# Second Semester

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**Total**
- Total Marks: 1050
- Total Credits: 28
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## BRANCH - MECHANICAL ENGINEERING

### 2nd Semester

**SPECIALIZATION: MACHINE DESIGN / MECHANICAL SYSTEMS DESIGN / SYSTEM DESIGN**

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Total

Total Marks: 1050

Total Credits: 28
### SPECIALIZATION: THERMAL AND FLUID ENGINEERING

#### Second Semester

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<td>2. Design of Material Handling</td>
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<td>4. Machine Tool Technology</td>
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<td>Lab-2 Compute Aided</td>
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## BRANCH - MECHANICAL ENGINEERING

### 2nd Semester

**SPECIALIZATION: MECHANICAL SYSTEM DESIGN & DYNAMICS / DESIGN & DYNAMICS**

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DETAILED SYLLABUS OF SECOND SEMESTER M.TECH 2016-17 ADMISSION BATCH
# BRANCH - MECHANICAL ENGINEERING

## SPECIALIZATION: CAD/CAM

### Second Semester

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<th>University Marks</th>
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<th>Hours/Week</th>
<th>Credit</th>
<th>Practical</th>
<th>Marks</th>
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| **Specialization Core-1**  
Computer Numeric Control Part programming                                   | 4 – 0      | 4      | 100              | 50                  | -          | -      | -         | 150    |
| **Specialization Core-2**  
Computer Integrated Manufacturing                                               | 4 – 0      | 4      | 100              | 50                  | -          | -      | -         | 150    |
| **Elective –I** (Specialization related)                                      | 4 – 0      | 4      | 100              | 50                  | -          | -      | -         | 150    |
| 1. Rapid Prototyping and Manufacturing                                         |            |        |                  |                     |            |        |           |        |
| 2. Mechantronics and Manufacturing Systems and simulation                      |            |        |                  |                     |            |        |           |        |
| 3. Manufacturing Systems and simulation                                         |            |        |                  |                     |            |        |           |        |
| 4. Metrology And Non Destructive Testing                                       |            |        |                  |                     |            |        |           |        |
| **Elective-II** (Departmental related)                                         | 4 – 0      | 4      | 100              | 50                  | -          | -      | -         | 150    |
| 1. Manufacturing Information System                                            |            |        |                  |                     |            |        |           |        |
| 2. Robotics                                                                    |            |        |                  |                     |            |        |           |        |
| 3. Performance Modeling And Analysis of Manufacturing System Performance       |            |        |                  |                     |            |        |           |        |
| **Elective-III** (Departmental Related)                                        | 4-0        | 4      | 100              | 50                  | -          | -      | -         | 150    |
| 1. Design for manufacturing                                                    |            |        |                  |                     |            |        |           |        |
| 2. Design of Material Handling Equipment                                       |            |        |                  |                     |            |        |           |        |
| 3. Management Information System                                              |            |        |                  |                     |            |        |           |        |
| 4. Machine Tool Technology                                                     |            |        |                  |                     |            |        |           |        |
| **Lab-2** Compute Aided Manufacturing Lab                                       |            | 4      |                  |                     | 4          | 4      |           | 150    |
| **Seminar/Project**                                                            |            | 4      |                  |                     | 4          | 4      |           | 150    |
| **Total**                                                                     |            |        |                  |                     |            |        |           |        |
| **Total Marks:** 1050                                                          |            |        |                  |                     |            |        |           |        |
| **Total Credits:** 28                                                          |            |        |                  |                     |            |        |           |        |
COMPUTER NUMERICAL CONTROL PART PROGRAMMING

1. INTRODUCTION:

Basic concepts in manufacturing systems, fundamentals of numerical control advantages of NC systems, Classification of NC systems, point to point and countering systems, incremental and absolute systems, open loop and close loop systems, encoder, punched tape.

2. FEATURES OF NC MACHINE TOOLS: Fundamental of machining, design consideration of NC Machine tools, methods of improving machine accuracy, tool deflection and chatter, lead screw, thermal deformations, increasing productivity with NC machines, machining centers.

3. NC PART PROGRAMMING: Introduction, NC coordinate system, manual part programming, coe and concepts types to tape formats, Tool length and radius compensation, point to point and contour programming examples, caned cycles, Subroutine, MACROS simple problems of drilling, turning, and two-dimensional milling.

4. COMPUTER AIDED PART PROGRAMMING: Advantages of computer aided programming, post processor, APT programming, Geometric statements, motion statements, additional APT statements, simple problems of APT programming.

5. CNC, DNC, AND ADAPTIVE CONTROL: Introduction, problems with conventional NC, principles of operation of CNC, features of CNC, advantages of CNC, direct numerical control, types and functions of DNC, advantages of DNC, Adaptive control machining systems, types, benefits of Adaptive control systems.

Books Recommended:

4. CAD/CAM-M.P.Groover and E.W.Zimmers(PHI)
5. Automation, production systems and CIM-M.P.Groover(P.H.I)
COMPUTER INTEGRATED MANUFACTURING

1. INTRODUCTION:
   Types of production system and their automation. CAD/CAM integration. Concept of FMS and CIMS.

2. ELEMENTS OF A GENERAL CIM SYSTEM:
   Type of the CIM systems. CAD?CAM link for CIMS> Manufacturing data base in a systems, equipment and their functions. Integration of robot in CIMS, Automatic storage and Retrieval system (AS/RS). Carousel, palletization and fixtures in process interfacing of storage with manufacture.


4. COMPUTER AIDED PRODUCTION PLANNING AND CONTROL:
   Inventory control and MRP, Computer aided cost estimation. Computer aided shop floor control, process monitoring, Computer aided inspection and quality control, SQC, SPC.

5. NET WORKING:

6. CIM DATABASE AND DATA BASE MANAGEMENT SYSTEM:
   Types, Management Information system, Manufacturing data preparation. Shop floor data collection systems, shop-floor control, sensors used, tool management system automatic identification systems, Barcode system.

7. CIMS CONFIGURATION:
   DNC based factory management and control, integrated CAD/CAM System and shared data base, Factories of the future. Impact of implementing CIMS on society. Introduction to rapid prototyping and rapid tooling Introduction to the concept of concurrent engineering.
Books Recommended:

8. Dr. Surender Kumar and Dr. A. K. Jha, CAD/CAM, Dhanpat Rai and Sons, New Delhi.
RAPID PROTOTYPING AND MANUFACTURING

Books Recommended:

MECHATRONICS AND MANUFACTURING SYSTEMS


Books Recommended:

MANUFACTURING SYSTEMS AND SIMULATION

COMPUTER MODELING AND SIMULATION SYSTEMS


2. RANDOM NUMBER GENERATION

10 Techniques for generating random numbers - midsquare method - the mid product method - constant multiplier technique - additive congruential method - linear congruential method - tests for random numbers - the Kolmogorov - Smirnov test - the Chi-Square test. 3. RANDOM VARIABLE GENERATION

8 Inverse transform technique - exponential distribution - uniform distribution - Weibull distribution. Empirical continuous distribution - generating approximate normal variates - Erlang distribution. 4. DISTRIBUTION AND EVALUATION OF EXPERIMENTS

10 Discrete uniform distribution - Poisson distribution - geometric distribution - acceptance rejection technique for Poisson distribution gamma distribution.

Simulation Experiments - Variance reduction techniques - antithetic variables - verification and validation of simulation models. Variance reduction techniques - antithetic variables - verification and validation of simulation models. 5. DISCRETE EVENT SIMULATION

9 Concepts in discrete-event simulation, manual simulation using event scheduling, single channel queue, two server queue, simulation of inventory problem. Programming for discrete event systems in GPSS - Case studies

Books Recommended:


Reference Books:

M.Tech (Mechanical Engineering) Syllabus for Admission Batch 2016-17

2nd Semester

METROLOGY AND NON DESTRUCTIVE TESTING


2. STATISTICAL QUALITY CONTROL 9 Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - Realiibility and life testing.  


4. RADIOGRAPHY 9 Sources of ray-x-ray production - properties of d and x rays - film characteristics - exposure charts - contrasts - operational characteristics of x ray equipment - applications.  

5. ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES 9 Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A, B, C scans - Principles of acoustic emission techniques - Advantages and limitations - Instrumentation - applications.  

Recommended Books: 

MANUFACTURING INFORMATION SYSTEMS

1. INTRODUCTION 5 The evolution of order policies, from MRP to MRP II, the role of Production organization, Operations control. 2. DATABASE 7 Terminologies - Entities and attributes - Data models, schema and subschema - Data Independence - ER Diagram - Trends in database. 3. DESIGNING DATABASE 13 Hierarchical model - Network approach - Relational Data model - concepts, principles, keys, relational operations - functional dependence - Normalisation, types - Query languages. 4. MANUFACTURING CONSIDERATION 10 The product and its structure, Inventory and process flow - Shop floor control - Data structure and procedure - various model - the order scheduling module, input / output analysis module the stock status database - the complete IOM database. 5. INFORMATION SYSTEM FOR MANUFACTURING 10 Parts oriented production information system - concepts and structure - computerised production scheduling, on-line production control systems, Computer based production management system, computerised manufacturing information system - case study.

Books Recommended:

DESIGN OF MATERIAL HANDLING EQUIPMENT
(USE OF APPROVED DATA BOOK IS PERMITTED)

1. MATERIALS HANDLING EQUIPMENT 4 Types, selection and applications
3. DRIVES OF HOISTING GEAR 6 Hand and power drives - Travelling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and luffing gear - cogwheel drive - selecting the motor ratings.
4. CONVEYORS 10 Types - description - design and applications of Belt conveyors, apron conveyors and escalators - Pneumatic conveyors, Screw conveyors and vibratory conveyors.
5. ELEVATORS 10 Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaftway, guides, counter weights, hoisting machine, safety devices - Design of form lift trucks.

Books Recommended

Reference books:
PERFORMANCE MODELING AND ANALYSIS OF MANUFACTURING SYSTEM PERFORMANCE

1. MANUFACTURING SYSTEMS & CONTROL

2. MANUFACTURING PROCESSES

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

4. QUEUING NETWORKS
   8 Examples of QN models in manufacturing - Little's law in queuing networks - Tandem queue - An open queuing network with feedback - An open central server model for FMS - Closed transfer line - Closed server model - Garden Newell networks

5. PETRI NETS

Text Books:
**COMPUTER AIDED PROCESS PLANNING**

1. **INTRODUCTION**

The Place of Process Planning in the Manufacturing cycle - Process Planning and Production Planning - Process Planning and Concurrent Engineering, CAPP, Group Technology.

2. **PART DESIGN REPRESENTATION**

Design Drafting - Dimensioning - Conventional tolerancing - Geometric tolerancing - CAD - input / output devices- topology - Geometric transformation - Perspective transformation - Data structure - Geometric modelling for process planning - GT coding - The optizsystem - The MCLASS system.

3. **PROCESS ENGINEERING AND PROCESS PLANNING**

Experienced, based planning – Decision table and decision trees - Process capability analysis - Process Planning - Variant process planning - Generative approach - Forward and Backward planning, Input format, AI.

4. **COMPUTER AIDED PROCESS PLANNING SYSTEMS**

Logical Design of a Process Planning - Implementation considerations -manufacturing system components, production Volume, No. of production families - CAM-I, CAPP, MIPLAN, APPAS, AUTOPLAN and PRO, CPPP.

5. **AN INTERGARATED PROCESS PLANNING SYSTEMS**


**Books Recommended:**

DESIGN FOR MANUFACTURING

1. INTRODUCTION
General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances - Geometric tolerances - Assembly limits - Datum features - Tolerance stacks.

2. FACTORS INFLUENCING FORM DESIGN
Working principle, Material, Manufacture, Design - Possible solutions - Materials choice - Influence of materials on from design - from design of welded members, forgeries and castings.

3. COMPONENT DESIGN-MACHINING CONSIDERATION

4. COMPONENT DESIGN - CASTING CONSIDERATIONS
Redesign of castings based on parting line considerations - Minimising core requirements, machined holes, redesign of cast members to obviate cores.

5. REDESIGN FOR MANUFACTURE AND CASE STUDIES
Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

Books Recommended:

Reference books:
ROBOTICS


Essential Reading:
1. S.R. Deb, *Robotic technology and flexible automation* - TMH.

Supplementary Reading:
MANAGEMENT INFORMATION SYSTEM


2. INFORMATION SYSTEM TAXONOMIES: Transaction processing system, management information systems. Decision support system, Executive information systems. Artificial intelligence, Expert Systems and Office automation system.

3. SYSTEM ANALYSIS AND DESIGN: Information system planning, introduction challenges, strategic issues, selecting systems, project management issues. Methodology and implication of system analysis and design, SDLC, prototyping. End user development, off-the-self software, out sourcing and application software.

4. TOOLS FOR INFORMATION SYSTEM DEVELOPMENT: Structural tools for analysis and design, tools to represent system data and process, tools for structured programming, tools to convert programs specified into code.

5. DATA BASE DESIGN AND MANAGEMENT: Components of DBMS, database models, Principle of DBMS.


7. CLIENT SERVER COMPUTING: Developing, Client server, organizational implication of c/s computing. Information system security and control.

8. ERP: Introduction, concepts, application advantages and disadvantages

Recommended books:
1. Uma G Guptha, Management information systems- a managerial perspective, Galgotia publishers, New Delhi.
2. Edward Yourdon, structured analysis, prentice hall of India, New Delhi.
4. Steve Alter, Management information system Benjamin Cummins, new york.
5. Gerald V post and david L Anderson, Mangement information systems, solving busnisses problem with information technology, Tata Mc-Graw Hills, New Delhi
6. Davis and Olson, management information systems Mc-Graw Hills, New York
7. Jawedkar, management information systems, Tata Mc-Graw Hills, New Delhi
8. Schultheis and sumner, management information system (A management perspective), Tata Mc Graw Hills, New Delhi
9. Landon and Landon, Management Information Systems, Prentice hall of India New Delhi
MACHINE TOOL TECHNOLOGY


Essential Readings:
2. N.K. Meheta, Machine Tool Design, TMH.

Supplementary Reading:
### Second Semester

<table>
<thead>
<tr>
<th>Course Name</th>
<th>Theory</th>
<th>Practical</th>
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<td><strong>Elective –I</strong>&lt;br&gt;Specialization related&lt;br&gt;1. Two-Phase Flow and Heat Transfer.&lt;br&gt;2. Thermal &amp; Nuclear Power Plant.&lt;br&gt;3. Introduction to Computational Fluid Dynamics.&lt;br&gt;4. Computational Methods in Thermal Engineering.</td>
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<td><strong>Elective-II</strong>&lt;br&gt;Departmental related&lt;br&gt;1. Internal Combustion Engine&lt;br&gt;2. Numerical Analysis&lt;br&gt;3. Heat Transfer Equipments.&lt;br&gt;4. Fluid &amp; Gas Dynamics.</td>
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Advanced Engineering Thermodynamics

Module-I

Module-II

Module-III
Compressibility factor, fugacity and activity, computation from the generalized charts, dependence of fugacity and activity on pressure and temperature, chemical – equilibrium. Phase rule – ideal and real solution of gases, liquids, equilibrium system.

Module-IV

Essential Readings:

Supplementary Reading:
Advanced Refrigeration Engineering

Module I
Analysis of refrigeration cycle, principles of psychrometry properties and processes, Air washer, Cooling towers, dehumidifiers, wet bulb and dew point temperatures. Multistage cycle and their optimization.

Module II

Module III
Analysis and thermal design of Refrigeration compressor, condenser, evaporator and flow control devices; Design, Lubrication, charging and testing of refrigeration plants, defrosting capacity control, system component balancing, Design and construction details of unitary refrigeration equipment.

Books
1. Refrigeration and Air Conditioning, C.P.Arora, Tata McGraw Hill
2. Refrigeration and Air Conditioning, Stoecker and Zones, McGraw Hill
3. Refrigeration and Air Conditioning, Domkundwar and Arora, Dhanpat Rai and Sons
4. Refrigeration and Air Conditioning, Manohar Prasad, East West Press
5. Refrigeration and Air Conditioning, P.L.Balaney
TWO-PHASE FLOW AND HEAT TRANSFER

Module-I
Definitions; Review of one-dimensional conservation equations in single phase flows; Governing equations for homogeneous, separated and drift-flux models;

Module-II
Flow pattern maps for horizontal and vertical systems; Simplified treatment of stratified, bubbly, slug and annular flows.

Module-III
Thermodynamics of boiling; Pool boiling- onset of nucleation, heat transfer coefficients, critical heat flux, effect of sub-cooling; Flow boiling- onset of nucleation, heat transfer coefficients, critical heat flux, effect of sub-cooling.

Module-IV
Condensation- Film and Dropwise condensation

Books:
M.Tech (Mechanical Engineering) Syllabus for Admission Batch 2016-17

2nd Semester

Thermal and Nuclear Power Plants

Module I:

Module II:

Module III:

Text Book:

Reference
Introduction to Computational Fluid Dynamics

Introduction: Basic tools of CFD, Numerical Vs experimental tools; Mathematical Behavior of PDEs: Parabolic, Hyperbolic and Elliptic PDEs; Methodology of CFDHT: Discrete representation of flow and heat transfer domain: Grid generation, Governing equations and boundary conditions based on FVM/FDM, Solution of resulting set of linear algebraic equations, Graphical representation and analysis of qualitative results, Error analysis in discretization using FVM/FDM; Solution of 1-D/2-D steady/unsteady: Diffusion problems, Convection problems, Convection-diffusion problems, source term linearization; Explicit and Implicit Approach: Explicit and implicit formulation of unsteady problems, Stability analysis; Solution of Navier-Stokes Equations for Incompressible Flows: Staggered and collocated grid system, SIMPLE and SIMPLER algorithms; Special Topics in CFDHT: Numerical Methodology for Complex Geometry, Multi-block structured grid system, Solution of phase change Problems.

Essential Reading:

Supplementary Reading:
Computational Methods in Thermal Engineering


Supplementary Reading(s):
Advanced Internal Combustion Engines

Module I

Module II

Module III

Books
I.C.Engine, Mathur and Sharma, Dhanpat Rai and Sons
NUMERICAL ANALYSIS

Transcendental and Polynomial equations: Initial approximations, First Degree Equation, Iteration Methods Based on Second Degree equation, Multipoint iteration method, Rate of Convergence, Efficiency of a method.

System of Linear Algebraic Equations: Effects of Round-off Error, Operations Counts, Standard Methods of Solutions, Convergence analysis Eigen values and Eigenvectors Interpolation: Lagrange Polynomial Interpolation, Cubic Spline Interpolation,


Numerical Integration: Trapezoidal and Simpson's Rules, Error Analysis, Integration and Extrapolation, Quadrature.


Text Books:

Reference Books
HEAT TRANSFER EQUIPMENTS


Essential Reading(s):

Supplementary Reading:
FLUID AND GAS DYNAMICS

Euler equation, Bernoulli’s equation, Navier strokes equations, moment of momentum, energy equations, Differential equations of energy, Potential flow theory, Velocity potential, Kinetic energy of irrotational flow, Two – dimensional sinks and sources, a doublet flow around bodies; cylinders, spheres and aerofoils, prediction of velocity and pressure distribution.

Introduction to compressible flow; velocity of sound and mach number, isentropic flow, flow with friction and heat transfer, analysis of flows with normal shock waves.

Ref. Books:
5. Shapiro: Compressible Fluid flow (Mc-Graw Hill Publication)
1. Radhakrishnan: Gas Dynamics (PHI)
HEAT EXCHANGER ANALYSIS & DESIGN


Essential Reading:


Supplementary Reading:

Renewable Energy Systems

Module I

Module II
Hot water system, practical consideration, solar ponds, Non-convective solar pond, extraction of thermal energy and application of solar ponds. Wind energy: The nature of wind. Wind energy resources and modeling. Geothermal energy: Origin and types of geothermal energy and utilization.

Module III

Books

Reference
Hydel Power and Wind Energy

Module I:
Elements of hydropower scheme, hydropower development in India. Power house structures and Layout. Hydropower plants classification: Surface and underground power stations, Low-medium-high head plants-layout and components, pumped storage plants. Load and power studies: load curve, load factor, load duration curve, firm capacity, reservoir capacity, capacity factor

Module II:
Hydraulic turbines and types and classification, constructional features, selection, characteristic curves, governing of turbine, drafts tubes-types, hydraulic principles. Gates and valves types. Penstock and surge tanks. Wind machine types, classification, parameters. Wind measurements, data presentation, power in the wind. Wind turbine aerodynamics, momentum theories, basic aerodynamics, airfoils and their characteristics

Module III:
Horizontal Axis Wind Turbine (HAWT) - Blade Element Theory, wake analysis, Vertical Axis Wind Turbine (VAWT) aerodynamics. HAWT rotor design considerations, number of blades, blade profile, 2/3 blades and teetering, coning, power regulation, yaw system, tower. Wind turbine loads, aerodynamic loads in steady operation, wind turbulence, static - dynamic - fatigue analysis, yawed operation and tower shadow, WECS control system, requirements and strategies. Wind Energy Conversion System (WECS) sitting, rotor selection, Annual Energy Output (AEO). Synchronous and asynchronous generators and loads, integration of wind energy converters to electrical networks, inverters. Testing of WECS.
Text Books

1. Water Power Engineering: M.M. Desmukh, Dhanpat Rai and Sons

Reference Books

1. Water power Development: Mosonyi
Advanced Fluid Mechanics

Description of fluid flow: with reference to translation, rotation and deformation concept of continuum, control mass & control volume approach, Reynolds transport theorem. Steady flow and uniform flow. Velocity field, one & two-dimensional flow analysis, circulation and vorticity, stream function and velocity potential function, potential flow, standard flow patterns, combination of flow patterns, flow net. Dimensional Analysis as a tool in design of experiments, identification of non-dimensional numbers and their significance, dimensional analysis methods.


References:
3. Fox R.W., Pitchard P.J, and McDonald A “Fluid Mechanics” Wiley India.
## BRANCH - MECHANICAL ENGINEERING

**SPECIALIZATION: MACHINE DESIGN / MECHANICAL SYSTEMS DESIGN / SYSTEM DESIGN**

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<th>Course Name</th>
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<td>Mechanics of Composite Materials</td>
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<td>Fatigue, Creep &amp; Fracture</td>
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<td>2. Bearing and Lubrication</td>
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<td>3. Basic Mechanical Handling systems</td>
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<td>4. Analysis and synthesis of Mechanism</td>
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**Total**

Total Marks: 1050

Total Credits: 28
MECHANICS OF COMPOSITE MATERIALS

Classification and characterization of composite materials; fibrous, laminated and particulate composites; laminae and laminates; manufacture of laminated fiber reinforced composite material. Macromechanical behaviour of lamina; stress strain relations, engineering constraints for orthotropic materials. Stress strain relations for lamina of arbitrary orientation. Strength and stiffness of an orthotropic lamina; Biaxial strength theories. Micromechanical behavior of laminae. Rule of mixtures. Micromechanical behaviour of laminates: single layered configurations, symmetric laminates, anti-symmetric laminates, known symmetric laminates; strength of laminates; Interlaminar stresses; Design of laminates. Buckling and vibration of laminated beams, plates and shells.

Text Books:

Reference Books:
FATIGUE, CREEP AND FRACTURE

Fatigue: Types of fatigue loading and failure, Fatigue test, endurance limit; Fatigue under combine stresses; Influence of stress concentration on fatigue strength, Notch sensitivity, Factors influencing fatigue behavior.

Creep: Creep-stress-time temperature relations, Mechanics of creep in tension, bending, torsion, creep buckling. Members subjected to creep and combined stresses.


Text Books

Reference Books
Finite Element Methods


Suggested books:
BEARING & LUBRICATION


Lubricants: Friction control and wear prevention, Characterization, types and selection, effects and testing of lubricants. Mechanisms of fluid flow : Reynolds equations and its applications to infinite long and short journal bearings and its limitations

Lubrications: Reigms; Hydrodynamics, Hydrostatics, Elastohydrodynamic lubrication, etc.

Bearing Design and design considerations

Text Books

Reference Books
5. Engineering Tribology - Prasant Sahoo, PHI Pvt. Ltd.
BASIC MECHANICAL HANDLING SYSTEMS

Objectives and Principles of Material Handling. Classification of handling equipment. Quantitative techniques for analysis of material flow.

Design of basic elements like wire ropes, chain hooks, shackles, grab, lifting electro-magnets, pulleys, sheaves, sprokets, drums, arresting gears, buffers, limit switches, rope tackle and pulley blocks, various power transmission units like gearing, belting, winches, capstans etc.

Kinematics analysis and basic design procedure of various forms of conveying and elevating equipments like scrapes, conveyors, Belt conveyor, Belt Chain, Bucket elevators, Enmasses chain conveyor, Overhead chain conveyors, crew and Ribbon conveyors, electric hoists, jibcranes, EOT cranes, Gantry cranes, Mobile Cranes etc.

Text Books
2. Conveying Machines (Vol I & II) - A.O.Spivakovsky, & V.K. Dyachkav. MIR Publication

Reference Books
ANALYSIS AND SYNTHESIS OF MECHANISMS

Basic concepts of kinematics and mechanisms-type, number and dimensions, kinematic pairs, chains and inversions, accuracy point and error analysis, velocity and acceleration analysis of different complex mechanism(I, II & III), gross motion in the 4-bar mechanisms, static and dynamic force analysis of mechanisms; Synthesis of coordinated positions, synthesis of mechanism to trace a curve or path generation, synthesis for function generation; Dimensional synthesis, method of approach and optimization of a solution; Equivalent and conjugate linkages, four bar chains, copular curves, Robert's Law chebycheve's polynomials, path curvature Euler-Savary equation, Polode curvature.; Planer and spatial problems, graphical and analytical methods, finite displacements, analytical design of 4-bar mechanisms for coordinated motion.; Cams: synthesis of cam profiles, advanced cam curves, dynamic analysis, accuracy analysis and design of cams; Gears and gyroscopes: Elements of different secondary space curves, conjugate action, general mechanism, noncircular sensors, dynamics of gears, Gyrodynamics, gyroscopic actions in machines.

Essential Reading:
OPTIMUM DESIGN OF MECHANICAL SYSTEMS

Basic concepts: Unconstrained and constrained problems. The Kuhn-Tucker conditions; Function of one variable, Polynomial approximation, Golden section method. Finding the bounds on the solution, a general strategy for minimizing functions of one variable; Unconstrained functions of n variables: Zero order, first-order and second-order methods, convergence criteria; constrained functions of n variables: linear programming, Sequential unconstrained minimization techniques, Direct Methods; Approximation techniques; Duality; General design application.

Text Books
1. Optimization for Engineering Design - K. Deb, PHI, 2005

Reference Books
Introduction to Optimization - J.C. Panth, Jain Brothers Publication, New Delhi, 1983
ROBOTICS


Essential Reading:

1. S.R. Deb, Robotic technology and flexible automation - TMH.

Supplementary Reading:

MATERIALS SELECTION IN MECHANICAL DESIGN

Module I (12 hours)

Introduction: Materials properties – chemical, physical, mechanical, dimensional; Materials categories; Design process, conceptual design, embodiment design, detail design; Ideology of optimization, materials selection charts.

Performance indices: Performance, objective function, constraints, performance index; Calculational Model, Measure of Performance, Equations for constrained variables; Design-fixed parameters, free parameters.

Optimization of selection without considering shape effects: Recipe for optimization, Applying performance indices to selection charts; Primary constraints; Reality Check; Case studies – mirrors for large telescopes, table legs, structural materials for buildings, flywheels, springs, elastic hinges and couplings, pressure vessels, Vibration effects, stiff and high damping materials; Thermal effects, insulations, solar heating, heat exchangers.

Module II (14 hours)

Manufacturing and process selection: Classification of manufacturing processes, review of shaping, joining and finishing processes, Strategy for processes selecting, translation, screening, ranking; Selection charts, process-material matrix, process-shape matrix, mass bar-chart, thickness bar-chart, tolerance and surface-roughness bar-charts; Manufacturing cost; Case studies: forming a fan, fabricating a pressure vessel, economical casting.

Multiple Constraints in Materials Selection – Overconstrained Design: Decision matrices, selection stages, coupling equations, value functions; Multiple Selection Stage Method, Active Constraint Method, Coupling Equation Method; CES Software; Fully determined design; Massively overconstrained designs; Conflicting objectives, penalty functions and exchange constants; Case studies – shipbuilding, con-rods for high-performance engines, windings for high-field magnets, casing for mini-disk player or cell phone, disk-brake caliper.

Module II (10 hours)

Optimization of selection considering shape effects: Shape factors, Microscopic or micro-structural shape factors; Limits to shape efficiency, stiffness-limited design, strength-limited design, material indices that include shape, elastic bending of beams and twisting of shafts, failure of beams and shafts, co-selection of material and shape; Case studies – choosing
optimal I-beam, spars for man-powered planes, ultra-efficient springs, forks for a racing bicycle.

*Designing hybrid materials*: Families of configurations of hybrid materials - composites, sandwiches, lattices and segmented; method “A+B+configuration+scale”; Anisotropy; Case studies – metal matrix composites, refrigerator walls, natural materials.

**Text book**

1. M. F. Ashby, MATERIALS SELECTION IN MECHANICAL DESIGN, Third Edition

**Reference books**

EXPERIMENTAL STRESS ANALYSIS

Basic elasticity theory. Strain Measurement Methods: Various types of strain gauges, Electric Resistance strain gauges, semiconductor strain gauges, strain gauge circuits, transducer applications, recording instruments for static and dynamic applications.

Photoelasticity: Theory of photoelasticity, Analysis techniques, Three dimensional photoelasticity, Reflection Palanscope and application.


Text Books:

Reference Books:
MACHINE VIBRATION

Characterization of Engineering vibration problems. Model study through single degree of freedom analysis. Two degrees and Multi degree of freedom system with application. Continuous medium, Vibration measuring instruments, computational techniques like matrix iterations, Transfer Matrix method and other methods, Lagrange’s Mechanics, system simulation technique.

Text Books

Reference Books
NUMERICAL ANALYSIS

Transcendental and Polynomial equations: Initial approximations, First Degree Equation, Iteration Methods Based on Second Degree equation, Multipoint iteration method, Rate of Convergence, Efficiency of a method.

System of Linear Algebraic Equations: Effects of Round-off Error, Operations Counts, Standard Methods of Solutions, Convergence analysis Eigen values and Eigenvectors

Interpolation: Lagrange Polynomial Interpolation, Cubic Spline Interpolation,


Numerical Integration: Trapezoidal and Simpson's Rules, Error Analysis, Integration and Extrapolation, Quadrature.


Text Books:

Reference Books
MACHINE LEARNING

Module: 1
Introduction, Linear classification, perceptron Update rule, perceptron convergence, generalization, Maximum margin classification, Classification errors, regularization, Logistic regression, linear regression.

Module: 2
Estimator bias and variance, active learning, on linear prediction, kernel, kernel regression, and Support vector machines (SVM) and kernels, kernel optimization and model selection, Model selection criteria.

Module: 3
Description length ,Feature selection, Combining classifiers, boosting margin and complexity, Margin and generalization, mixture models ,Mixture and expectation maximization,(EM) algorithm, Regularization.

Module: 4
Clustering and Spectral Clustering,Markov models, Hidden Markov Models(HMM),Bayesian Networks, Learning Bayesian Networks, Probabilistic inference, Collaborative filtering.

Text book(s):


Reference Book(s):

Computer Aided Design


Suggested books:

## BRANCH - MECHANICAL ENGINEERING

**SPECIALIZATION: MECHANICAL SYSTEM DESIGN & DYNAMICS / DESIGN & DYNAMICS**

### Second Semester

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<td>3. Mechatronics</td>
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<td>4. Analysis and Design of Smart Materials and Structure</td>
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<td>3. Finite Element Method in Engineering</td>
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Vibration of Structures


Text Books:

1. Walter C. Hurty & Moshe F. Rubinstein, “dynamic of structures”, PHI,

Reference Books:

1. Tees, Mores and Hincle, Mechanical vibrations and it’s applications, Students Edition.
DYNAMICS OF ROTORS


Text Books:


Reference Books:

1. Dynamics of Rotor Bearings Systems – M. J. Goodwin. Unwin Hyman
**ACOUSTICS**

Fundamentals of vibration, vibrations of continuous systems (strings, rods, beams and membranes), one dimensional wave equation, initial values and boundary conditions, acoustic wave equation, concept of impedance, sound radiation from simple sources, near field and far field, directivity of sources, sound waves in pipes standing waves and travelling waves, resonances, wave guides, lumped parameter modeling of acoustic systems, transmission of sound through partitions, dynamics of microphones and speakers, room acoustics, sound in enclosures (cylinders).

**Recommended Books:**

MACHINE FAULT DIAGNOSTICS AND SIGNAL PROCESSING


Text Books:

Reference Books
MECHATRONICS

Fundamental of Mechatronics: Definition and concepts of Mechatronics, Conventional system vs. mechatronic system, Need and Role of Mechatronics in Design, Manufacturing and Factory Automation. Hardware components for Mechatronics Number system in Mechatronics, Binary Logic, Karnaugh Map Minimization, Transducer signal conditioning and Devices for Data conversion programmable controllers. ; Sensors and Transducers: An introduction to sensors and Transducers, use of sensor and transducer for specific purpose in mechatronic. ; Signals, systems and Actuating Devices: Introduction to signals, systems and control system, representation, linearization of nonlinear systems, time Delays, measures of system performance, types of actuating devices selection. ; Real time interfacing: Introduction, Element of a Data Acquisition and control system, overview of the I/O process. Installation of the I/O card and software. ; Application of software in Mechatronics: Advance application in Mechatronics. Sensors for conditioning Monitoring, Mechatronic Control in Automated Manufacturing, Micro sensors in Mechatronics. Case studies and examples in Data Acquisition and control. Automated manufacturing etc.

Text Books:

1. C.W. De Silva, Mechatronics: An Integrated Approach, Publisher: CRC;
Analysis & Design of Smart Materials and Structures

Introduction to smart materials and their applications; coupled field systems; hysteresis typical of smart structures and systems; limit analysis; analysis of standard forms of the smart components such as cables, wires, axial members, beams, frames, etc; analysis of smart structural systems such as VGTS, material selection and design of structural members.

REFERENCES

1. Engineering analysis of smart material systems , Donald J. Leo, John Wiley Sons.
2. Smart material systems: model development, R.C. Smith, SIAM.
FINITE ELEMENT METHODS IN ENGINEERING


Text Books:


BEARING AND LUBRICATION

Introduction-Historical background, Bearing concepts and typical applications. Viscous flow concepts-Conservation of laws and its derivations: continuity, momentum (N-S equations) and energy, Solutions of Navier-Stokes equations. Order of magnitude analysis, General Reynolds equation-2D and 3D (Cartesian and Cylindrical), Various mechanisms of pressure development in an oil film, Performance parameters. ; Boundary Layer Concepts-Laminar and turbulent flow in bearings, mathematical modeling of flow in high-speed bearings. Elastic Deformation of bearing surfaces-Contact of smooth and rough solid surfaces, elasticity equation, Stress distribution and local deformation in mating surfaces due to loadings, methods to avoid singularity effects, Estimation of elastic deformation by numerical methods-Finite Difference ; Method (FDM), Governing equation for evaluation of film thickness in Elasto Hydrodynamic Lubrication (EHL) and its solution, Boundary conditions. Development of computer. ; Programs for mathematical modeling of flow in bearings, Numerical simulation of elastic deformation in bearing surfaces by FDM.

Text Books:

1. B.C.Majumdar, Introduction to Tribology of Bearings.
2. Dr S.P.Srivastava, Lubricants Additives & Tribology, 2008, Tech book international,New Delhi
VIBRATION AND SHOCK ISOLATION

Vibration under general forcing conditions: Response under general periodic force, Periodic force of irregular from and non-periodic force response spectrum (for Base excitation, Earthquake response spectra and design under a shock environment) response to irregular forcing conditions using numerical methods, Vibration Control: Vibration monograph, and vibration criteria, reduction of vibration at the source, Balancing of rotating machines, whirling of rotating shaft, Balancing of reciprocating engines, controls of vibration and natural frequencies. Vibration Isolation: Vibration isolation systems with rigid foundation, isolation of science of vibration from surroundings, vibration isolation system with flexible foundation and with partially flexible foundation, shock isolation, active vibration control, vibration absorbers both damped and undamped.

Text Books:-

2. Theory of Vibrations with applications W. T. Thomason, CBS Publication
3. Mechanical Vibration- J. S. Rau and K. N. Gupta, New-Age intimation
Computer Graphics & Visualization


Text Books


Reference Books

1. AutoCAD 2002 - New Riders, Techmedia

Robotics and Automation


Recommended Books:

2. Industrial Robotics/Groover M P /Pearson Edu.
3. Robotics and Control/Mittal R K &Nagrath I J / TMH.
5. Robotic Engineering / Richard D. Klafter,
Random Vibrations & Failure Analysis

Introduction, Fundamentals of probability theory: probability space, random variables, functions of random variables, Stochastic processes and random signals: stationarity, ergodicity, power spectrum, covariance functions, calculus of random processes, Linear single and multi degree of freedom structural systems: input-output relations, time domain and frequency domain analysis, linear and nonlinear systems, the fokker-Planck equation, Computational issues, Level crossing and first passage times, extreme value and peak distributions, Applications: random fatigue, probabilistic crack growth, risk analysis.

REFERENCES

Experimental Stress Analysis


Text Books:


Reference Books:


Nonlinear Vibration

Introduction, Linear vibration, Free vibrations of undamped systems with nonlinear restoring forces, Free oscillations with damping and the geometry of integral curves – a) study of singular points, b) applications using the notion of singularities, Forced oscillations of systems with nonlinear restoring force, self sustained oscillations – a) free oscillations, b) forced oscillations in self-sustained systems, Hill’s equation and its application to the study of the stability of nonlinear oscillations.

Text Books:


Reference Books:


## BRANCH - MECHANICAL ENGINEERING

### SPECIALIZATION: PRODUCTION ENGINEERING/PRODUCTION ENGINEERING & OPERATIONAL MANAGEMENT

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<tr>
<th>Course Name</th>
<th>Hours/Week</th>
<th>Credit</th>
<th>University Marks</th>
<th>Internal Evaluation</th>
<th>Hours/Week</th>
<th>Credit</th>
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<td>Non-Traditional Machining</td>
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<td>Rapid Prototyping and Tooling</td>
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<td>3. Theory of Plastic Deformation</td>
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<td>4. Finite Element Methods in Engineering</td>
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**Total**

Total Marks: 1050

Total Credits: 28
Non-Traditional Machining


Reference Book:

1. Advanced Machining Processes by Hassan Abdel- Gawad E l- Hofy Tata McGraw Hill,
5. P K Mishra, Non Conventional Machining, Narosa India publication
Rapid Prototyping and Tooling

Review of solid modeling techniques with comparison advantages and disadvantages, basic principal of RP processes, classification of RP processes various industrial RP systems like stereo lithography, fused deposition modeling, selective Laser Sintering, Laminated object manufacturing, 3D printing, Ballistic particle modeling etc, roll of rapid prototyping and rapid tooling in product development and simultaneous engineering. Process planning for rapid prototyping, STL file generation defects in STL files and repairing algorithm, slicing and various slicing procedures, accuracy issues in rapid prototyping, strength of RP parts, surface roughness problem in rapid prototyping, part deposition orientation and issues like accuracy, surface finish, build time, support structure, cost etc, rapid tooling techniques such as laminated metallic tooling, direct metal laser sintering, vacuum casting. Introduction to reverse engineering, integration of reverse engineering and rapid prototyping.

Text Book:

Reference Book
Advanced Decision Modeling Techniques


Text Book:
1. Operations Research - Fredrick S. Hillter and Gerald J. Liebumana, 2nd Ed. (Chap. 5, 6, 7, 14, 15, 16, 17 and 18)
Metal Forming Technology

Technological advances in metal forming process- forging, rolling, extrusion, wiredrawing and sheet metal forming, design of roll pass and rolling schedules, description of typical cold rolling and hot rolling mill plants computer aided die design for forging, extrusion and wiredrawing, automation in metal forming processes, recent development in forming equipment(high speed presses etc) advances in sheet metal forming, sheet metal die design, formability evaluation, unconventional forming process like hydrostatic extrusion, high energy rate forming process, hydro forming of sheets and tubes, power forming, finite element simulation of forming processes.

Text Books
Computer Aided Design & Computer Integrated Manufacturing

Introduction to CAD/CAM, representation of curves, surfaces and solids for CAD/CAM applications, computational geometry for manufacturing, product design for manufacture and assembly, computer aided process planning, computer aided assembly planning, computer aided inspection and reverse engineering, manufacturing processes simulation, virtual and distributed manufacturing, computer integrated manufacturing.


Text Books:
1. Automation, Production systems & Computer Integrated Manufacturing - M.P. Groover, PHI.
2. CAD, CAM & CIM - P. Radhakrishna and V. Raju, New Age International

Reference Books:
(1) Principles of CAD/CAM/CAE - Kunwoolee.
(2) Computer aided design and manufacturing –Farid M.L a mirouche.
METROLOGY AND NON DESTRUCTIVE TESTING


2. STATISTICAL QUALITY CONTROL  Data presentation - Statistical measures and tools - Process capability - Confidence and tolerance limits - Control charts for variables and for fraction defectives - Theory of probability - Sampling - ABC standard - Realibility and life testing.


4. RADIOGRAPHY  Sources of ray-x-ray production - properties of d and x rays - film characteristics - exposure charts - contrasts - operational characteristics of x ray equipment - applications.

5. ULTRASONIC AND ACOUSTIC EMISSION TECHNIQUES  Production of ultrasonic waves - different types of waves - general characteristics of waves - pulse echo method - A, B, C scans - Principles of acoustic emission techniques - Advantages and limitations - Instrumentation - applications.

Recommended Books:

Composite Materials


Text Books:

QUALITY ENGINEERING AND RELIABILITY


Essential Reading:
1. Freund and Miller, Statistics for engineering and scientists by PHI
2. Quality Engineering using Robust design by M/s Phadke, Prentice Hall.

Supplementary Reading:
3. L.S. Srinath, Reliability Engineering by EWP.
Theory of Plastic Deformation

True stress-strain curve, Bauschinger effect, theory of plasticity, empirical equations to strain, strain curves, three dimensional stress and strain, invariants of stress and strain Yield criteria of metals, Treasca and Von Mises theory, Pandtl Reuss and Levy-Mises stress-strain relations work handling. Plastic instability application to rods in tension, thin walled pipes spherical shells subjected to internal pressure circular natural diaphragm. Equilibrium approach, concepts of friction in metal forming column friction and constants shear friction factor. Application of stress equilibrium approach to extrusion, drawing, rolling and forging, Discipline field theory, application to frictionless flat punch and wedge indentation, simple solution for frictionless extrusion and drawing. Upper and lower bound theorems, application plane-strain problems, simple indentation and extrusion using hodographs.

Text Books:
1. Plasticity for mechanical Engineering - Johnson, Von Nostrand. (Chap.1, 2, 4, 5, 10,12,13)

Reference Books:
1. An introduction to the principles of Metal working - Rowe, Edward Arnold, 1968
2. Metal Forming Processes and Analysis -Avitzur, TMH, 1977
PRODUCTION MANAGEMENT

Introduction to Production Management: Role of production/operation management, Decision making in production/operation management cost models. Analytical methods: System concepts-analytical methods in production/operation. Design of Production System: Design of production and services distribution and facility location processes and job design layout of physical facilities line. Production planning and control: Demand for casting and operation-aggregate planning.

Text Book:
Quantitative Techniques in Production Management

Frequency distribution, measure and central tendency-comparing of mean, median and mode, Measuring variability, Probability-introductory ideas, probability distributions, Sampling and sampling distribution, estimation, testing hypothesis, chi-square and analysis of variance, Simple regression and correlation, multiple regression and modeling techniques, non-parametric methods, time series, Linear programming, Simplex method, Transportation problems, assignment problems.

Text Book:
Modern Production Management - Buffa, 5th Ed, John Wiley

Reference Books:
Production & Operation Management –Strategies &Tactics (Quantitative Methods and Applied Statistics)
Alternative Energy


Text Books:

Reference Books:
MACHINE FAULT DIAGNOSTICS AND SIGNAL PROCESSING


Text Books:

Reference Books
Finite Element Methods in Engineering


Suggested books:
TRIBOLOGY


Text:
1. E. I. Radzimogky – Lubrication of bearing (John Willey)
### Second Semester

#### Course Name

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<th>Internal Evaluation</th>
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**Total Marks:** 1050  
**Total Credits:** 28
Advanced Engineering Thermodynamics


Essential Readings:

Supplementary Reading:
Advanced Fluid Mechanics

Description of fluid flow: with reference to translation, rotation and deformation concept of continuum, control mass & control volume approach, Reynolds transport theorem. Steady flow and uniform flow. Velocity field, one & two-dimensional flow analysis, circulation and vorticity, stream function and velocity potential function, potential flow, standard flow patterns, combination of flow patterns, flow net. Dimensional Analysis as a tool in design of experiments, identification of non-dimensional numbers and their significance, dimensional analysis methods.


References:
3. Fox R.W., Pitchard P.J, and McDonald A “Fluid Mechanics” Wiley India.
Advanced Refrigeration Engineering

Module I
Analysis of refrigeration cycle, principles of psychrometry properties and processes, Air washer, Cooling towers, dehumidifiers, wet bulb and dew point temperatures. Multistage cycle and their optimization.

Module II

Module III
Analysis and thermal design of Refrigeration compressor, condenser, evaporator and flow control devices; Design, Lubrication, charging and testing of refrigeration plants, defrosting capacity control, system component balancing, Design and construction details of unitary refrigeration equipment.

Books
2. Refrigeration and Air Conditioning, Stoecker and Zones, McGraw Hill
3. Refrigeration and Air Conditioning, Domkundwar and Arora, Dhanpat Rai and Sons
4. Refrigeration and Air Conditioning, Manohar Prasad, East West Press
5. Refrigeration and Air Conditioning, P.L.Balaney
Gas Turbine & Jet Propulsion

Introduction, application, shaft power gas dynamics – Compressibility effect, steady one dimensional compressible flow of a perfect gas in a duct, isentropic flow in a constant area duct with friction, normal shock waves, oblique shock wave, isentropic two dimensional, supersonic expansion and compression; Centrifugal fans Blowers and Compressors: Principle of operations, work done and pressure rise, slip factor, diffusers, compressibility effects, non dimensional qualities for plotting compressor characteristics. Bray ton cycle, regeneration and reheating cycle analysis; Axial flow fans and compressors: Elementary theory, degree of reaction, three dimensional flow, simple design methods, blade design, calculation of stage performance, overall performance, and compressibility effects. Performance characteristics. ; Combustion system: Form of combustion, important factors affecting combustion chamber design, combustion processes, combustion chamber performance, practical problem. ; Axial flow turbines: elementary theory, vortex theory, choice of blade profile, pitch and chord; estimation of stage performance, he cooled turbine. ; Prediction of performance of simple gas turbines: component characteristic, off design shaft gas turbine, equilibrium running gas generators, off design o free turbine and jet engine, methods of displacing the equilibrium, running line, incorporation of variable pressure losses, methods of improving part load performance, matching procedure for twin spool engines, behavior of gas turbine.Gas turbine rotors and stresses.

Supplementary Reading:
1. J.E Lee, Theory and design of stream and gas turbine.
2. Cohen & Rogers, Gas Turbines
Introduction to Computational Fluid Dynamics

Introduction: Basic tools of CFD, Numerical Vs experimental tools; Mathematical Behavior of PDEs: Parabolic, Hyperbolic and Elliptic PDEs; Methodology of CFDHT: Discrete representation of flow and heat transfer domain: Grid generation, Governing equations and boundary conditions based on FVM/FDM, Solution of resulting set of linear algebraic equations, Graphical representation and analysis of qualitative results, Error analysis in discretization using FVM/FDM; Solution of 1-D/2-D steady/unsteady: Diffusion problems, Convection problems, Convection-diffusion problems, source term linearization; Explicit and Implicit Approach: Explicit and implicit formulation of unsteady problems, Stability analysis; Solution of Navier-Stokes Equations for Incompressible Flows: Staggered and collocated grid system, SIMPLE and SIMPLER algorithms; Special Topics in CFDHT: Numerical Methodology for Complex Geometry, Multi-block structured grid system, Solution of phase change Problems.

Essential Reading:

Supplementary Reading:
Computational Methods in Thermal Engineering


Supplementary Reading(s):
TWO-PHASE FLOW AND HEAT TRANSFER

Module-I
Definitions; Review of one-dimensional conservation equations in single phase flows; Governing equations for homogeneous, separated and drift-flux models;

Module-II
Flow pattern maps for horizontal and vertical systems; Simplified treatment of stratified, bubbly, slug and annular flows.

Module-III
Thermodynamics of boiling; Pool boiling- onset of nucleation, heat transfer coefficients, critical heat flux, effect of sub-cooling; Flow boiling- onset of nucleation, heat transfer coefficients, critical heat flux, effect of sub-cooling.

Module-IV
Condensation- Film and Dropwise condensation

Books:
GAS DYNAMICS

Module I:
Fundamental Aspects of Gas Dynamics: Introduction, Isentropic flow in a stream tube, speed of sound, Mach waves; One dimensional Isentropic Flow: Governing equations, stagnation conditions, critical conditions, maximum discharge velocity, isentropic relations; Normal Shock Waves: Shock waves, stationary normal shock waves, normal shock wave relations in terms of Mach number;

Module II:
Oblique Shock Waves: Oblique shock wave relations, reflection of oblique shock waves, interaction of oblique shock waves, conical shock waves; Expansion Waves: Prandtl-Meyer flow, reflection and interaction of expansion waves, flow over bodies involving shock and expansion waves; Variable Area Flow: Equations for variable area flow, operating characteristics of nozzles, convergent-divergent supersonic diffusers; Adiabatic Flow in a Duct with Friction: Flow in a constant area duct, friction factor variations, the Fanno line;

Module III:
Flow with Heat addition or removal: One-dimensional flow in a constant area duct neglecting viscosity, variable area flow with heat addition, one-dimensional constant area flow with both heat exchanger and friction; Generalized Quasi-One-Dimensional Flow: Governing equations and influence coefficients, solution procedure for generalized flow with and without sonic point; Two-Dimensional Compressible Flow: Governing equations, vorticity considerations, the velocity potential, linearized solutions, linearized subsonic flow, linearized supersonic flow, method of characteristics.

Essential Reading:

Supplementary Reading:
HEAT EXCHANGER ANALYSIS & DESIGN


Essential Reading:

Supplementary Reading:
Aircraft & Rocket Propulsion


Supplementary Reading:

Cryogenic Technology


Essential Reading:

Supplementary Reading:
Advanced Internal Combustion Engines

Module I

Module II

Module III

Books
I.C.Engine, Mathur and Sharma, Dhanpat Rai and Sons
VISCOS FLUID FLOW

Preliminary concepts; Conservation of mass, momentum and energy; Exact solutions of the viscous flow equations: Couette flows, Poiseuille flow through ducts, unsteady duct flows; Laminar boundary-layers: integral analysis and similarity solutions; Laminar free shear flows: jet, wake, and plume; Stability of laminar flows; Turbulent flow: fundamentals, Reynolds-averaged equations, velocity profile in wall-bound flows, turbulent flow in pipes and channels, turbulent free-shear flows (jet, wake, and plume); Turbulence modelling: zero, one, and two equation models of turbulence; Numerical methods.

Books:

WIND ENERGY CONVERSION

Sources and characteristics of wind, selection of site, wind resource assessment, power in the wind; classification of wind turbines, horizontal and vertical axis wind turbines, wind turbine aerodynamics, applications—wind diesel systems, wind farms, wind pumps and offshore wind turbines; turbine airfoils and rotor wakes, operational characteristics; structural considerations, wind turbine acoustics, electric power systems, economic assessment, environmental and social issues.

Books: