessor and computers: Introduction to 8085 , Architecture, programming, I/O, Computer interfacing, Function of PLC, Architecture, Components of PLC, selection of PLC, Ladder Logic diagram, Logic functions: latching, sequencing, counters, shift registers, jumpers, manipulation of data, arithmetic operations

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Mechatronics	W. Bolton	Pearson Education
Pneumatic system	Majumdar	TMH
Hydraulic and Pneumatic systems	Andrew Parr	TMH
Automation, production systems and computer integrated manufacturing	M.P. Groover	TMH
Mechatronics system design	Shetty and Kolk	Thomson learning
Mechatronics	Mahalik	TMH

ME 8202 ADVANCED MACHINING PROCESSES & ANALYSIS

L T P **Credits:4**
3 1 0

Unit-I

Overview of mechanical removal processes: Introduction, Classification of various modern machining processes. Considerations in process selection, Working principle, selection of processes, Material removal rate, Horn design, process capabilities, applications & limitations of the Ultrasonic machining (USM)

(12 Hrs)

Unit-II

Abrasives water-jet processes: Working principles, mechanism of material removal study and selection of process parameters, machining characteristics, applications & limitations of the following processes, Abrasive jet Machining (AJM), Water jet machining (WJM), Abrasive Flow Machining Process (AFM), Abrasive water jet Machining (AWJM)

(12 Hrs)

Unit-III

Electro chemical processes: Principle of operation, mechanism of material removal, study of equipment and selection of process parameters, process capabilities, tool design applications & limitations of the following processes, chemical machining (CM), Electro chemical machining (ECM). Electrochemical Honing, Electrochemical de-burring, Electro stream and shaped Tube Electrolytic Machining

(12 Hrs)

Unit-IV

Thermal metal removal processes: Thermal energy methods of material processing by Electric Discharge machining (EDM), Electron Beam machining (EBM), Ion-beam machining (IBM), and Laser Beam machining (LBM), .Introduction to new concept of High Speed Machining, Ultra-Precision Machining and hard turning

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Non conventional Machining	P.K. Mishra	Narsoa
Modern machining methods	Pandey & Shan	TMH
Principles of Electrochemical Machining	Mc Geough	Chapman & Hall
Plasma, Electron and Laser beam Technology	Arata. A	ASM
Laser Machining-Theory & Practice	George Chryssolouris	Springer

ME 8203 MODELING AND SIMULATION OF MANUFACTURING SYSTEMS

L T P **Credits:4**
3 1 0

Unit-I

Introduction: Introduction and Overview, concept of system environment, element of systems, system modeling, types of models. Monte Carlo method, system simulation, Simulation-Management Laboratory, Advantages limitations of systems, Simulation of Continuous and Discrete system

Simulation of Continuous system: Characteristics of Continuous System, comparison of Numerical integration with continuous simulation system simulation of integration formula

(12 Hrs)

Unit-II

Simulation of Discrete System: Time flow mechanisms, Discrete and continuous probability density function, Generation of random numbers, Testing of random numbers for randomness and for auto correction, generation of random verities for discrete distribution, generation of random varieties for continuous probability distribution-binomial, normal exponential and beta distribution, combination of discrete event and continuous models.

Simulation of queuing system: Concept of queuing theory, Characteristics of queues, stationary and time dependent queue, queue discipline, time series analysis, measure of system performance, Kendell's notation, auto covariance and auto correlation function, auto correlation effects in queuing system, simulation of single server queues, Multi server queues, queues involving complex arrivals and service times with blanking and reneging

(12 Hrs)

Unit-III

Simulation of inventory system: Rudiments of inventory theory, MRP in progress inventory, Necessity of simulation in inventory problems. Forecasting and regression analysis, forecasting through simulation, generation of Poisson and Erlang variants simulation of complex inventory situations

Design of simulation experiments: Length of run, elimination of initial bias. variance reduction techniques, stratified sampling, antipathetic sampling common random numbers, time series analysis, spectral analysis, model validation, optimization procedures, search methods, single variable deterministic case search, single variable non-deterministic case search, regenerative techniques

(12 Hrs)

Unit-IV

Simulation of PERT: Simulation of –Maintenance and replacement problems, capacity planning production system, reliability

Simulation Languages: Continuous and Discrete simulation languages block structure continuous languages, special purpose simulation languages

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Simulation and Modeling	Loffick	Tata McGraw Hill
System Simulation with Digital Computer	Deo Narsingh	Prentice Hall of India
System Simulation	D.S. Hira	S. Chand & Co.
System Simulation	Gorden	Prentice Hall
Simulation Modeling & Analysis	David Kelton	Tata McGraw Hill

ME – 8204A TOOL AND CUTTER DESIGN

L T P **Credits:4**
3 1 0

Unit-I

Classification of cutting tools: Various machining operations and the tools required to carry out these operations: principle elements of various cutting tools; single point cutting tool geometry in ASA, ORS & NRS systems.

Tool Materials: Properties of cutting tool materials, development of cutting tool materials, composition, production process and application of different cutting tool materials viz. High carbon steel, HSS, carbides, Ceramics, CBN, UCON, diamond, etc.

(12 Hrs)

Unit-II

Design of Single point cutting tools: Cutting parameters of a lathe, different turning operations and cutting tools used for these operations. Classification of single point cutting tools: solid, carbide tipped tools, geometrical parameters of a single point cutting tool, design procedure of single point cutting tool, re-sharpening of single point cutting tools

Form Tools: Purpose and types, design procedure and their sharpening

(12 Hrs)

Unit-III

Drill design: Drilling operations, Cutting parameters of drilling operations, different drilling operations and cutting tools used for these operations, Types of drills, solid, carbide tipped drills, geometrical parameters of a twist drill, design procedure of a twist drill, re-sharpening of the twist drill.

Milling Cutter Design: Milling operations, milling cutting parameters, different milling operations and cutting tools for these operations, Types of milling cutters, solid, and carbide tipped cutter; geometrical parameters of a milling cutter, design procedure of a disc type milling cutter, re-sharpening of the cutters

(12 Hrs)

Unit-IV

Broach design: Broaching operation and its advantages, broaching cutting parameters, types of broaches, solid, and carbide tipped broaches; design procedure of a broach, re-sharpening of the broach.

Hob design: Gear nomenclature, construction of involutes profile, hobbing operation and its advantages, geometrical parameters of a hob, design procedure of a hob

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Tool Design	Donaldson	McGraw Hill
Cutting tools	Prakash Joshi	Wheeler Publishing
Metal Cutting theory & practice	Arschinow & Alearoev	Mir publication

ME – 8204B COMPOSITE MATERIALS & THEIR MANUFACTURING

L T P **Credits:4**
3 1 0

Unit-I

Introduction: General introduction to composites; historical background; concept of matrix and reinforcement and particulates.

Matrix and reinforcement: Types of matrix and reinforcement, volume fraction and weight fraction Fiber architecture fiber packing arrangements, whiskers

(12 Hrs)

Unit-II

Fabrication methods of polymer composites: Liquid resin impregnated routes, pressurized consolidation of resin pre-pegs, consolidation of resin molding compounds, injection molding of thermoplastics, hot press molding of thermoplastics

Fabrication of ceramic composites: Powder based routes, reactive processing, layered ceramic composites, carbon/carbon composites

(12 Hrs)

Unit-III

Fabrication routes of metal matrix composites: Squeeze infiltration, stir casting, spray deposition, powder blending and consolidation, diffusion bonding of foils, PVD

Testing and characterization: Different tests like internal stress measurement by diffraction, metallographic preparation etc with special emphasis to metal matrix composites

(12 Hrs)

Unit-IV

Secondary processing and application of composites: Secondary processing like machining, joining, extrusion of composites; Application and case studies

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Composite materials	S.C.Sharma	Narosa Publishers
Metal matrix composite	R.K.Everret & R.J. Arsenault	Academic press
Introduction to metal Matrix Composite	T. W. Clyne & P. J. Withers	Cambridge press

ME 8204C ADVANCED OPTIMIZATION TECHNIQUES

L T P **Credits:4**
3 1 0

Unit-I

Linear programming: Modelling of linear programming problem – a few examples; Solution of linear programming problem – simplex method, two-phase method, M-method; Sensitivity analysis – graphical approach

(12 Hrs)

Unit-II

Non-linear programming: Convex and non-convex search space, Kuhn-Tucker conditions, Hessian matrix; Transformation of constrained optimization problems into unconstrained ones – penalty function approach; Direct search – variable elimination method, random search method

(12 Hrs)

Unit-III

Integer Programming: Modelling of integer programming problem – a few examples; Solution of integer programming problem – branch & bound algorithm, cutting-plane algorithm; Travelling salesman problem – formulation, solution and practical applications

(12 Hrs)

Unit-IV

Heuristic models: Limitations of traditional optimization approaches to solve real world problems, Population based optimization techniques, Simple genetic algorithms – introduction, representation of variables, fitness function, genetic operators – reproduction, crossover, mutation; Advantages and limitations of population based optimization techniques over the point-to-point based ones

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Operations Research	Taha, H. A.	PHI
Optimization of Engineering Design	Deb, K.	PHI
Operations Research	D.S. Hira, P. K. Gupta	S. Chand
Optimization techniques	Rao	New Age international

ME-8204D CONTROL SYSTEMS IN MANUFACTURING

L T P **Credits:4**
3 1 0

Unit-I

Introduction: Examples of control systems, closed loop and open loop control systems, Laplace transform

Mathematical Modelling of Dynamic systems: Transfer function and impulse response function, block diagrams, signal flow graph, state-space representation

Transient response analysis of first order and second order systems

(12 Hrs)

Unit-II

Time domain analysis and design: Root locus method, Routh stability criteria, effect of poles and zeros on system performance

(12 Hrs)

Unit-III

Frequency domain analysis and design: Bode plot , Nyquist stability criteria, Lag , lead compensation

(12 Hrs)

Unit-IV

Analysis and design in state-space method: Controllability and obervability, pole placement method, examples of control system design using MATLAB

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Modern Control Engineering	K. Ogata	PHI
Automatic Control Systems	B.C. Kuo	PHI
Control System Engineering	Nise	Wiley
Modern Control Systems	Dorf and Bishop	Pearson Education
Modern Control System Theory	M. Gopal	New Age International

ME 8205A MACHINE TOOL DESIGN

L T P **Credits:4**
3 1 0

Unit-I

Design approach: Design requirements of machine tools, A design approach for machine tools. Identification and quantification of objectives and constraints in machine tool design
Power requirements: Estimation of power requirements and selection of motor for metal cutting machine tool spindles

(12 Hrs)

Unit-II

Gearbox design: Design of gearbox, spindle and guide-ways.
Structural design: Principles of design of structural components, namely, head stock, tail stock, carriage, table, knee, column and overarms to achieve desired static & fatigue strength, stiffness, dynamic characteristics and other requirements, Exercises on the design of machine tools using existing CAD software packages

(12 Hrs)

Unit-III

CNC machine design: Introduction to computer integrated manufacturing systems and CNC machine tools

(12 Hrs)

Unit-IV

Design of CNC systems: Design/selection of linear motion systems, ball, screws, CNC feedback devices, controllers, feed drives and servomotors for CNC machine tools. Recent developments in CNC and other machine tools

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Design of Devices and Systems	William H. Middendorf and Richard H. Engelmann	CRC Press
Computer numerical control of machine tools	G. E. Thyer	Heinemann Prof. Publishing
Machine Design Fundamentals: A Mechanical Designers' Workbook	Joseph Edward Shigley and Charles R. Mischke	McGraw Hill
Numerical Control and Computer aided manufacture	Kundra, Rao, Tiwari	Tata McGraw Hill

ME-8205B TRIBOLOGY

L T P **Credits:4**
3 1 0

Unit-I

Introduction: Friction, wear and lubrication, Types of Engg. Contacts: conforming and non-conforming. Types of Motion, rubbing, sliding, oscillating, Rolling and surface of interactions, elastic and plastic deformations, properties of materials, surface energy and flash temp theory

(12 Hrs)

Unit-II

Friction: Law of sliding friction, concept of adhesion, Taylor's model of friction, Measurement of friction.

Wear: Laws of wear, types of wear such as adhesive, declamation, abrasive, fatigue, corrosive, fretting erosive, electrical and oxidative. Measurement of wear in dry atmosphere and different environments preventive, control of wear, wear of cutting tool and dies, study of abrasion in grinding, lapping and honing

(12 Hrs)

Unit-III

Lubricants: Mechanisms of lubricants, boundary, squeeze film hydrodynamic and elasto hydrodynamic and hydrostatic lubricants plasto hydrodynamic lubricants, solution of Reynolds equation in two and three-dimensional flow. Pressure distribution load carrying capacity friction forces in oil film and coefficient of friction in journal bearing. Solid lubricants types and applications

Bearing Design: Design of bearing, Clearance in journal bearing, minimum film thickness, sommar-field number, oil grooves and flow of oil in axial and circumferential grooves cavitations and turbulence in oil bearings, Heat generation and cooling or bearing hydrostatic and dynamic and their applications in machine tools, Design of air bearing ad other gas bearing

(12 Hrs)

Unit-IV

Rolling friction: Reynolds's slip, concept, selection of roller bearings and their methods of lubrication design aspects and modes of bearing failures and also hydrodynamic lubrication

Solid Lubricants: Solid lubricants and its applications in metal forming processes

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
A text book	Sharma & Aggarwal	Kataria
A Machine Design Handbook	Powell	McGraw Hill
Standard handbook of machine design	Shigley, Mischke & Brown	McGraw Hill
Industrial Tribology	Dr.B.S.Prabhu	McGraw Hill

ME 8205C PRODUCT DESIGN & DEVELOPMENT

L T P **Credits:4**
3 1 0

Unit-I

Stages in design process: Introduction to various stages of the design process: Formulation of problem, Generation of alternatives, Evaluation, Guided Redesign. Case study

Product life cycle: New product introduction: early introduction, increased product life. Life cycle management tools: System integration, QFD, House of quality, Pugh's method, Pahl and Beitz method, Case studies

(12 Hrs)

Unit-II

Value engineering: Introduction, nature and measurement of value, Value analysis job plan, Creativity and techniques of creativity, Value analysis test, Case studies

Concurrent/ reverse engineering: Introduction, basic principles, components, benefits of concurrent engineering. Concept of reverse engineering

(12 Hrs)

Unit-III

Material selection: Materials in design, The evolution of engineering materials, Design tools and material data, Function, material, shape and process, Material selection strategy, attribute limits, selection process, computer aided material selection, Case studies

Process selection: Introduction, Process classification: shaping, joining and finishing, Systematic process selection, Ranking, process cost, Computer – aided process selection

(12 Hrs)

Unit-IV

Design for manufacture and assembly: Design for Manufacture and Assembly (DFMA), Reasons for not implementing DFMA, Advantages of DFMA with case studies, Design features and requirements with regard to assembly, production, Design for Manufacture in relation to any two manufacturing processes: machining and injection molding, Need, objectives

Design for 'X': Introduction, Design for: Safety, packaging and storage, quality, reliability, energy conservation, environment, aesthetics, ergonomics, maintenance, recyclability and disposal, Case studies.

Patents, liability and ethics: Introduction, Protecting your design: patents, copyright, basic tools of design protection. Liability issues in product design. Ethical considerations, Examples/ case studies

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
Product Design & Development	Karl T. Ulrich, Steven D. Eppinger	Mc GrawHill
Integrated Product and Process Development	John M. Usher, Utpal Roy and H. R. Parasaei	Tata McGraw Hill
Product Design for Manufacture and Assembly	G. Boothroyd, P. Dewhurst and W. Knight	Marcel Dekker
Product Design and Manufacture	A. K. Chitale and R. C. Gupta	PHI
Selection of Materials and Manufacturing Processes for Engineering Design	Mahmoud M. Farag	Printice Hall
Engineering Design and Design for Manufacturing: A structured approach	John R. Dixon and Corrodo Poli	Field Stone Publishers, USA
Material Selection in Mechanical Design	M. F. Ashby	Elsevier
Concurrent Engineering	Biren Prasad	Prentice Hall

ME 8205D SYSTEM ANALYSIS

L T P **Credits:4**
3 1 0

Unit-I

System Components: The environment and the system concept; system structure; system inputs and outputs; system approach to macro problems; problem definition with system concepts and approach

System Modeling: Model formulation; Representation of dynamics signal and system flow graph; System interactions; System compatibility; Sub-systems and inter-connections; Functional and equipment structuring. Linear graph approach, Time models

(12 Hrs)

Unit-II

System Simulation: Basic philosophy of simulation; Analog and Digital Computers; System with feedback. Continuous and Discrete system simulation

(12 Hrs)

Unit-III

System Dynamics: Dynamic analysis of systems; Dynamic behavior of organization; Total flow of man, information and materials; Dynamic analysis of the models for capital equipment and orders; Derivation of the policies for management based on system models

(12 Hrs)

Unit-IV

Optimization: Optimization of system performance; Perturbation analysis of system parameters; Criteria for optimization, Gradient method; Dynamic programming method

System Design: Elements of Decision analysis; Game theory; Application of game and decision theory to system design. Techniques for creative design; Elementary sensitivity analysis

(12 Hrs)

Recommended Books:

Title	**Author(s)**	**Publisher**
System Engg. Tools	Chestnut,	John Wiley
Design of Engg. Systems	Gosling	John Wiley
System Engg.,	A.D.Hall	Van Nostrand, U.K.
System Engg. Handbook	Machol,	McGraw Hill Inc
Introduction to System Science	G.M.Sandquist	Prentice-Hall
System Modeling and Analysis	Nagrath & Gopal	Tata McGraw Hill
System Simulation	Geoffrey Gordon	Prentice Hall of India
Industrial Dynamics	Forester	MIT Press
Concepts of Engineering System Design	Warren E. Wilson	McGraw Hill,
Realtime System Design and Analysis	P. A. Laplante,	Prentice Hall of India
System Design & Analysis,	Avadh	Galgotia Publishers