## MECHANICAL ENGINEERING

### PAPER I

(Choose Any ONE Subject)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Sub Name</th>
<th>Sub code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ADVANCED MECHANICS OF SOLIDS</td>
<td>ME101</td>
</tr>
<tr>
<td>2</td>
<td>FINITE ELEMENT METHOD</td>
<td>ME102</td>
</tr>
<tr>
<td>3</td>
<td>MATERIAL TECHNOLOGY</td>
<td>ME103</td>
</tr>
<tr>
<td>4</td>
<td>MECHANICS OF COMPOSITE MATERIALS</td>
<td>ME104</td>
</tr>
<tr>
<td>5</td>
<td>NON-DESTRUCTIVE EVALUATION</td>
<td>ME105</td>
</tr>
<tr>
<td>6</td>
<td>FUELS, COMBUSTION AND ENVIRONMENTAL POLLUTION CONTROL</td>
<td>ME106</td>
</tr>
<tr>
<td>7</td>
<td>CONVECTIVE HEAT AND MASS TRANSFER</td>
<td>ME107</td>
</tr>
<tr>
<td>8</td>
<td>NON-CONVENTIONAL SOURCES OF ENERGY</td>
<td>ME108</td>
</tr>
<tr>
<td>9</td>
<td>ADVANCED THERMODYNAMICS</td>
<td>ME109</td>
</tr>
<tr>
<td>10</td>
<td>QUALITY ENGINEERING IN MANUFACTURING</td>
<td>ME110</td>
</tr>
<tr>
<td>11</td>
<td>WORK STUDY AND I.E PRACTICE</td>
<td>ME111</td>
</tr>
<tr>
<td>12</td>
<td>COMPUTER INTEGRATED MANUFACTURING</td>
<td>ME112</td>
</tr>
<tr>
<td>13</td>
<td>THEORY OF METAL CUTTING AND TOOL DESIGN</td>
<td>ME113</td>
</tr>
<tr>
<td>14</td>
<td>METAL FORMING PROCESSES</td>
<td>ME114</td>
</tr>
</tbody>
</table>

### PAPER-II

(Choose any one subject)

<table>
<thead>
<tr>
<th>S.No</th>
<th>Sub Name</th>
<th>Sub Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>COMPUTATION FLUID DYNAMICS</td>
<td>ME201</td>
</tr>
<tr>
<td>2</td>
<td>CAD THEORY AND PRACTICE</td>
<td>ME202</td>
</tr>
<tr>
<td>3</td>
<td>EXPERIMENTAL STRESS ANALYSIS</td>
<td>ME203</td>
</tr>
<tr>
<td>4</td>
<td>MECHANICAL VIBRATIONS</td>
<td>ME204</td>
</tr>
<tr>
<td>5</td>
<td>ADVANCED OPTIMIZATION TECHNIQUES</td>
<td>ME205</td>
</tr>
<tr>
<td>6</td>
<td>APPLIED SOLAR ENERGY</td>
<td>ME206</td>
</tr>
<tr>
<td>7</td>
<td>DESIGN OF HEAT TRANSFER EQUIPMENT</td>
<td>ME207</td>
</tr>
<tr>
<td>8</td>
<td>REFRIGERATION EQUIPMENT &amp; CONTROLS</td>
<td>ME208</td>
</tr>
<tr>
<td>9</td>
<td>I.C ENGINES &amp; ALTERNATE FUELS</td>
<td>ME209</td>
</tr>
<tr>
<td>10</td>
<td>INTELLIGENT MANUFACTURING SYSTEMS</td>
<td>ME210</td>
</tr>
<tr>
<td>11</td>
<td>LOGISTICS AND SUPPLY CHAIN MANAGEMENT</td>
<td>ME211</td>
</tr>
<tr>
<td>12</td>
<td>SIMULATION AND MODELLING</td>
<td>ME212</td>
</tr>
<tr>
<td>13</td>
<td>SPECIAL MANUFACTURING PROCESSES</td>
<td>ME213</td>
</tr>
<tr>
<td>14</td>
<td>PRODUCTION AND OPERATIONS MANAGEMENT</td>
<td>ME214</td>
</tr>
</tbody>
</table>
ADVANCED MECHANICS OF SOLIDS

Unit I
Shear center: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections

Unit II
Unsymmetrical bending: Bending stresses in Beams subjected to Nonsymmetrical bending; Deflection of straight beams due to nonsymmetrical bending.

Unit III

Unit IV
Torsion: Linear elastic solution; Prandtl elastic membrane (Soap-Film) Analogy; Narrow rectangular cross Section; Hollow thin wall torsion members, Multiply connected Cross Section.

Unit V
Contact stresses: Introduction; problem of determining contact stresses; Assumptions on which a solution for contact stresses is based; Expressions for principal stresses; Method of computing contact stresses; Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact, Normal and Tangent to contact area.

Unit VI
Two Dimensional Elasticity Problems: Plane stress & Plain strain-Problems in Rectangular Co-ordinates, bending of cantilever loaded at the end, bending of a beam by uniform load.

Unit VII
Two Dimensional Elasticity Problems: in polar co-ordinates, general equations in polar coordinates, stress distribution symmetrical about an axis, pure bending of curved bars, displacements for symmetrical stress distributions, rotating discs.

Unit VIII
Introduction to Three Dimensional Problems: Uniform stress stretching of a prismatical bar by its own weight, twist of circular shafts of constant cross section, pure bending of plates.

Reference book:
3. Advanced strength of materials by Den Hortog J.P.
5. Strength of materials & Theory of structures (Vol I & II) by B.C Punmia
Subject Code : ME102

FINITE ELEMENT METHOD

UNIT – I  Formulation Techniques: Methodology, Engineering problems and governing
differential equations, finite elements, Variational methods-potential energy method, Raleigh
Ritz method, strong and weak forms, Galerkin and weighted residual methods, calculus of
variations, Essential and natural boundary conditions.

UNIT – II One-dimensional finite element methods: Bar elements, temperature effects.
Element matrices, assembling of global stiffness matrix, Application of boundary conditions,
Elimination and penalty approaches, solution for displacements, reaction, stresses,
temperature effects, Quadratic Element, Heat transfer problems: One-dimensional,
conduction and convection problems. Examples: - one dimensional fin,

UNIT – III Trusses: Element matrices, assembling of global stiffness matrix, solution for
displacements, reaction, stresses, temperature effects.

UNIT – IV Beams and Frames: Element matrices, assembling of global stiffness matrix,
solution for displacements, reaction, stresses.

UNIT – V Two dimensional problems: CST, LST, four nodded and eight nodded
rectangular elements, Lagrange basis for triangles and rectangles, serendipity interpolation
functions. Axisymmetric Problems: Axisymmetric formulations, Element matrices, boundary
conditions. Heat Transfer problems: Conduction and convection, examples: - two-
dimensional fin.

UNIT – VI Isoparametric formulation: Concepts, sub parametric, super parametric
elements, numerical integration.

UNIT – VII Finite elements in Structural Dynamics: Dynamic equations, eigen value
problems, and their solution methods, simple problems.

UNIT – VIII Convergence: Requirements for convergence, h-refinement and p-refinement,
complete and incomplete interpolation functions, pascal’s triangle.

Reference Books:
1. Finite element methods by Chandrubatla & Belagondu.
5. K. J. Bathe, Finite element procedures, Prentice-Hall

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MATERIAL TECHNOLOGY

UNIT I:
Elasticity in metals and polymers, mechanism of plastic deformation, role of dislocations, yield stress, shear strength of perfect and real crystals, strengthening mechanism, work hardening, solid solution, grain boundary strengthening

UNIT II:
Poly phase mixture, precipitation, particle, fiber and dispersion strengthening, effect of temperature, strain and strain rate on plastic behavior, super plasticity, deformation of non crystalline material.

UNIT III:
Griffith’s Theory, stress intensity factor and fracture Toughness, Toughening Mechanisms, Ductile and Brittle transition in steel, High Temperature Fracture, Creep, Larson : Miller Parameter, Deformation and Fracture mechanism maps.

UNIT IV:
Fatigue, Low and High cycle fatigue test, Crack Initiation and Propagation mechanism and Paris Law, Effect of surface and metallurgical parameters on Fatigue, Fracture of non:metallic materials, fatigue analysis, Sources of failure, procedure of failure analysis.

UNIT V:
Motivation for selection, cost basis and service requirements, Selection for Mechanical Properties, Strength, Toughness, Fatigue and Creep.

UNIT VI:
Selection for Surface durability, Corrosion and Wear resistance, Relationship between Materials Selection and Processing, Case studies in Materials Selection with relevance to Aero, Auto, Marine, Machinery and Nuclear Applications.

UNIT VII:
MODERN METALLIC MATERIALS : Dual Phase Steels, Micro alloyed, High Strength Low alloy (HSLA) Steel, Transformation induced plasticity (TRIP) Steel, Maraging Steel, Intermetallics, Ni and Ti Aluminides, Smart Materials, Shape Memory alloys, Metallic Glass, Quasi Crystal and Nano Crystalline Materials.

UNIT VIII:

TEXT BOOKS:

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MECHANICS OF COMPOSITE MATERIALS

Unit – I  Basic concepts and characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.


Unit – III  Micromechanics: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.

Unit – IV  Coordinate transformations: Hooke’s law for different types of materials, Hooke’s law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off - axis, stiffness modulus, off - axis compliance.

Unit – V  Elastic behavior of unidirectional composites: Elastic constants of lamina, relation ship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

Unit – VI  Strength of unidirectional lamina: Micro mechanics of failure, Failure mechanisms, Strength of an orthotropic lamina, Strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micro mechanical predictions of elastic constants.

Unit – VII  Analysis of laminated composite plates
Introduction, thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

Unit – VIII  Manufacturing methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM.

Reference Books:

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Subject Code: ME105

NON - DESTRUCTIVE EVALUATION


Unit – IV  Introduction to Ultrasonic Testing: Generation of ultrasonic waves, Horizontal and shear waves, Near field and far field acoustic wave description, Ultrasonic probes-straight beam, direct contact type, Angle beam, Transmission/reflection type, and delay line transducers, acoustic coupling and media,


Unit – VI  Holography: Principles and practices of Optical holography, acoustical, microwave, x-ray and electron beam holography techniques.

Unit – VII  Applications - I: NDT in flaw analysis of Pressure vessels, piping

Unit – VIII  Applications - II: NDT in Castings, Welded constructions, etc., Case studies.

Text books:

1. Ultrasonic testing by Krautkramer and Krautkramer
2. Ultrasonic inspection & Training for NDT : E. A. Gingel, Prometheus Press,
3. ASTM Standards, Vol 3.01, Metals and alloys
**FUELS, COMBUSTION AND ENVIRONMENTAL POLLUTION CONTROL**

**UNIT I:** Fuels:- Detailed classification-Conventional and unconventional, solid, liquid, gaseous fuels – Coal-carbonization, Gasification and liquefaction – Lignite; Petroleum based fuels- problems associated with low calorific value gases.

**UNIT II:** Coal gas, Blast furnace gas, Alcohols, Biogas and Nuclear fuels.


**UNIT IV:** Environmental considerations:- Air pollution – Effects on environment, human health, etc., Principal pollutants – Legislative measures – Methods of emission control.

**UNIT IV:** Environmental segments, Natural cycles of environment, Atmospheric structure, Green house effect, Ozone hole, Effect of pollution on living systems, Minimum national standards.

**UNIT V:** AIR POLLUTION - Sources and classification of pollutants, Effect of air pollution, Pollution from industries, Chemical reactions in a contaminated atmosphere, urban air pollution, Acid rain, Photo chemical smog, Meteorological aspects of air pollution. Air pollution sampling and measurement, Air pollution control methods and equipment.


**UNIT VII:** SOLID WASTE MANAGEMENT - Sources and classification, Public health aspects, methods of collection, Disposal methods, Potential methods of disposal.

**UNIT VIII:** NOISE POLLUTION - Human acoustics, Sound and its general features, Noise and its measurement, Noise pollution hazards & Controlling methods.

**Textbooks:**
8. Energy Technology - S.Rao and B.B.Parulekar /Khanna publishers

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CONVECTIVE HEAT & MASS TRANSFER.

CONVECTIVE HEAT TRANSFER:

1. Introduction to convection, review of conservation equations - Forced convection in laminar flow - Exact and approximate solutions of Boundary layer energy equation for plane isothermal plate in longitudinal flow - problems.


3. Approximate analysis of laminar free convective heat transfer on a vertical plate-external flows-correlations-problems.


MASS TRANSFER:

5. Definitions of concentration and velocities relevant to mass transfer, Fick's law, species conservation equation in different forms.

6. Steady state diffusion in dilute solutions in stationary media, transient diffusion in dilute solutions in stationary media, one dimensional non dilute diffusion in gases with one component stationary.

7. Convective mass transfer - governing equations-forced diffusion from flat plate-Dimension less correlation's for mass transfer.

8. Simultaneous heat and mass transfer - analogy between heat, mass and momentum transfer.

REFERENCES BOOKS:

1. Heat transfer - J. P. Holman.
2. Heat and Mass transfer- R.C. Sachdeva

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Subject Code : ME108

NON-CONVENTIONAL SOURCES OF ENERGY


3. OCEAN THERMAL ENERGY: Ocean thermal energy sources, Ocean thermal energy power plant development, Closed and open cycles. Advantages and operating difficulties.

4. TIDAL & WAVE ENERGY: Tidal power sources, Conventional and latest design of tidal power system, The ocean wave, Oscillating water column (Japanese) and the Dam, Atol design.


6. FUEL CELL ENERGY: Description, properties and operation of fuel cells, Major components & general characteristics of fuel cells, Description of low power fuel cell systems, portable fuel cell systems. Indirect methanol fuel cell systems. Phosphoric acid fuel cell systems and molten carbonate fuel cell systems.

7. PHOTO VOLTAIC ENERGY: solar cells. Photovoltaic conversion efficiency, Performance characteristics of solar cells as a function of light intensity, temperature and cell area, Solar cell response under normal condition, solar cell arrays, energy calculation of solar cells, Methods of concentration.


BOOKS:
7. Energy technology Hand Book: EdD.M.Considine
ADVANCED THERMODYNAMICS

1. BASIC CONCEPTS: Thermodynamics - Temperature and zeroth law of thermodynamics - first law of thermodynamics - limitations of first law - concept of internal energy - second law of thermodynamics - concept of entropy.


3. GENERALIZED RELATIONS: Generalized relation for Cp, Cv, K and β - relations for internal energy and enthalpy - the various Tds equation - clapeyron equation - gas tables - enthalpy and internal energy - pressure ratio - volume ratio - change of entropy - Introduction to third law of thermodynamics.


6. NON RELATIVE GAS MIXTURES: Introduction - basic definitions for gas mixtures - PVT relations ship for mixtures of ideal gases - properties of mixtures of ideal gases - entropy change due to mixing - mixtures of perfect gases at different initial pressure and temperatures.


REFERENCE BOOKS:
1. Advanced Thermodynamics: Van Wyllan, TMGH
2. Engineering Thermodynamics: P.K.Nag, TMGH
QUALITY ENGINEERING AND MANUFACTURING

UNIT-I

Quality value and Engineering: An overall quality system, quality engineering in production design, quality engineering in design production processes.

UNIT-II

Loss function and quality level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances (N-type-, S-type and L-type)

UNIT-III

Tolerance Design and Tolerancing: Functional limits, tolerance design for N-type, L-type and S-type characteristics, tolerance allocation for multiple components.

UNIT-IV

Parameter and tolerance design: Introduction to parameter design, signal to noise ratios, parameter design strategy, Introduction to tolerance design, tolerance design using the loss function, identification of tolerance design factors.

UNIT-V

Design of Experiments: Introduction, Task aids and Responsibilities for DOE process steps, DOE process steps description.

Analysis of variance (ANOVA): no-WAY anova, One-way ANOVA, two-way ANOVA, Critique of F-test, ANOVA for four level factors, multiple level factors.

UNIT-VI

Orthogonal Arrays: Typical test strategies, better test strategies, efficient test strategies, conducting and analyzing an experiment.

UNIT-VII

Interpolation of experimental results: Interpretation methods, percent contribution, estimating the mean

UNIT-VIII

ISO-9000 Quality system, BDRE,6-sigma, benchmarking, quality circles-brain storming-fishbone diagram-problem analysis.

REFERENCE BOOKS:

3. Taguchi methods explained: Practical steps to Robust Design/Papan
WORK STUDY AND IE PRACTICES

1. Introduction to work study – work study and its benefits.


4. Principles of Motion Economy, Ergonomic design of tools and equipment.

5. Functions of Industrial Engineering I.E. Department in relation to other departments Organizing IE department.


7. Planning, training methods, identification of training needs, designing and evaluation of training programmes.


Reference Books

1. “Work Study” by H.O
2. Method Study” by Krish Pennather
3. “Motion and Time Study” by Harec, Ralph M
4. “Industrial Engineering Hand Book” by Maynard
5. “Industrial Health Engineering Hand Book”
COMPUTER INTEGRATED MANUFACTURING

1. **Introduction:** Fundamental concepts in Manufacturing and Automation, Automation Strategies, Economic analysis in production, fundamentals of CAD / CAM, product cycle and CAD/CAM,

2. **Automation and CAD/CAM:** Scope of CIM, Automated flow lines, Transfer mechanisms, methods of Line balancing.

3. **Conventional Numerical control:** Introduction- basic components of an NC system-the NC procedure- NC coordinate system, NC motion control system- application of numerical control- Economics of Numerical control.

4. **NC part programming:** Introduction - part programming methods - Computer assisted part programming, APT Language, macro statement in APT. NC programming with manual data input.

5. **Computer controls in NC:** NC controllers’ technology - Computer Numerical Control (CNC), Direct Numerical control (DNC), Adaptive control machining systems: Adaptive control optimization, Adaptive control constraint.

6. **Group Technology:** Part families, parts classification and coding, production flow analysis, Composite part concept, Machine cell design, benefits of GT.

7. **Flexible Manufacturing Systems:** Components of FMS, FMS Work stations, Material Handling Systems, and Computer Control system, FMS layout configurations and benefits of FMS.


**Text books:**
3. CNC machines – Adithan and Pabla,New Age Publications
4. Computer Automated Manufacturing - David Bed Worth
5. Understanding CAD/CAM by DAVID J.Bowman

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THEORY OF METAL CUTTING AND TOOL DESIGN

UNIT I:
Mechanics of Metal Cutting: Geometry of Metal Cutting Process, Chip formation, Chip Thickness ratio, radius of chip curvature, cutting speed, feed and depth of cut - Types of Chips, Chip breakers.

UNIT II:
Orthogonal and Oblique cutting processes-definition, Forces and energy calculations (Merchant’s Analysis).- Power consumed – MRR – Effect of Cutting variables on Forces, Force measurement using Dynamometers.

UNIT III:
Single Point Cutting Tool: Various systems of specifications, single point cutting tool geometry and their inter-relation. Theories of formation of built-up edge and their effect, design of single point contact tools throwaway inserts.

UNIT IV:
Multipoint Cutting Tools: Drill geometry, design of drills, Rake & Relief angles of twist drill, speed, feed and depth of cut, machining time, forces, milling cutters, cutting speed & feed – machining time – design - from cutters.

UNIT V:
Grinding: Specifications of grinding of grinding wheel, mechanics of grinding, Effect of Grinding conditions on wheel wear and grinding ratio. Depth of cut, speed, machining time, temperature, power.

UNIT VI:
Tool Life and Tool Wear: Theories of tool wear-adhesion, abrasive and diffusion wear mechanisms, forms of wear, Tool life criteria and machinability index.

UNIT VII:
Types of sliding contact, real area of contact, laws of friction and nature of frictional force in metal cutting. Effect of Tool angle, Economics, cost analysis, mean co-efficient of friction.

UNIT VIII:
Cutting Temperature: Sources of heat in metal cutting, influence of metal conditions. Temperature distribution, zones, experimental techniques, analytical approach. Use of tool-work thermocouple for determination of temperature. Temperature distribution in Metal Cutting

REFERENCE BOOKS:
2. Fundamentals of Machining - Boothryd / Edward Arnold publishers Ltd.
3. Metal cutting theory and cutting tool design -V. Arshinov and G. Alekseev / Mir Publishers, Moscow
4. Fundamentals of Metal cutting and Machine tools -B.L.Juneja, G. S. Sekhom and Nitin Seth / New Age International publishers
METAL FORMING PROCESSES

UNIT I:
Fundamentals of Metal Forming: Classification of forming processes, mechanism of metal forming, temperature of metal working, hot working, cold working, friction and lubricants.

UNIT II:
Rolling of metals: Rolling processes, forces and geometrical relationship in rolling, simplified analysis, rolling load, rolling variables, theories of cold and hot rolling, problems and defects in rolling, torque and power calculations.

UNIT III:
Forging: Classification of forging processes, forging of plate, forging of circular discs, open die and closed-die forging, forging defects, and powder metallurgy forging.

UNIT IV:
Extrusion: Classification, Hot Extrusion, Analysis of Extrusion process, defects in extrusion, extrusion of tubes, production of seamless pipes.

UNIT V:
Drawing: Drawing of tubes, rods, and wires: Wire drawing dies, tube drawing process, analysis of wire, deep drawing and tube drawing.

UNIT VI:
Sheet Metal forming: Forming methods, Bending, stretch forming, spinning and Advanced techniques of Sheet Metal Forming, Forming limit criteria, defect in formed parts. Advanced Metal forming processes: HERF, Electromagnetic forming, residual stresses, in-process heat treatment, computer applications in metal forming.

UNIT VII:
Press tool design: Design of various press tools and dies like piercing dies, blanking dies, compound dies and progressive blanking dies, design of bending, forming and drawing dies.

UNIT VIII:
Jigs and Fixture design: Principles of location, six-point location principle, clamping elements and methods.

Reference Books:

2. Principles of Metal Working / Sunder Kumar
4. Principles of Metal Working processes / G.W. Rowe
5. ASM Metal Forming Hand book.

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Subject Code: ME201

COMPUTATIONAL FLUID DYNAMICS


Unit – II Solution methods: Solution methods of elliptical equations – finite difference formulations, interactive solution methods, direct method with Gaussian elimination.
Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

Unit – III  Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations.
Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

Unit – IV  Formulations of incompressible viscous flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

Unit – V  Treatment of compressible flows: potential equation, Eluer equations, Navier-Stokes system of equations, flowfield-dependent variation methods, boundary conditions, example problems.

Unit – VI  Finite volume method: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

Unit – VII  Standard variational methods - 1: Linear fluid flow problems, steady state problems.


Text Books:


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Subject Code: ME202

CAD THEORY AND PRACTICE

UNIT I: CAD TOOLS:
Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas of CAD, Modeling and viewing, software documentation, efficient use of CAD software.

UNIT II: GEOMETRIC MODELLING:
Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Bezier curves B-splines rational curves.

UNIT III: SURFACE MODELING:
Mathematical representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

UNIT IV: PARAMETRIC REPRESENTATION OF SYNTHETIC SURFACES –
Hermite Bi-cubic surface, Bezier surface, B-Spline surface, COONs surface, Blending surface, Sculptured surface, Surface manipulation – Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

UNIT V: GEOMETRIC MODELLING-3D:
Solid modeling, Solid Representation, Boundary Representation (B-rep), Constructive Solid Geometry (CSG).

UNIT VI:
CAD/CAM data Exchange: Evaluation of data – exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF.

UNIT VII: DESIGN APPLICATIONS:
Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly.


REFERENCE BOOKS:
3. CAD/CAM / P.N.Rao / TMH.
4. CAD CAM: Principles, Practice and Manufacturing Management / Chris Mc Mohan, Jimmie Browne / Pearson edu. (LPE)

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EXPERIMENTAL STRESS ANALYSIS

Unit – I Introduction: Theory of Elasticity, Plane stress and plane strain conditions, Compatibility conditions. Problems using plane stress and plane strain conditions, Three-dimensional stress strain relations.

Unit – II Strain Measurement Methods: Various types of strain gauges, Electrical Resistance strain gauges, semiconductor strain gauges, strain gauge circuits

Unit – III Recording Instruments: Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.

Unit – IV Brittle coatings: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

Unit – V Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometrical approach to Moire-Fringe analysis, the displacement field approach to Moire-Fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of Moire-Fringes, experimental procedure and techniques.

Unit – VI Photo elasticity: Photo elasticity – Polariscope – Plane and circularly polarized light, Bright and dark field setups, Photo elastic materials – Isochromatic fringes – Isoclinics

Unit – VII Three dimensional Photo elasticity: Introduction, locking in model deformation, materials for three-dimensional photo elasticity, machining cementing and slicing three-dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions, applications of the Frozen-stress method, the scattered-light method.

Unit – VIII Birefringent Coatings Introduction, Coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, Fringe-order determinations in coatings, stress separation methods.

Reference Books:

1. Theory of Elasticity by Timoshenko and Goodier Jr
2. Experimental stress analysis by Dally and Riley,Mc Graw-Hill
3. A treatise on Mathematical theory of Elasticity by LOVE .A.H
4. Photo Elasticity by Frocht

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MECHANICAL VIBRATIONS

Unit I  Single degree of Freedom systems I: Undamped and damped free vibrations: forced vibrations; coulomb damping; Response to harmonic excitation; rotating unbalance and support excitation; Vibration isolation and transmissibility.

Unit II  Single degree of Freedom systems II: Response to Non Periodic Excitations: unit impulse, unit step and unit ramp functions; response to arbitrary excitations, The Convolution Integral; shock spectrum; System response by the Laplace Transformation method.

Unit III  Vibration measuring instruments: Vibrometers, velocity meters & accelerometers

Unit IV  Two degree freedom systems: Principal modes – undamped and damped free and forced vibrations; undamped vibration absorbers;

Unit V  Multi degree freedom systems: Matrix formulation, stiffness and flexibility influence coefficients; Eigen value problem; normal modes and their properties; Free and forced vibration by Modal analysis; Method of matrix inversion; Torsional vibrations of multi – rotor systems and geared systems; Discrete-Time systems.

Unit VI  Numerical Methods: Rayleigh’s, stodola’s, Matrix iteration, Rayleigh-Ritz Method and Holzer’s methods.

Unit VII  Continuous systems: Free vibration of strings – longitudinal oscillations of bars- traverse vibrations of beams- Torsional vibrations of shafts.

Unit VIII  Critical speeds of shafts: Critical speeds without and with damping, secondary critical speed.

Reference books:
1. Elements of Vibration Analysis by Meirovitch.
3. Vibrations by W.T. Thomson
ADVANCED OPTIMIZATION TECHNIQUES

UNIT – I  Linear programming: Two-phase simplex method, Big-M method, duality, interpretation, applications.

UNIT - II Assignment problem: Hungarian’s algorithm, Degeneracy, applications, unbalanced problems, traveling salesman problem.


UNIT – IV Numerical methods for optimization: Nelder Mead’s Simplex search method, Gradient of a function, Steepest descent method, Newton’s method, types of penalty methods for handling constraints.

UNIT – V Genetic algorithm (GA): Differences and similarities between conventional and evolutionary algorithms, working principle, reproduction, crossover, mutation, termination criteria, different reproduction and crossover operators, GA for constrained optimization, draw backs of GA,


UNIT – VII Multi-Objective GA: Pareto’s analysis, Non-dominated front, multi – objective GA, Non-dominated sorted GA, convergence criterion, applications of multi-objective problems 

UNIT VIII Applications of Optimization in Design and Manufacturing systems: Some typical applications like optimization of path synthesis of a four-bar mechanism, minimization of weight of a cantilever beam, optimization of springs and gears, general optimization model of a machining process, optimization of arc welding parameters, and general procedure in optimizing machining operations sequence.

Text Books:
2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers
5. Genetic Programming- Koza
6. Multi objective Genetic algorithms - Kalyanmoy Deb, PHI Publishers
APPLIED SOLAR ENERGY

1. **SOLAR RADIATION:** Pyrhelio and pyranometers-earth-sun angles-equation of time-estimation of average radiation falling on tilted surface.

2. **FLAT PALTE COLLECTORS:**
   Construction-thermal performance-factors influencing efficiency.

3. **FOCUSSING COLLECTORS:**
   Relative merits & demerits-nomenclature-various configurations-thermal performance & losses.

4. **THERMAL STORAGE:**
   Need-location-design parameters-thermal analysis of non-stratified storage-principle of stratification.

5. **ECONOMICS:**
   Discounted cash flow-life cycle coasting of a solar system, production function, cost function & optimization.

6. **THERMAL POWER:**
   The power concept – design aspects – distributed receiver concept- thermochemical reactors.

7. **SOLAR POND & SOLAR STILL:**
   Working principle- construction- operating difficulties and remedies.

8. **AGRICULTURAL & DOMESTIC APPLICATIONS:**
   Stills, timber - drying, crop - drying, cookers.

**REFERENCE BOOKS:**


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DESIGN OF HEAT TRANSFER EQUIPMENT

1. DESIGN OF HEAT EXCHANGERS:

2. DESIGN OF CONDENSERS:

3. DESIGN OF EVAPORATORS TYPES:
   Temperature distribution and heat flow in an evaporator-pressure drop- factor to be consider in the design of heat transfer equipment-types of heat consideration of fouling factor –correction factor

4. DESIGN OF COOLING ROWERS AND SPRAY PONDS:

5. DESIGN OF COMPRESSORS:
   Types-equivalent shaft work-volumetric efficiency-factors affecting total volumetric efficiency –compound compression with inter cooling- rotary compressors-surging.

6. DESIGN OF DUCTS:
   Continuity equation-Bernoulli’s equation-pressure losses-frictional charts- coefficient of resistance for fillings- duct sizing methods.

7. DESIGN OF FANS:
   Standard air-fan horsepower-fan efficiency-similarity laws-fan laws-performance coefficients- theoretical expression for total pressure drop by a fan-centrifugal fan- axial flow fan-system resistance.

8. PIPING SYSTEM:
   Requirements of a good piping system-pressure drop in pipes-moody chart-refrigerant piping-discharge line-liquid line-suction line-piping arrangement

REFERENCE BOOKS:
1. Heat and mass transfer by Arora & Domkundwar.
4. Refrigeration & Air-Conditioning by Stoecker

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REFRIGERATION EQUIPMENT AND CONTROLS


5. Defrosting - necessity - methods - manual, automatic, periodic defrosting, solid and liquid adsorbents, water defrosting, defrosting by reversing the cycle, automatic hot gas defrosting, thermo balance defrosting, electric control defrosting. (no problems)

6. Expansion devices - Capillary tube, thermostatic expansion valve - float valves, externally equalized valves - automatic expansion valves - solenoid control valve - location of piping and pump design consideration. (no problems)

7. Performance of complete Vapour compression system - Performance of condensing unit-compressor - Evaporator - balancing of load in two stage compression. (no problems)

8. Installation of vapour compression refrigeration system - evaluation and dehydration testing for leakages - charging - adding oil. (no problems)

REFERENCES:

2. 'Refrigeration and Air Conditioning' - by Domkundwar – Dhanpat Rai & Co.
3. ‘Refrigeration and Air Conditioning’ - by C.P.Aroma – TMGH
I.C. ENGINES AND ALTERNATE FUELS

1. Introduction: Historical Review – Broad classification of fuels - Engine Types – Design and operating Parameters.


4. Charge Motion: Mean velocity and Turbulent characteristics – Swirl, Squish – Pre-chamber Engine flows. Fuel supply systems for SI and CI engines to use gaseous fuels like LPG, CNG, and Hydrogen.


REFERENCES:

1. I.C. Engines Fundamentals/Heywood/Mc Graw Hill
2. I.C. Engines /Ferguson
3. I.C. Engines / Maleev
4. IC Engines / V Ganesan
7. Combustion Engine Processes / Lichty
8. Scavenging of two stroke Cycle Engines / Switzer

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UNIT I:
Computer Integrated Manufacturing Systems – Structure and functional areas of CIM system - CAD, CAPP, CAM, CAQC, ASRS. Advantages of CIM.

UNIT II:

UNIT III:
Components of Knowledge Based Systems – Basic Components of Knowledge Based Systems, Knowledge Representation, Comparison of Knowledge Representation Schemes, Interference Engine, Knowledge Acquisition.

UNIT IV:
Machine Learning – Concept of Artificial Intelligence, Conceptual Learning, Artificial Neural Networks - Biological Neuron, Artificial Neuron, Types of Neural Networks, Applications in Manufacturing.

UNIT V:

UNIT VI:
Knowledge Based System for Equipment Selection (KBSES) – Manufacturing system design, Equipment Selection Problem, Modeling the Manufacturing Equipment Selection Problem, Problem Solving approach in KBSES, Structure of the KBSES.

UNIT VII:

UNIT VIII:
Knowledge Based Group Technology - Group Technology in Automated Manufacturing System, Structure of Knowledge based system for group technology (KBSGT) – Data Baswe, Knowledge Base, Clustering Algorithm.

Text Books:
1. Intelligent Manufacturing Systems by Andre Kusaic.
2. Artificial Neural Networks by Yagna Narayana
3. Automation, Production Systems and CIM by Groover M.P.
4. Neural Networks by Wassarman.
LOGISTICS AND SUPPLY CHAIN MANAGEMENT


UNIT-VI : Sourcing, transporting and pricing products: Sourcing decisions – transportation in the supply chain – basic transportation economics and pricing – transportation documentation – pricing and revenue management in the supply chain – pricing and revenue management in supply chains.

UNIT-VII : Coordination and Technology in Supply chain: Lack of coordination and Bullwhip Effect – obstacles to coordination – managerial levers to achieve coordination – Building strategic partners and trust within a supply chain. Role of IT in the supply chain – E-business.


Reference Books:
1. Donald J. Bowersox and David J. Closs, Logistical Management: The Integrated Supply Chain Process, TMH.
4. B.S.Sahay, supply Chain Management for Global competitiveness, Macmillan.
5. Philip B.Schary, Tage Skjott – Larsen: Managing the Global Supply Chain.
SIMULATION AND MODELLING

UNIT I:
System – ways to analyze the system – Model - types of models – Simulation – Definition – Types of simulation models – steps involved in simulation – Advantages & Disadvantages.

UNIT II:

UNIT III:

UNIT IV:

UNIT V:

UNIT VI:

UNIT VII:

UNIT VIII:
Applications of Simulation – flow shop system – job shop system – M/M/1 queues with infinite and finite capacities – Simple fixed period inventory system – Newboy paper problem.

Text books:
SPECIAL MANUFACTURING PROCESSES

UNIT I:
Surface treatment: Scope, Cleaners, Methods of cleaning, Surface coating types, and ceramic and organic methods of coating, economics of coating. Electro forming, Chemical vapour deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding.

UNIT II:

UNIT III:
EDM – principles, equipment, generators , analysis of R-C circuits, MRR , Surface finish, WEDM. ECM – principle, equipment, mechanical properties, MRR, parameter analysis

UNIT IV:
LBM – working , equipment, PAM – working , system ,performance, EBM - working, equipment , process parameters,

UNIT V:
Processing of ceramics : Applications, characteristics, classification .Processing of particulate ceramics, Powder preparations, consolidation, Drying , sintering, Hot compaction, Area of application , finishing of ceramics.

UNIT VI:
Processing of Composites: Composite Layers, Particulate and fiber reinforced composites, Elastomers, Reinforced plastics, MMC, CMC, Polymer matrix composites.

UNIT VII:
Fabrication of Microelectronic devices: Crystal growth and wafer preparation, Film Deposition oxidation, lithography, bonding and packaging, reliability and yield, Printed Circuit boards, computer aided design in micro electronics, surface mount technology, Integrated circuit economics.

UNIT VIII:
E-Manufacturing, nanotechnology, and micromachining, High Speed Machining.

TEXT BOOKS:
4. MEMS & Micro Systems Design and manufacture / Tai – Run Hsu / TMGH
5. Advanced Machining Processes / V.K.Jain / Allied Publications.

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PRODUCTION AND OPERATIONS MANAGEMENT

UNIT-I

UNIT-II

UNIT III

UNIT-IV

UNIT-V
Aggregate Planning – definition – Different Strategies – Various models of Aggregate Planning-Transportation and graphical models

UNIT-VI

UNIT – VII

UNIT – VIII

REFERENCE BOOKS:
5. “Operation Management” by Chase
6. “Production & Operation Management” by PannerSelvam
7. “Production & Operation Analysis” by Nahima

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