CE/CS/EB/EC/EE/EI/IT/ME/MRE/SE 301 ENGINEERING MATHEMATICS-III

Module I

Fourier series and Fourier integrals:Periodic functions, Euler formulae for Fourier coefficients, functions having period, even and odd functions, half range expansions, Fourier integral, Fourier cosine and sine transformartions, linearity property, transform of derivatives, convolution theorem (no proof)

Gamma and Beta functions, error functions – definitions and simple properties.

Module II

Special functions: Legendre polynomial, Rodrigue's formula-generation function, recurrence formula for Pn(x), orthogonality. Besse; function, Jn(x)-recurrence formula, general function, orthoganilty.

Module III

Partial differential equations: Solutions of equations of the form F(p,q)=0, F(x,p,q)=0, F(y,p,q)=0, F(z,p,q)=0, F1(x,p)=F2(y,q), Lagrange's form Pp+Qq=R.

Vibrating string : one dimensional wave equation, D'Alembert's solution, solution by the method of separation of variables. One dimensional heat equation, solution of the equation by the method of separation of variables, solution of Laplace's equation over a rectangular region and a circular region by the method of separation of variables.

Module IV

Probability and Statistics: Probability distributions: random variables (discrete & continuous), probability density, mathematical expectation, mean and variance of a probability distribution, binomial distribution, Possion approximation to the binomial distribution, uniform distribution, normal distribution.

Curve fitting: method of least squares, correlation and regression, lines of regression.

Module V

Sampling distributions: population and samples, the sampling distribution of the mean (O known), the sampling distribution of the mean (O unknown), the sampling distribution of the variance, point estimation, interval estimation, tests of hypotheses, null hypotheses and significances tests, hypothesis concerning one mean, type I and II errors, hypotheses concerning two means.

The estimation of variances: Hypotheses concerning one variances – Hypotheses concerning two variances.

Note: Treatment of the topics under Modules IV, V should be oriented towards application of statistical techniques to problems in real life.

Reference

1) Ervin Kreyszing :Advanced Engineering Mathematics, Wiley Eastern
2) Potter, Goldberg :Mathematical Methods, Prentice – Hall
3) Churchill R.V. :Fourier series and Boundary Value Problems-McGraw Hill
4) Irvrin Miller & John E Friend : Probability and statistics for Engineers, Prentice Hall of India.
5) Bowker and Lieberman :Engineering Statistics Prentice-Hall
6) Kirk – Patrick :Introductory statistics and probability for engineering science and technology, Prentice – Hall

7) Parzen E :Modern Probability Theory and its Applications, Wiley Eastern.

CS/EB/EC/EI/IT/ME/MRE 302 ELECTRICAL TECHNOLOGY

Module I

Transformers : working principles and elementary theory of an ideal transformer, Constructional features of single phase transformer, emf equation, turns ratio, vector diagram, equivalent circuit, impedence transformation, transformer losses, flux leakage, efficiency, open circuit and short circuit test, load test. Auto transformer – working principle and saving copper, basic idea of current transformer and potential transformer, distribution and power transformer, applications, standard rating, IS specifications.

Module II

Basic principles of electrical machines: Concepts of motoring and generating action, **DC machines**- Main constructional features, principles of operation, types of generators, emf equation, characteristics, applications, armature reaction and commutation, types of efficiency, speed control, testing, load of dc machines.

Module III

AC Machines : Alternator- rotating field, speed and frequency, effect of distribution of winding, coil span, characteristics, emf equation, losses and efficiency, regulation (emf method only), applications, synchronous motor-principles of operation, over excited and under excited, starting, applications, synchronous capacitor.

Module IV

Induction Motor: Three phase induction motor, principles of operation, constructional features of squirrel cage and slip ring motors, torque-slip characteristics, starting, speed control, losses and efficiency.

Single phase induction motor:Principle of operation, types of single phase induction motors.

Module V

Generation, transmission & distribution of electrical energy:

Different methods of power generation-thermal, hydro-electric, nuclear, diesel, gas turbine stations(general idea only), electrical equipment in power stations, concept of bus bar, load dispatching, methods of transmission, transmission lines, overhead lines and insulators, corona and skin effect of DC & AC distribution, substation (elementary idea only)

References

1) Electrical Machines : By F.S.Bimbra, Khanna publications.
2) Advanced Electrical Technology : By H.Cotton, Wheeler publications.
3) Electrical Machines : Nagarath & Kothari, (TMH)

ME 303 MACHINE DRAWING

Note: The examination will be of 4 hrs. duration

Module I

Screwed fastenings: Screw thread forms, v and square threads, conventional representation of threads, hexagonal headed bolt and nut, square headed bolt, nut locking arrangements, foundation bolts- ray bolt and Lewis foundation bolt.

Cotter and Pin joints: socket and spigot joints, glib and cotter joint for rectangular rods, sleeve and cotter joints, knuckle joint.

(30 marks)

Module II

Pipe joints : Coupler joints, nipple joints, union, socket and spigot, integral flanged joints and hydraulic joints.

Couplings: parallel and tapered sunk keys, saddle keys, feather keys and pin keys, muff coupling, protected type flange coupling, pin type flexible coupling.

Bearings : solid journal bearings, bushed bearings, plummer block and foot step bearing, thrust bearings. (30 marks)

Module III

Assembly of machine parts:

Steam Engine parts : Stuffing box, cross head

I.C. engine: piston and connecting rod.

Valves: Steam stop valve, spring loaded safety valve, lever safety valve,

Miscellaneous machine part assemblies: Machine vice, tail stock of a lathe,

(40 marks)

References:

1) P.I. Varghese & K.C. John : Machine Drawing
2) P.S. Gill : Geometric drawing (Kataria & Sons, Ludhiana)
3) N.D. Bhatt : Elementary engineering drawing (Charotar publishing house, Anand)
4) Parkinson : First year engineering drawing (Pitman, London)
5) K.R.Hert : Engineering drawing with problems and solutions (ELBS)

ME/MRE 304 MECHANICS OF SOLIDS

Module I

Stresses and strains : Introductory concepts, Scope and assumptions, definition of stress and strain, stresses in axially loaded members, statically indeterminate problems, physical meaning of strain, mathematical definition of strain Constitutive relations – Hook's law, Poisson's ratio, thermal strain, elastic strain energy for uni-axial stress, shearing stress, multiaxial states of stress. Transformation of stresses and strains: (2 dimenstional case only) Principal stresses, Equations of transformation, Mohr's circle of stress.

Module II

Axial force, shear force & bending moment: diagrammatic conventions for supports and loading, axial force, shear and moment diagrams. Bending stresses in beams, shear flow, shearing stress formulate for beams, limitations.

Module III

Deflection of beams : Direct integration method and moment area method, conjugate beam idea statically indeterminate problems, fixed beams, continuous beams (elementary ideas only). Castigliano's theorem and its applications for determination of beam deflections.

Module IV

Torsion: Torsion of circular sections, Coulomb's theory, basic assumptions, torsion formulae, angle of twist, shearing stresses and deformations in circular shafts in the elastic range.
Compound stresses : Super position and its limitations, eccentrically loaded members, superposition of shearing stresses.

Module V

Thin & Thick cylinders : thin cylinders and shells subjected to internal and external pressures, thick cylinders and shells, Lame's equation.
Theory of Coloums: buckling, Euler's formulae, effect of conditions.
Theory of failures : Various theories of failure and their applications to ductile and brittle materials.

TEXT BOOKS

E.P.Popov : Introduction to machanics of solids, Printice Hall India.

References :

1) S.P. Timoshenko & D.H.Young : Elements of strength of materials, Inaternational students edition McGraw Hill
2) Mechanics of Solids : Beer & Johnston, Mc Graw hill
3) Stefan H. Crandall, Nouman C. Dahl & : An introduction to the mechanics of solids, International Thomas J. Hardner **students edition McGraw Hill**

ME/MRE/SE 305 FLUID MECHANICS & MACHINERY

Module I

Fluids and their properties: Fluids, shear stress in a moving fluid, viscosity, Newtonian and non Newtonian fluids, viscosity in liquids and gases. Fluid statics: Pressure, variation of pressure in a static fluid, absolute and gauge pressure, measurement of gauge pressure, hydrostatic forces on plane and curved surfaces, center of pressure, buoyancy and stability of submerged and floating bodies, metacentric height.

Module II

Kinematics of fluid flow : Eulerian and Langragian approaches, classification of fluid flow as steady and unsteady flow, uniform and non uniform flow, laminar and turbulent flow, Path line, stream line, streak line and stream tube, one, two, and three dimensional flow, velocity and accelerations in steady and unsteady flow. **Basic Hydrodynamics:** Ideal fluids, Equations of continuity in the differential form, rotational and irrotational flow, circulation and vorticity, Stream function, Velocity potential, one dimensional flow along a stream line, Bernoulli's equation and its limitations, measurement of velocity, Pitot tube and Pitot-static tube, venturi meter, orifice meter, flow nozzles, notches and weirs.

Module III

Steady flow of incompressible fluids in pipes: laminar and turbulent flows, critical Reynolds number, hydraulic radius, general equation for friction, laminar flow in circular pipes, Darcy-Weisbach equation, friction factor, equivalent pipes, minor losses in pipes, Development of boundary layer. **Dimensional Analysis & Similitude** : Rayleigh's method, Buckingham's Pi theorem, nondimensional parameters in fluid machanics and machinery – principles of similitude – geometric, kinematic and dynamics similarities – model studies. Physical meaning of important dimensional groups of fluid mechanics and their practical use.

Module IV

Dynamic action of fluid : Momentum equation applied to a control volume, impact of jets, flow of an incompressible fluid over fixed and moving vanes, work done and efficiency.

Hydraulic turbines : velocity triangles, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine, their constructional features and performance characteristics – non dimensional parameters for comparative study of turbine study of turbine performance, theory of draft tubes, speed regulation of turbines, selection of type and speed of turbines.

Module V

Pumping machinery: general features of positive displacement and rotodynamic pumps, centrifugal pumps, classification, principle of working, velocity diagrams, losses in pumps, circulatory flow, multistage pumps, propeller pumps, priming, cavitation and its significance. **Reciprocating pumps** : Acceleration head, effect of friction, use of air vessels, efficiencies, pump characteristics.

References

1) Douglas, Gasiorek, and Swaffield : Fluid mechanics – Pitman
2) Daugherty & Franzini : Fluid mechanics with engg. Applications McGraw Hill
3) Dr. Jagdish Lal : Hydraulic machanics, Metropolitan book Co. Delhi-6
4) N.S.Govinda Rao : Fluid flow machines, Tata McGraw Hill
5) F.M. White : Fluid Mechanics
6) Vallentine : Applied hydrodynamics – Butter worths – London.
7) Massery : Fluid mechanics - ELBS
8) K.L.Kumar : Engineering fluid mechanics – Eurasia publishing house, N.Delhi.
9) Herbert Addison : A treatise on applied hydraulics.
10) A.J. Stepanof : Centrifugal and axial flow pumps, Wiley, New York.
11) D.G.Shepherd : Principles of turbo machinery-Mac Millan Publishing Co. Inc.
12) Som & Biswas : Introduction to fluid mechanics & Machinery (TMH)
13) Agarwal : Fluid mechanics & Machinery, TMH.

ME/MRE 306 FLUID MECHANICS AND MACHINERY LABORATORY

Study of pipe fittings, and study of devices used for measurement of pressure, velocity rate of flow, metacentric height and radius of gyration of floating bodies.

Experiments :

Experimental verification of Bernoulli's theorem.

Steady flow through pipes – determination of friction factor and Reynold's number.

Determination of the loss coefficients for pipe fittings.

Hydraulic coefficients of mouth pieces, nozzles and orifices.

Calibration of venture meters, orifice meters, nozzle and bend meters.

Force due to impact of jets on vanes.

Performance characteristics of centrifugal pumps at constant speed.

Constant head characteristics of Francis turbine.

Performance of hydraulic ram.

Constant head characteristics of Pelton wheel.

Note : students must present the laboratory records duly certified by the teacher to the Head of the department before commencement of the semester examination.

ME/MRE 307 MATERIAL TESTING LAB

Experiments

Shear test on M.S.Rod.

Vicker's pyramid hardness test.

Brinnel Hardness test.

Tension test on M.S.Rod.

Impact test.

Spring test.

Bonding test on R.S.J. Beam.

Rockwell hardness test.

Compression test on concrete cubes and cylinders (300 T machine)

Preparation of cubes and cylinders.

Testing of cubes and cylinders.

Torsion test.

Note: Students must present the laboratory records duly certified by the teacher to the Head of the Department before commencement of the semester examinations.

CS/EB/EC/EE/EI/IT/ME/SE 401 ENGINEERING MATHEMATICS – IV

Module I

Complex analytic functions and Conformal Mapping : Curves and regions in the complex plane, complex functions, limit, derivative, analytic function, Cauchy - Riemann equations, Elementary complex functions such as powers, exponential function, logarithmic, trigonometric and hyperbolic functions.

Conformal Mapping : Linear fractional transformations, mapping by elementary functions like e^z, sin z, cos z, sin hz and cos hz, Schwarz-Christoffel transformation.

Module II

Complex integration: Line integral, Cauchy's integral theorem, Cauchy's integral formula, Taylor's series, Laurent's series, Residue theorem, evaluation of real integrals using integration around unit circle, around the semi circle, integrating contours having poles, on the real axis.

Module III

Numerical Analysis : Errors in numerical computations, source of errors, significant digits. Numerical solution of algebraic and transcendental equations : bisection method, regula falsi method, Newton-Raphson method, method of iteration, rates of convergence of these method.

Solution of the linear system of algebraic equations : exact methods, Gauss elimination method, iteration methods, Gauss-Jacobi method.

Polynomial interpolation: Lagrange interpolation polynomial, divided differences, Newton's divided differences interpolation polynomial.

Module IV

Finite differences : Operators ?, v, E and ?, Newton's forward and backward differences interpolation polynomials, central differences, Stirlings central differences interpolation polynomial.

Numerical differentiation : Formulae for derivatives in the case of equally spaced points.

Numerical integration : Trapezoidal and Simpson's rules, compounded rules, errors of interpolation and integration formulae. Gauss quadrature formulae (No derivation for 2 point and 3 point formulae).

Module V

Numerical Solution of Ordinary differential equations: Taylor series method, Euler's method, modified Euler's method, Runge-Kutta formulae 4^{th} order formula.

Solution of linear difference equations with constant co-efficients : Numerical solution of boundary value problems, methods of finite differences, finite differences methods for solving Laplace's equation in a rectangular region, finite differences methods for solving the wave equation and heat equation.

References :

1) Ervin Kreysig : Advanced Engineering Mathematics
2) S.S. Sastry : Introductory method of Numerical Analysis, Prentice Hall of India.
3) Ralph G. Stanton : Numerical Methods for Science and Engineering, Prentice Hall of India.
4) S.D. Conte and Carl de Boor :Elementary Numerical Analysis Analograthamic Approach, McGraw Hill.
5) M.K. Jani, S.R.K. Iyengar and R.K. Jain :Numerical methods for scientific and Engineering Computations, Wiley Eastern
6) P. Kandaswamy, K. Thilagavathy, K. Gunavathy : Numerical methods[S. Chand & Co.]
7) E.V. Krishnamurthy, S.K. Sen. : Numerical Algorithms, Affiliated East West

ME/MRE 402 METALLURGY AND MATERIAL SCIENCE

Module I

Crystallography : crystal structure, space lattice, crystal systems, miller indices of crystal planes and directions, atomic density of crystallographic planes and lines, atomic packing factor, co-ordination number, inter planar spacing.

Solidification of metals : homogenous and heterogeneous nucleation, crystal growth, grains and grain boundaries, equi-axed and columnar grains, dendritic pattern, polymorphism.

Crystal imperfections : point defect, line defect, edge dislocation, screw dislocation, interaction between dislocation, planar defects, stacking faults, grain boundary, twist and twin boundaries, volume defects.

Diffusion : mechanism of diffusion in crystals, types of diffusion, factors affecting diffusion, Fick's law of diffusion, metallurgical application of diffusion.

Module II

Phase: Equilibrium between phases, Gibb's phase rule, solid solution, interstitial, substitutional, ordered and disordered types, Hume – Rothery rules, equilibrium phase diagrams of binary alloys- complete solid solubility, partial solid solubility, no solid solubility,: eutectic, peritectic and eutectoid reactions, Cu- Ni, Cd-Bi, Pb-Sn, Ag-Pt, and Fe-C systems as examples.

Module III

Heat treatment of steel: Definition and aims of heat treatment, T T T diagram, isothermal and continuous cooling, annealing, normalizing, hardening, tempering, austempering, martempering, hardenability of steels, jomini test, surface treatments –case hardening, carburising, cyaniding, nitriding, flame hardening, induction hardenting, metal coating- hot dipping, electro plating, metal cladding, impregnation, metal spraying.

Module IV

Deformation of metals : Elastic, anelastic and visco elastic behaviour, plastic deformation, mechanism of slip, slip planes and slip directions, mechanism of twinning, strengthening mechanisms, work hardening, grain boundary hardening, precipitation hardening, cold working, hot working, recovery, recrystalisation and grain growth.

Failure of metals : creep, mechanism of creep, creep curves, creep resistant materials, fracture, brittle fracture, Griffith's theory, ductile fracture, ductile-brittle transition, protection against fracture, fatigue, mechanism of fatigue, S-N Curve.

Module V

Cast Irons : classification- gray, white, malleable, and spheroidal graphite cast irons, composition, properties and uses.

Steels : Classification of steels, function of alloying elements of steels, composition and properties of common commercially important alloy steels.

Non-ferrous alloys : composition, properties and use of common commercial alloys of Cu, Al, Mg, bearing metals.

References

1) L.W. Van Vlack : Elements of material science – Addison – Wesley.
2) Reed Hill : Physical metallurgy principles – Affiliated east-west press N.Delhi
3) Clark & Varney : Physical metallurgy for engineers – Van Nostrand
4) V.Raghavan : Material science and engineering, Prentice Hall of India
5) Dieter : Mechanical metallurgy, McGraw Hill
6) Avner: Mechanical metallurgy, McGraw Hill
7) Narula : Material Science, Tata McGraw Hill
8) B.K.Agarwal : Introduction to engineering materials, Tata McGraw Hill
9) Manas Chanda : Science to Engg. Materials Vol I, II and III, Macmillan Co. of India.

ME 403 APPLIED THERMODYNAMICS

Module I

First and second law of thermodynamics, Carnot theorem, Thermodynamic temperature scale, Internal Energy and entropy, Claussius inequality, entropy charge in various thermodynamic processes of ideal gases, Application of first and second law of thermodynamics for steady flow processes, reversibility, irreversibility & Availability, Tds equations, (Helmoholtz, Gibbs function & Marwell relations) Claussius clapeyon equations.

Module II

Properties of Mixtures of Gases and Gas and vapors: Datton's law of Partial Pressure, Amagat's law of Partial volume, Volumetric and Gravimetric analysis of Gas mixtures, Gibb's Datton Law, Mean value of Gas constant, Equivalent Molecular weight, Density, Specific volume, specific heat and Molar heat capacity of gas mixture, Advanced Problem on Adiabatic Mixing.

Module III

Fuels and combustion – Solid, liquid and gaseous fuels – calorific value – calorimeter – combustion equation – Air – Fuel ratio gravimetric & volumetric analysis – excess air Enthalpy and Internal Energy of Combustion – application of first law of thermodynamics to chemical reaction (combustion), adiabatic flame temperature – application of second law of thermodynamics to chemical reaction.

Module IV

Actual cycles of four stroke and two stroke IC Engines, valve timing diagram – Engine testing – Performance and characteristics of constant speed and variable speed engines – heat balance test – Morse test – retardation test – effect of dissociation – variable specific heads and heat losses – scavenging – objectives – effects and methods – Efficiencies (thermal, mechanical and volumetric efficiencies)

Module V

Systems and components of IC Engines – fuel systems – Ignition systems – Cooling – starting – lubrication – governing of IC engines – super charging of SI and CI Engines – turbo charging – exhaust emissions of IC engines –alternate Potential Engines – free piston engines – Wankel Engine and Stratified charged engine automotive transmission system and its components.

Combustion in IC engines – flame propagation normal and abnormal combustion detonation – Pre ignition – after burning – HUCR – fuel rating – additives in petrol – combustion chambers of SI engines – combustion in CI engines – phase of normal combustion diesel knock – effect of engine variables on diesel knock – cetane number – additives in diesel – combustion chambers of CI engines.

Reference:

1. Engineering Thermodynamics : P.K.Nag
2. Engineering Thermodynamics : D.B. Spalding & E.H.Cole
3. Engineering Thermodynamics : Van Wylon
4. Thermal Engineering : P.L.Ballaney
5. Thermodynamics : J.P.Holman
6. Internal Combustion Engines : M.I.Mallev
7. Elements of Internal Combustion Engines : Rogowsky, Tata McGraw Hill
8. Fundamentals of Internal Combustion Engines : Gill, Smith & Ziurys, Oxford & IBH
9. Modern Petrol Engine : Judge,Chapman & Hall
10. Internal Combustion Engines : Benson& Whitehoues, Vol& II, Pergamon Press.

ME /MRE 404 INDUSTRIAL ELECTRONICS

Module I

Transister Amplifiers : need for blacing, stabilization concepts of load line, small signal amplifiers, h parameters model, working principle or RC coupled amplifiers, frequency response, power amplifier, classification, theory of operation and comparison, expression for gain Zin, Zo.
Concepts of Feedback: positive and negative feedback (voltage shunt and current series feedback configuration only)

Module II

Wave shaping networks: RC differentiator and integrator, clipping and clamping circuits using diodes, differential amplifier, common mode and differential mode operations, characteristics of OPAMP, applications, summer, Integrater, Differentiator and scale changes.

Module III

Oscillators: sinusoidal and non sinusoidal oscillation, conditions for oscillation, basics of RC and LC oscillators (RC phase shift Oscillator and Hartely Oscillator) transister as a switch, classification, transistorized sweep generator
Multivibrators : Monostables, bistables, astable generator, working principle of astable multivibrators only.

Module IV

Thyristers : classifications, SCR, series and parallel operation of SCR. Single phase controlled rectifier, half wave and full wave. Half controlled and fully controlled-wave forms.

Module V

Power suppliers : - Transisterised regulated power supply using Zener diodes, theory of operation, regulation characteristics.
SMPS – UPS (Basic concept and block diagram treatment only)
Industrial heating: Induction heating, dielectric heating, principle and applications, application of power electronics in welding.

References:

1) Electronic Devices and Circuits : Milman & Halkias (McGraw Hill)
2) Integrated Electronics : Millman & Halkias (McGraw Hill)
3) Basic Electronics : Bhargava
4) Power Electronics : NED Mohan

ME 405 METAL CASTING, FORMING AND JOINING PROCESS

Module I

Moulding & Casting: Patterns, pattern materials, pattern allowances, types of patterns. Types of moulding sands, ingredients of moulding sands, requirements of moulding sands, gating and risering, Cores and coremaking- core sands, different types of cores. Sand conditioning and testing.

Shell mould casting, plaster mould casting, investment process, permanent mould casting, die casting, centrifugal casting, continuous casting.

Module II

Metal joining process: welding processes and classifications, fusion welding, manual arc welding- arc theory, ionization emission, welding machines, characteristics of arc and machine, arc blow and stability, metal transfer, weld bead geometry and characteristics, electrodes, types, specifications and applications, Submerged arc welding, atomic hydrogen welding, TIG and MIG welding, stud welding.

Gas welding – types of flames, gas and welding equipment.

Gas and arc cutting.

Module III

Resistance Welding: Basic principles, spot welding, seam welding, butt welding, projection welding, electrode welding, electrode materials, resistance welding unit. **Special welding processes**: Thermit welding, Percussion welding, CO2 welding, Electron beam welding, Laser welding, Explosive welding and Electroslag welding. **Brazing :** Copper and silver equilibrium diagram, brazing principles, brazing alloys, methods of brazing and its applications. **Soldering :** lead-tin phase diagram, Soldering alloys and its applications.

Module IV

Metallurgy of welding: Fusion and heat affected zones, heat flow and temparature distribution in and around weldment, cooling rate of welds, weldability of cast irons, steels, stainless steel and aluminium, defects in welds. **Metallurgy of castings :** Solodification and section geometry, cooling rate, solidification and mechanical properties, heat treatment, metallurgical characteristics of cast metals, defects in casting. **Inspection and testing :** Destructive and non destructive test methods- X-ray, radiography, magnetic particles, dye penetration, ultrasonic, eddy current techniques.

Module V

Metal forming processs: Rolling : principle of rolling, types of rolls and rolling mills, semifinished and finished rolled products like tubes, wheels, axles. **Forging:** classification of forging process, forging hammers and forging presses, drop forging-basic design of dies, upset forging, types of products, forging defects **Extrusion:** forward and backward extrusion, tube extrusion **Wire drawing.**

References:

1) Heine & Rosenthal : Principles of Metal casting, McGraw Hill
2) B.J. Ranganath –Metal Cutting and Tool Design, Vikas
3) Little : Welding Technology McGraw Hill
4) P C Sharma : Production Technology
5) Udin-Funk and Wulff – Welding for engineers – John Wiley.
6) American Welding society – Welding handbook.
7) Instn. Of metals, USA – Metals hand book – vol 5, 9th edition.
8) J.L.Morris – Welding process and procedure
9) Glen J.Cook – Engineered castings, McGraw Hill
10) ASM – Casting: Metals Hand book

ME 406 COMPUTATIONAL LAB

Review of fundamentals of C programming,
Pointers-pointer declaration-pointers and one dimensional arrays-pointers and functions,
Data files- opening and closing a data file-creating a data file- processing a data file.
C-graphics- drawing lines, rectangles, circles and ellipse

Numerical Techniques: Preparation of computer programs for

solution of polynomial and transcendental equations: bisection method-regula falsi method-successive iteration- Newton Raphson method.
Solution of system linear algebraic equations: Gauss elimination- matrix inversion, Gauss Jordan method, Gauss-Seidel method.
Numerical integration : trapezoidal rule- Simpson's 1/3 rule- Gauss quadrature formulae
Numerical solution of ordinary differential equations : Taylor series method- Runge- kutta method
Numerical solution of boundary value problems.

ME 407 ELECTRICAL LAB

a) Determination of voltage current relation of a linear resistance and incandescent lamp.

b) Measurement of high and low resistances using voltmeter and ammeter

R, L & C series and parallel circuits – measurement of voltage – current relation and verification by calculation - plotting the instantaneous power against time.

Calibration of the single phase energy meter by direct loading at various power factors.

Measurement of power in the three phase circuit using single, two and three watt meters for balanced/unbalanced load and three and four wire systems.

Determination of the efficiency and regulation of the single phase transformer by direct loading.

Determination of Equivalent circuit of a transformer by open and short circuit test calculation of efficiency and regulation at various loads and power factors.

Determination of the regulation of the alternator by emf and mmf methods.

Synchronisation of alternator to the A.C. mains and studying the effect of changes in excitation of alternator and power input to their alternator by plotting the V-curve.

Starting the cage induction motor using star-delta switch and plotting the performance characteristics.

Conducting the no load and blocked rotor tests on slip ring induction motor –determining equivalent circuit and calculating torque-slip characteristics.

a) Plotting OCC of a D.C. shunt generator at rated speed – determining the critical resistance.

b) Conducting load test on D.C. shunt generator and plotting external characteristics – deducting internal characteristics.

Conducting load test on D.CL Series motor and plotting the performance characteristics.

Study of single phase capacitor start and capacitor run induction motors – plotting speed – voltage relation of single phase fan motor.

Note: Students must present the laboratory records duly certified by the teacher to the Head of the Department before commencement of the semester examinations.

ME / MRE 501 MECHANICS OF MACHINERY

Module I

Introduction: Mechanism and machines; plane mechanisms; kinematic chains and their classification; kinematic inversion; equivalent linkages. **Kinematic analysis of plane mechanisms:** introduction; general case of plane motion; velocity acceleration; Corioli's component; velocity and acceleration images; Arnold Kennedy's theorem of three centers; velocity analysis using instantaneous centers (graphical method only)

Module II

Analytical treatment of slider crank machanism and four bar linkage.

Introduction to linkage synthesis: (limited to dimensional synthesis of planar mechanisms) Precision points; graphical synthesis of slider crank mechanism, crank and rocker mechanis,; optimum transmission angle; synthesis of four bar linkage (using three and four precision points); overlay method; use of Coupler curve.

Analytical method of synthesis; Freudenstein's equation.

Module III

Path generator: Pantograph, exact straight line mechanism- Paucellier mechanism & Thompson indicator mechanism, approximate straight line mechanism – Watt's mechanism- Intermittent motion mechanism: Geneva mechanism - Steering Mechanism.

Cams: Classification of cams and followers; geometry of radial cam; displacement diagram; uniform, simple harmonic, parabolic and cycloidal motions; graphical layout of cam profiles; basic follower motions; displacement, velocity, acceleration and jerk relations; comparison of follower motions; pressure angle, comparison of follower curvature; analysis of tangent cam, convex and concave sided cams with roller follower and with flat footed follower, polynomial cam design.

Module IV

Spur gears: Gear terminology; conjugate motion; involute arc of action; contact ratio; generation of gear tooth profiles; interference; cycloidal properties; comparison of characteristics of involute and cycloidal profiles; interchangeable gears; standard and non-standard gear tooth properties; description of different tyes of gears such as helical, bevel, and worm gears. **Gear trains:** introduction; example of gear trains; simple and compound gear trains calculation of gear ratios, epicyclic gear train, solution of epicyclic gear train problems.

Module V

Belt and Rope Drives: Ratio of belt tensions, power transmitted, centrifugal tension, and initial tension, flat belts, v-belts and ropes. **Clutches:** Analysis of single plate, multi-plate and cone clutches. **Brakes**: Analysis of different types of brakes-block brake, band brake, internal expanding shoe brake, condition for self locking, power transmitted and heat generated. **Dynamometers:** rope brake dynamometer, belt transmission dynamometer.

Reference:

1) J.E.Shigley & J.J.Uicker : Theory of machines and mechanisms, McGraw Hill
2) J.E.Shigley : Kinematic analysis of mechanisms.
3) Thomas Beven : Theory of machines
4) Zimmerman : Elementary kinematics of mechanism, John Wiley Pub
5) Rattan : Theory of machines, Tata McGraw Hill

EE/EI/ME/SE 502 INDUSTRIAL ORGANISATION & MANAGEMENT

Module I

Organisation : Concept of organization, characteristics of organization, elements of organization, organizational structure, organization charts, Types of organization- formal line, military or scalar organization, functional organization, line & staff organization, project organization, matrix organization, authority and responsibility, span of control, delegation of authority.

Management: Concept of management and administration, difference and relationship between management, administration, and organisation, evolution of management theory, principles of scientific management, levels in management, introduction to project management and MIS.

Industrial ownership: Types of ownership- single ownership, partnership, joint stock company, co-operative societies, public sector, private sector.

Module II

Personal management: Recruitment and training, training methods, labour turnover, suggestion systems.

Wages and incentives- feature of wages, time and piece rate, different incentive plans, profit sharing, job evaluation and merit rating- Concepts &methods .

Industrial safety: Working conditions &environmental factors , accidents and hazards.

Industrial relations: industrial disputes, collective bargaining, trade unions, workers's participation in management, labour welfare.

Module III

Marketing Management: Concept of marketing .Marketing VS sales approach, consumer behaviour, buying motives, influence of income level, marketing of new products, pricing methods and tools, break even analysis and marginal costing in pricing, sales promotion, marketing research, test marketing,

Advertising management- types of advertising, choice of media, economic and psychological factors in advertising.

Module IV

Finance Management :Functions of financial management, long term financing, share & and debenture capital, different types of shares, term loans, dividends and share valuation, short term financing, working capital influencing factors, cash budgeting, terms of liquidity, budget, objectives of budgeting and budgetary control- ratio analysis.

Module V

Management accounting: Fundamentals of book keeping, journalizing, ledger accounts, cash book, banking transactions, trial balance, preparation of trading, profit and loss account, and balance sheet.

References

1) Industrial Organisation and Management : Bethel et.al, McGraw Hill
2) Principles of Industrial Management : Kootnz & Donnel
3) Financial Management : Prasanna Chandra, TMH
4) Financial Management : IM Pandey , Vikas Publishing House
5) Operation Management : Fabricky et al, Tata McGraw Hill
6) Hand Book of MBO : Reddin & Ryan, Tata McGraw Hill
7) Management: concept and Strategies : J.S. Chandan , Vikas Publishing House
8) First steps in book keeping : J B Batliboi
9) Management accounting : Hingrani & Bemnath

ME 503 ADVANCED MECHANICS OF SOLIDS

Module I

2D problems in Cartesian co-ordinates

stress & strain at a point, components of stress & strain , Hooks law plane stress & plane strain, measurement of surface strains, construction of Mohr circle for stress & strain , strain rosettes, differential equations of equilibrium , boundary conditions, compatibility equations, stress function. Solution by polynomials, St.Venants, principle, bending of a cantilever loaded at the end.

Module II

2D problems in polar co-ordinates

General equations in polar co-ordinates. Stress distribution symmetrical about an axis pure bending of curved bars. Strain components in polar coordinates, displacement for symmetrical stress distribution, rotating disks, thick cylinders

Module III

Analysis of stress & strain in 3D

Principal stresses, stress ellipsoid, stress invariants, maximum shearing stress, homogenous deformation. Strain at a point, rotation, differential equations of equilibrium, compatibility. Equations of equilibrium in terms of displacements

Module IV

Strain energy. Principles of virtual work, Castigliano's theorem . Stretching of a prismatic bar by its own weight pure bending of prismatic bars. Pure bending of plates unsymmetrical bending, shear centre.

Module V

Torsion of noncircular straight bars, elliptic cross sections. Membrane analogy. Torsion of thin tubes,open and closed sections, shear flowflow.

Reference:

1) Theory of elasticity : Timoshenko & Goedier, Mc Graw Hill
2) Theory of elasticity : Fioemenk & Broaldich
3) Advanced Mechanics of Solids : L.S. Srinath, Tata Mc Graw Hill
4) Advanced Strength of Materials : Den Hartog
5) Theory of Elasticity : M Filonenoko & Borodich.

ME 504 METROLOGY & MACHINE TOOLS

Module I

General concepts of measurements: concept of precision and accuracy, standards of measurements, slip gauges, bevel protractors, spirit levels, clinometers, sine bars, angle gauges, optical dividing head.

Optical measuring instruments: principles of interferometry, optical flat, interferrometer, auto collimator.

Surface finish measurements: surface finish, surface texture, measurements of surface roughness- CLA, RMS, PV methods, Profilometers.

Module II

Limits and fits: Tolerance and allowances, systems of limits and fits, types of fits, BIS system of tolerance specification, interchangeability and selective assembly.

Gauges: Classification of gauges- plug, ring, gap, snap, profile, and position gauges. Gauge tolerance and wear allowances, gauge materials.

Comparators: Mechanical, optical, pneumatic, electrical, and electronic comparators.

Module III

Basic concept of Machine tools: General requirements of Machine tools, Tool-work motions on lathe, milling machine, drilling machine, shaping, planning, slotting, and grinding machine.

Lathe: Introduction to lathe, specification for a lathe, lathe operations, work holding devices, speeds, feeds, and depth of cut, estimation of machining time.

Production lathes: Turret and capstan lathes, turret indexing mechanism, operation and tool layout, single spindle automatic screw machine.

Module IV

Shaping, planning and slotting machines: Specification, operations performed, speeds and feeds, estimation of machining time, quick return mechanisms.

Drilling and boring machines: Specifications, work and toll holding methods, operations performed.

Grinding machine: plain, cylindrical and surface grinding operations, cutting action of grinding wheels, centreless grinding, thread grinding, profile grinding, tool and cutter grinder.

Module V

Milling machine: types and specifications, work & cutter holding devices, peripheral milling, face milling and end milling, up & down milling, standard milling cutters, different milling machine operations, calculation of machining time, milling of spur and helical gears, universal indexing head- simple and differential indexing.

Reference:

1) Engineering Metrology :K.J.Hume
2) Metrology :Judge
3) Engineering Metrology :I C Gupta
4) Fits, Tolerance & Engg. Measurement Y.Tenasevich & E. Yavoish
5) Hand Book of industrial metrology :ASTME (Prentice Hall)
6) Production Technology :HMT (Tata McGraw Hill)
7) Workshop Technology Vol, I, II &III: W A J Chapman
8) Materials Science & Mfg. Process :Dharmendrakumar , Vikas Publishing House
9) Fundamentals of machine tools :ASTM
10) Machine tool operations 1 & 2 :Burghardt, Axllered and Anderson
11) Automatic & Semi automatic Lathes :B.L. Boguslavsky (Peace Publications)
12) Workshop Technology –I : P.K. Sapra & Kapur , Vikas Publishing House

ME 505 HEAT AND MASS TRANSFER

Module I

Introduction to heat transfer – basic modes of heat transfer – conduction heat transfer – energy balance – integral and differential approaches – general heat conduction equation in Cartesian, cylindrical and spherical coordinates – initial and boundary conditions – one-dimensional steady state conduction with heat generation – conduction shape factor – temperature dependence ;of thermal conductivity – applications like extended surface heat transfer and critical insulation thickness – two dimensional steady state heat conduction – examples – unsteady state heat conduction in one dimension – lumped heat capacity system – semi-infinite solids with sudden and periodic change in surface temperature – numerical methods in conduction problems.

Module II

Convective heat transfer – Newton's law of cooling – thermal boundary layer – Prandtl number – hydrodynamic and thermal boundary layer equations – laminar forced convection heat transfer from flat plates – similarity and integral solutions – internal flow and heat transfer – fully developed laminar flow in pipes – turbulent forced convection – Reynolds' analogy – empirical relations in forced convection – natural convection – similarity and integral formulation of natural convection heat transfer from vertical plates – empirical relations in free convection – condensation and boiling – film and drop wise condensation – film boiling and pool boiling – empirical relations for heat transfer with phase change – introduction to multiphase flow and heat transfer.

Module III

Radiative transfer – electromagnetic radiation spectrum – thermal radiation – black body, grey body and coloured body – monochromatic and total emissive power – Planck's law – Stefan-Boltzman law – Wien's displacement law – absorptive – reflectivity – transmissivity – emissivity – Kirchhoffs identity – radiation exchange between surfaces – shape factor – shape factors for simple configurations – heat transfer in the presence of re-radiating surfaces – radiation shields – surface and shape resistances – electrical network analogy.

Module IV

Heat Exchangers: Type of heat exchangers, Logarithmic mean temperature difference (LMTD, analysis using fouting factors, derivation of LMTD for parallel flow and counter flow heat exchangers, effectiveness, NTU method of heat exchanger analysis, fouting factors, simple design problems.

Module V

Mass transfer – definition of terms like concentration, mass velocity and mass flux – Fick's law of diffusion – temperature and pressure dependence of mass diffusivity – diffusion in gases at low density – diffusion in liquids – multi-component systems and their governing equations – concentration distribution in solids and in laminar flow – example problems.

Text Book

1. Holman J.P., "Heat Transfer", McGraw Hill International Students Edition

Reference:

1) Incorpera F.P. & De Witt D.P., "Fundamentals of Heat and Mass Transfer", John Wiley
2) Kreith F., "Heat Transfer", International Text Book Company
3) Gebhart B., "Heat Transfer", McGraw Hill
4) R.K. Rajput, "Heat and Mass Transfer"
5) Kothanda Raman, "Heat and Mass Transfer"
6) Domkunduwar, "Heat and Mass Transfer"

ME 506 HEAT & MASS TRANSFER LABORATORY

Introduction to fundamentals of heat transfer - condensation and boiling heat exchanges experimental techniques in thermal sciences

Exercise

Performance studies on a shell and tube heat exchanger

Performance studies on parallel and counter flow arrangements in a concentric pipe heat exchanger

Emissivity measurement of a radiating surface

Measurement of solar radiation

Thermal conductivity of a metal rod

Measurement of unsteady state conduction heat transfer

Experimental study on forced convection heat transfer

Experimental study of dropwise and flimwise condensation

Experiments on boiling heat transfer

Measurement of critical heat flux.

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ME 507 MACHINE SHOP - I

Introduction to Lathe : Spindle drive – work holding devices – types of Lathe tools – tool holders – tool movement – selection of speeds. Feed and depth of cut – use of cutting coolants – principle of thread cutting – V-thread and Square thread – thread standards – cutting tool types – grinding of tools – selection of cutting speeds.

Exercise : Exercises involving cylindrical turning, Taper, Turning, Facing, Shoulder turning and curve turning – thread cutting.

Exercise : Exercises on lathe – curve turning, multi start thread, drilling and boring, internal thread.

References

1) Production technology : H.M.T
2) Tool Engineer's hand book : ASTME
3) Machine tool operations 1 & 2 : Burghardt, Axllered and Anderson
4) Automatic and semiautomatic lathes : B.L.Boguslavsky, Pease publications.
5) Fundamentals of tool design : ASTME

Note : Students must present the laboratory records duly certified by the teacher to the Head of the Department before commencement of the semester examinations.

ME/ MRE 601 DYNAMICS OF MACHINERY

Module I

Force analysis of plane motion mechanisms : Static Force Analysis: Analysis of four bar chain – slider crank chain – static force analysis with friction. Dynamic force analysis: D'Alembert's principle, inertia forces, dynamic force analysis of four bar chain, slider crank mechanism, shaking forces

Dynamics of reciprocating engines: gear force, equivalent masses, inertia force in the single engine, bearing loads in the single cylinder engine,

Module II

Flywheels: inertia torque-turning moment diagrams for multi cylinder engines, coefficient of fluctuation of speed and energy, fly wheel mass calculation.

Gyroscopes : motion of rigid body in 3 Dimension, Euler's equation of motion, gyrodynamics, gyroscope and gyroscopic couples, gyroscopic stabilization of ships and aeroplanes, gyroscopic effects on automobiles.

Module III

Balancing: Static and dynamic balancing, balancing of several masses in a plane, balancing of masses rotating in several planes, conditions for complete balancing of an engine, reciprocating and rotating parts, locomotive balancing- hammer blow, variation of tractive effort, swaying couple, locomotive balancing of opposed piston engines. Multicylinder in-line engines – radial engines and V engines. Balancing machines and their principles of working.

Module IV

Fundamentals of vibration: Kinematics of vibratory motion: simple harmonic motion, periodic motion and fourier analysis. Vibrations of single degree of freedom systems: natural vibration, equation of motion, natural frequency, equilibrium method, energy method, viscous damping, logarithmic decrement, coulomb damping, forced vibration, harmonic excitation with and without damping, non dimensional expression for amplitude and phase, rotating unbalance, critical speed for shafts, support excited motion, vibration isolation.

Vibration measuring instruments: Seismometer, accelerometer, vibration exciters.

Module V

Free vibration of two degree and multi degree freedom systems: solution for free vibration, normal modes, vibration absorber, coupled vibration, general solution, matrix method of formulation, numerical evaluation of natural frequencies and natural mode.

Approximate numerical methods: Rayleigh's method – Dunkerly method.

Torsional vibration in multi – rocker systems, geared system.

Reference:

1) Rattan : Theory of machines, Tata McGraw Hill
2) Hollowenko : Dynamics of machinery, McGraw Hill
3) Singeresu S.Rao : Mechanical Vibrations, Addison wesely
4) Myklestad : Fundamentals of vibration analysis, McGraw Hill
5) Denharto : Mechanical Vibration, McGraw Hill
6) Thomas Beven : Theory of machines – Longmans, Green and Co. Ltd.
7) A.Ghosh & A.Mallik : Theory of machines and mechanisms, Prentice Hall

ME 602 MACHINE DESIGN – 1

Module I

Introduction to design: Steps in design process, design factors, practical considerations in design, selection of materials, strength of mechanical elements, Theories of failure, impact load, shock load, fatigue loading, effects of surface finish, size, temperature and stress concentration, consideration of creep and thermal stress in the design.

Module II

Detachable joints: design of screws, standards, thread stresses, preloading of bolts, external load with pre-load, fatigue and shock loading, eccentric loading. Power screws, thread standard, mechanism of power screws, thread stresses, efficiency of power screws, Types of keys, stesses in keys, design of socket and spigot, gib and cotter, and kuckle joints. Design of rigid couplings and flexible couplings.

Module III

Riveted joints: stresses in riveted joints, design of riveted joints with central and eccentric loads, boiler and tank joints, structural joints.

Welded joints : types of welded joints, stresses, design of welded joints subjected to axial, torsional and bending loads, welds subjected to fluctuating loading. Design of welded machine parts;

Module IV

Springs: stresses in helical springs, deflection of helical compression and extension spring, spring subjected to fatigue loading, concentric and helical torsion spring, critical frequency of springs, leaf springs, designs of automotive leaf springs.

Module V

Power shafting: stresses in shafts, design for static loads, combined stresses, reversed bending and steady torsion, design of shaft for strength and deflection, critical speed of shafts.

Text book

1. Joseph Edward Shingley : Mechanical engineering Design, McGraw Hill

References

1) Bhandari : Design of machine elements, TMH
2) M.F.Spotts : Design of Machine Elements, Prentice Hall of India
3) Siegel, Maleev & Hartman : Mechanical Design of Machines – International Book
4) R.M.Phelan : Fundamentals of Mechanical Design, TataMcGraw Hill
5) V.L.Doughtie & A.V.Valence: Design of machine Elements, McGraw Hill

Hand book

Prof. B.R.Narayana Iyengar & Dr.K.Lingaiah : Design Data Hand Book
P.S.G., TECH : Design Data Hand Book
K Mahadevan & Balaveera Reddy : Design data hand book, CBS Publishers & Distributers

ME 603 INSTRUMENTATION THEORY AND CONTROL ENGINEERING

Module I

Applications of measuring instruments-functional elements of an instrument-instrument as transducer-generalized measuring instrument-generalized mathematical model of measuring systems-zero order, first order and second order instruments-classification of instruments-input-output configurations-methods of correction for spurious inputs-inherent insensitivity-high gain feedback-signal filtering and opposing inputs-static calibration and determination of bias-systematic error and random error-static characteristics-accuracy, loading effect, backlash, friction, hysterisis, threshold, dead space, resolution, static sensitivity and linearity, calibration-potentiometer transducer as a zero order instrument-analysis of its loading error-mercury in glass thermometer as a first order instrument-step ramp, frequency response-seismic instrument as a second order instrument.

Module II

Measurement of strains: strain gauge classification-unbonded and bonded strain gauges-gauge factor-strain rosettes-temperature compensation-calibration.

Measurement of force: multiple lever system for weighing-load cells-temperature sensitivity-calibration-ballistic weighing-hydraulic and pneumatic load cells.

Measurement of Torque: water break-Heenan and Froude hydraulic dynamometer-beam and strain gauge transmission dynamometer.

Measurement of Temperature: pressure thermometer-RTDs-compensation for lead resistance-thermocouples-five laws of thermocouples and their applications-series and parallel connected thermocouples-pyrometry-optical pyrometer-infrared pyrometry-total radiation pyrometers.

Air pollution measurements: gas chromatography-ORSAT's apparatus.

Nuclear instrumentation: Gieger Muller Counter-ionization chamber-scintillation counter.

Acoustical measurements: basic acoustical parameters-sound pressure-sound pressure level-power-intensity-power level-microphones-sound level meter.

Module III

Principles of automatic control : transfer functions, transient response of second order systems, steady state response and error constants. Mathematical modeling of dynamic systems: state space representation of dynamic systems- mechanical systems, electrical systems, analogue systems, electro mechanical systems, liquid level systems, thermal systems, and robot arm systems.

Module IV

Stability analysis of linear systems: concepts of stability, characteristic equations, stability analysis, determination of stability by Routh-Hurwitz criterion, frequency response using Bode plot, and stability from Bode plot, concept of Liaponov's stability of linear time, invariant systems.

Module V

Basic control action and industrial automation: basic control actions, pneumatic controllers, hydraulic controllers, integral and derivative control and system performance.

Control system components: DC and AC servo motors, tacho generators, synchros and stepper motors.

Reference:

1) Modern control engineering : Ogata K., Prentice Hall of India
2) Control system engineering : Nagarath J M & Gopal M, Wiley
3) Control systems engineering : Sivanandan, Vikas Publishing House
4) Automatic control systems : Kuo B C., PHI
5) Measurement systems : Doebelin E.O., McGraw Hill Publishing Co.
6) Mechanical Measurements : Beckwith T.G.
7) Control Systems : Gopal (TMH)

ME 604 TOOL ENGINEERING AND DESIGN

Module I

Cutting tools**:** Geometry of cutting tools and tool nomenclature, single point and multiple point cutting tools and used for turning, milling, drilling and broaching, cutting tool materials and their properties, grinding wheels and their selections.

Module II

Metal Cutting : Mechanics of chip formation, types of chips, mechanism of orthogonal cutting, velocity relationship, cutting forces, factors affection cutting forces, tool dynamometers, cutting force and power analysis, turning, drilling, milling and broaching, thermal aspects of machining, cutting fluids and their selection.

Module III

Mach inability and tool life**:** Tool wear and tool life, tool life equations, tool life specification and criteria, tool life testing, effect of machining parameters on tool life, machinability, variables affecting machinability, machinability index. Economics of Machining: Selection of optimal machining conditions, productivity of machine tools

Module IV

Jigs and Fixtures: Basic principle, elements of jigs and fixtures, location and clamping, 3-2-1 method of location, principles of pin location, radial location, v-location, cavity location, Types of clamps-strap, cam, screw, latch, wedge, and toggle clamps, hydraulic and pneumatic clamps, design considerations common to jigs and fixtures, drill jigs-leaf, box, plate and indexing jigs, milling fixtures.

Module V

Press working: Different types of presses, principles of operation and selection, computation of capacities and tonnage requirements, shear action in die cutting operations, blanking & piercing, clearances, die block design, punch dimensions, punch support, stops & strippers, design of compound and progressive dies, bending and drawing dies, bending allowances, bending methods, spring back, calculation of blank size & press tonnage for drawing.

References:

1) Boothroyd : Fundamentals of Metal Machining and Machine Tools - McGraw Hill
2) Sen & Bhattacharya : Metal cutting Theory & Practice – New central book agency, Culcutta
3) HMT : Production Technology – Tata McGraw Hill
4) Black : Theory of metal cutting (McGraw Hill)
5) B.J. Ranganath : Metal Cutting & Tool Design , Vikas Publishing House
6) P C Sharma : A text book of production engineering (S Chand & Co)
7) Suresh Dalela : Production Technology
8) Pandey & Shah : Modern machining processes (Tata McGraw Hill)
9) Koeingberg : Machining Science & their application (Pergamon Press)
10) Donaldson : Tool Design, Mc Graw Hill
11) ASTME : Fundamentals of Tool Design,PHI

ME 605 THERMAL ENGINEERING

Module I

Pure substance – PV, PT and TS systems – PVT surface – Properties of steam – steam table and mollier diagram – gas mixtures – mass and mole fractions – PVT behaviour of gas mixtures – properties of gas mixtures – ideal and real gases. Analysis of vapor process – thermodynamic analysis of steam power cycles – Rankine, reheat, and regenerative – binaray vapor cycles – modern steam generators – performance calcuation of boilers.

Module II

Steam nozzles – mass flowrate – throat pressure for maximum discharge – throat area – effect of friction – super saturated flow – effect of back pressure – steam engine – components – compounding of steam engines – indicator diagram engine performance – steam turbines – types and classification – velocity diagram – force on blades, W.D. by blades, Arial thrust, blade or diagram efficiency- effect of friction on blades, Applied problems.

Module III

Gas turbine plants – open and closed cycles – thermodynamics cycles – regeneration – reheating – intercooling – efficiency and performance of gas turbines – rotary compressors – analysis – centrifugal and axial flow compressors – combustion chambers of gas turbines – cylindrical – annular and industrial type combustion chamber design – combustion intensity – combustion efficiency – pressure loss combustion process and stability loop axial flow turbines – elementary and vortex theories – design of nozzles and blades for turbines - limiting factors in turbine design.

Module IV

General layout of thermal power plants – fuel handling and burning systems – dust and ash handling systems – draft and chimney calculations – condensers – cooling systems.
Fundamentals of nuclear fission – nuclear power plants – reactors – classification – components layout of simple plant – thermal design of nuclear reactors – nuclear power safety and waster disposal. General layout of diesel and hydroelectric power plants.

Module V

Alternative energy utilization – solar thermal collection and calculations – Wind power potential and wind turbine selection – ocean energy possibilities and future scope – geothermal energy usage – plant storage calculation – power plant economics – estimation of load – load curve – load factor – diversity factor – capacity factor – use factor – selection of units – number and size – scheduling operation – cost of energy – depreciation and replacement – Environmental aspects of thermal power systems.

Reference:

1) Cohen & Rogers, “Gas Turbine Theory”, Longmans
2) s.K. Kushresta, Thermal Engineering, Vikas Publishing House
3) E.I. Wakil, Power Plant Engineering, McGraw Hill
4) Morse, Power Plant Engineering, Van Nostrand Co.
5) Lee J.F., Power Station Engineering and Economy, Tata McGraw Hill
6) Bacon, Engineering Thermodynamics, Butterworth
7) Robert Loftness, Nuclear Power Plants, McGraw Hill
8) P.L., Ballaney, Thermal Engineering
9) A.Valan Arasu , Turbo Machines , Vikas Publishing House

ME 606 METROLOGY AND MEASUREMENTS LAB

1. Use of vernier caliper, micrometer, depth gauge and height gauge – source of error in measurement ideas on range, precision and accuracy
2. Slip gauges and their use in linear measurements.
3. Ideas on tolerance allowance, limits, fits.
4. Dial gauges – their use in the measurement of small linear displacements, parallelism and concentricity.
5. Measurements using tool maker's microscope – tool angles and tool wear.
6. Measurement of surface roughness – surface roughness parameters – surface finish evaluation using perth-O-meter/Ialysurf
7. Standards for screw threads – Screw thread measurements using Universal Measuring Microscope/Measuring Projector.
8. Use of measuring Projector to evaluate form error.
9. Linear measurements using UMM.
10. Microstructure studies using Metallurgical Microscope.
11. Lathe tool dynamometer – study and use of measurement of cutting forces in turning.
12. Milling forces – Milling parameters – measurement of milling forces in slab milling operations.
13. Measurement of drilling thrust and torque using drill toll dynamometer.
14. Tool life evaluation in cylindrical turning.
15. Influence of cutting parameters in surface finish.
16. Experiment on effect of machining on microstructure.
17. Study of phenomenon of formation of built up edge in turning.
18. Grinding of single point tools for fixed tool geometry and measurement using tool maker's microscope.
19. Study of grinding wheel and grinding parameters – experiments in grinding.
20. Study of electro discharge – machine and machining tests to study parameters.
21. Study of electro discharge – machine and machining tests to study process parameters.
22. Measurement of metal cutting temperatures – use of thermo couples.
23. Non-destructive tests.

Note: Students must present the laboratory records duly certified by the teacher to the Head of Department before commencement of the semester Examinations.

ME 607 MACHINE SHOP - II

Introduction to machine tools like horizontal milling machines, vertical milling machines, slotting and shaping machines, work holding devices- spindle drives-milling cutters – gear milling – surface slot milling – indexing head – simple and differential indexing – grinding wheel – specification and selection – drilling and reaming – capstan and turret lathes – ideas of tool layout.

Exercise on milling machines – surface milling and slot and keyway milling, straddle milling, machining of spur and helical gears.

Exercises on – Shaper and slotting – machining of plane and bevel surfaces – keyway and slot machining, exercises on drilling and reaming, surface grinding and tool grinding.

References

1) Production technology : H.M.T
2) Tool Engineer's hand book : ASTME
3) Machine tool operations 1 & 2 : Burghardt, Axllered and Anderson
4) Automatic and semiautomatic lathes : B.L.Boguslavsky, Pease publications.
5) Fundamentals of tool design : ASTME

Note : Students must present the laboratory records duly certified by the teacher to the Head of the Department before commencement of the semester examinations.

ME 701 COMPRESSIBLE FLUID FLOW

Module I

Introduction to gas dynamics : system, and control volume approach, conservation of mass, continuity equation, conservation of energy, steady flow energy equation, entropy changes in fluid flow, stagnation state, impulse function, acoustic waves, and sonic velocity, mach number, classification of fluid flow based on mach number, physical differences between different types of flow, mach cone.

Module II

Effects of area variation on one dimensional compressible flow: isentropic flow of an ideal gas, basic equation, reference conditions for isentropic flow of an ideal gas, mass flow, and chocking, isentropic flow in converging nozzle, calculations using coefficient of velocity, nozzle efficiency and discharge coefficient.

Effects of friction in one dimensional flow : Adiabatic flow in constant area duct with friction, fanno line, fanno relation for perfect gas, tables for computation of fanno flow, chocking resulting from friction.

Module III

Effects of heat exchange in one dimensional flow : frictionless flow in constant area duct with heat transfer, Raleigh line, Rayleigh equations for a perfect gas, tables for computation of rayleigh flow, choching resulting from heat transfer.

Module IV

Irreversible discontinuity in supersonic flow : (stationary normal shock only) fundamental equation for normal shock, normal shock equation for a perfect gas, Prandtl relation for normal shock, tables for computation of normal shock, normal shock on T-S diagram.

Module V

Methods of flow measurement and flow visualization : pressure probes, Prandtl probe, pitot tube, Prandtl pitot static tube, Kiel probe, supersonic pitot tube,
Rayleigh supersonic pitot formula, temperature recovery factor, hot wire anemometer, working principles of shadow graph, schlieren apparatus and interferometer.

Reference:

1) Compressible fluid flow : Patrick H. Oosthuizen, McGraw Hill
2) Gas dynamics : Cambell & Jannings
3) Dynamics and thermodynamics of compressible fluid flow : A.N Shapire
4) Gas dynamics : Yahya

ME 702 INDUSTRIAL ENGINEERING

Module I

Network techniques: Basic concept of network construction, CPM&PERT, information requirement, critical path, algorithm for critical path, various slacks, crashing, multi-time estimate, Smoothing of network.

Forecasting: Objectives& methods of forecasting- time series, moving average method, exponential smoothening.

Module II

Basic concepts of Aggregate & Capacity planning - process of capacity planning .

Production planning and control: Objectives &functions-Preplanning, planning & control functions - Gantt charts.

Basic concepts of sequencing, one machine n jobs, 2 machine n jobs, m machine n jobs problems, critical ratio method of loading & scheduling

Module III

Product Design-Product life cycle, design function, product design, cost factors, simplification, standardization, specialisation, inter-changeability.

Inventory control: Structure of inventory problems, relevant cost, Basic EOQ model, Selective control techniques-ABC analysis.

Quality control: Brief descriptions of – quality, inspection, quality control, control charts for variables and attributes- X bar & R charts, quality circles, concepts of Total Quality Management

Module IV

Plant Location and Layout: Factors influencing location, need for layout, layout design process, determination of equipment and employee requirement, relationship chart.

Maintenance & replacement: preventive, predictive and breakdown maintenance, replacement of equipment-simple numerical problems-total life average method, annual cost method, rate of return method.

Module V

Work Study- definition and concept, techniques of work study &basic procedure of work study.

Method Study-Basic procedure, recording the facts, flow process chart ,(Material type &man type),Flow diagram ,two handed process chart, micro motion study, SIMO charts, defining the improved method, installing the improved method.

Time study-Stopwatch procedure ,performance rating, allowances,

Work sampling-Principle &procedure, simple examples

Predetermined time standards-Definition, different forms of PTS systems, use of PTS systems.

References

1) James L.Riggs : Economic decision models for engineers and managers McGraw Hill ISE.
2) Hiller & Liberman : Introduction to Operations Research – Holden Day Inc San Francisco
3) Wiest & Levy : A management guide to PERT and CPM – Prentice Hall of India
4) Starr & Miller : Inventory control – Theory & Practice – Prentice Hall India.
5) Sammuel Eilon : Production planning and control – universal book corporation, Bombay.
6) Biegel : Production control – Prentice hall of India.
7) Francis & White : Facility layout and location – Prentice hall Inc.
8) Moore : Plant layout and Design – The Macmillian Company Newyork
9) Barnes R.M. : Time and motion study – Asia publication.
10) Miller & Blood : Modern maintenance management
11) Plant engg hand book : McGraw Hill
12) Introduction to Work Study :International Labour Office,Geneva,Universal Book Corporation.
13) Thomas Morton : Production Operations Managemetn, Vikas Thomson Learning

ME 703 AUTOMOBILE ENGINEERING

Module I

Power Plant: Automotive engine classification, S.I. & C.I. engines, combustion chamber types, engine balancing, multi cylinder arrangements. **Automobile engine parts**: Cylinder block, cylinder head, crank case, oil pan, cylinder liners, piston, arrangements to control piston slap, piston rings, connecting rod, crank shaft, valves, valves actuating mechanism, valves lay out, materials used, valve and port timing diagrams.

Module II

Fuel supply system: Simple carburetor, constant choke, constant vacuum carburetor, types of carburetor, mixture strength requirements, fuel pumps for petrol engines, petrol injections, MPFI systems, diesel fuel pump and fuel injector for diesel engines. **Ignition System:** Battery ignition system, comparisons between battery ignition and magnetic ignition system, ignition advance methods, electronic ignition. **Cooling System:** Necessity, methods of cooling. **Lubrication System:** Objectives, system of engine lubrication, crank case ventilation

Module III

Chassis construction: The frame and its functions, unitary or frameless, Layout of the components of transmission system in four wheels, rear drive vehicles. **Clutches:** Purpose, requirements, construction details of single plate clutch, multiplate clutch, centrifugal clutch, diaphragm clutch, fluid flywheel, relative merits and demerits. **Gear box:** Purpose, sliding mesh gear box, constant mesh gear box, synchro mesh gear box, epicyclic gear box, construction, relative merits and demerits, power flow diagrams, overdrive, torque converter, automatic transmission an overview, calculation for road resistance, tractive effort, power requirement for hauling the vehicle, relation between vehicle speed and gear ratios.

Module IV

Universal coupling, propeller shaft, final drive – type, functions. Different – Purpose, construction, working, Hotchkiss drive, torque tube drive – background, functions, relative merits and demerits. Rear axle types – semifloatibng, full floating and three quarter floating construction, working, relative merits and demerits. Front axle and steering – function of front axle. Steering mechanisms, steering linkages, steering gears – for rigid front axle ad independent front wheel suspension. Simple problems related to steering mechanism like conditions for pure rolling, turning circle radius **Factors for wheel alignment:** camber, caster, kingpin inclination, toe – in, toe – out – definition, magnitude and purpose cornering force, slip angle, under steer and over steer. Suspension elements – purpose, types, comfort curves. Independent front suspension – advantages, types, shock absorber.

Module V

Brakes: Braking requirements, brake efficiency, stopping distance, fading of brakes **Types of brakes:** Drum and disc brakes, construction and working, mechanical brake linkages, hydraulic brake system master cylinder, wheel cylinder, air brakes – layout and working. Numerical problems related to brake torque, minimum stopping distance with front wheel braking, rear wheel braking, all wheel braking and weight transfer and heat dissipation **Electrical equipment:** Generator, voltage regulator and cut-out, starter, lighting circuit.

Reference:

1) Newton, steed and Garette: "Motor Vehicle", Butter worth 2nd Ed., 1989.
2) Kirpal singh "Automobile Engineering" Vol-I & Vol-II Standard Publishers Distributors.
3) Heitner Joseph, "Automotive mechanics" East west press
4) Crouse "Automotive mechanics" McGraw Hill book Co.
5) N.K. Giri "Automobile mechanics" Khanna publishers 7th Ed., 1996.

ME 704 CAD/CAM

Module I

Fundamentals of CAD: Role of computers in design, geometric modeling- wireframe and solid modeling, engineering analysis-FEM, design review and evaluation, automated drafting, design data base, softwares used in CAD, data exchange between CAD and CAM. **Fundamentals of CAM:** Definition of automation, levels of automation, high volume discrete parts production, Detroit type of automation, basic concepts, types of transfer machines, analysis of automated flow lines, assembly machines, flow line balancing, manual and computerized line balancing.

Module II

Computer Numerical Control : basic theory of numerical control, advantages of numerical control, open and closed loop system, information flow and control theory, classification of CNC machine tools, position control and continuous path control, principles of displacement measurement, digital linear and rotary displacement transducer, analog displacement measuring system. **CNC part programming :** Manual programming, work piece modeling and computer aided part programming, G function, M function, canned cycles, CAPP languages, structure and use of major CAPP languages, programming in APT languages.

Module III

Design features of CNC machines : Special design features to match machine tools to numerical control system **CNC tooling:** Automatic tool changer, automatic pallet changer, features of CNC systems for lathes and machining centre. Accuracy and testing of NC machine tools, static and dynamic errors.

Module IV

Basic concepts of Robotics: introduction, advantages and applications of Robots, basic structure of Robots, resolution, accuracy, and repeatability. **Classification and structure of Robotic systems:** point-to point and continuous path systems, control loops of robotic systems, various types of robots **Drives and Control systems :** hydraulic systems, direct-current servo motors, control approaches of Robots.

Module V

Applications of Robots : handling, loading and unloading, welding, spray painting, assembly, machining. **Programming :** manual teaching, lead – through teaching, programming languages.
Sensors and Intelligent Robots : introduction to Robotic sensors, vision systems, range detectors, force and torque sensors. **Advanced concepts in automation:** direct numerical control, computer aided engineering, FMS, computer integrated manufacturing – basic concepts of AI and expert systems for manufacturing automation

Text books

1. Grover & zimmers "CAD/CAM" PHI
2. Rdhakrishnan "CAD/CAM"
3. Michael P.G Grover, "Automation, Production Systems and Computer Aided Manufacturing", Prentice Hall, 1980
4. Mechatronics : HMT (TMH)

References

1) CNC Machine Tools and Computer aided Kundra T.K, Rao P.N. and Tiwari N.K.
2) Manufacturing Engineering Hand Books 1984 SME
3) CAD/CAM theory & Practice : Zeid (TMH)
4) CNC Programming made easy: B.K.Jha , Vikas Publishing House
5) Robot Technology – Fundamental: James G Keramas , Vikas Thomson Learning

ME 705 (A) FINITE ELEMENT METHOD

Module I

Introduction to finite element method (FEM)
Brief history of the development, advantages and disadvantages of FEM, 1-D, 2-D and 3-D elements, Rayleigh-Ritz method, Balerkin Weighted residiual method, matrix inversion.

Module II

Finite element method – the displacement approach (Minimization of potential energy).
Criteria for the choice of the displacement function, polynomial displacement functions, number of terms in a polynomial, convergence requirements, linear interpolation polynomials in terms of local coordinates for 1-D, 2-D and 3-D element, Euler-Lagranze Equations. Deruvation of FEM equations using minimization of potential Energy.

Module III

MATRIX METHODS FOR STRUCTURAL ANALYSIS: Introduction to flexible & stiffness Matrix methods. Flexibility Matrix Methods, Determination of member Displacements, member forces. STIFFNESS MATRIX METHODS: Overall stiffness matrix, Equivalent joint loads, deformation matrix.

Module IV

FEM APPLICATION TO SOLID MECHANICS: Analysis of truss, plane stress Analysis, Boundary conditions. Various solutions of Finite Element equations incorporating boundary conditions.

Module V

FEM APPLICATIONS TO HEAT TRANSFER, FLUID FLOW AND VIBRATIONS:
Heat transfer: 1-D Heat transfer, 2-D Steady state Heat Transfer, FE equations, Boundary conditions, solution methods. Fluid Flow-steady state confined flow around a cylinder, FE equations based on Potential Function. Formulation for inviscid incompressible flows.
Vibration: FE equations for longitudinal vibration of a uniform or stepped bar.

Text books:

1. Finite Element Methods - Zienkiewicz.
2. Finite Elements in Engineering- Chandrupatla and Belegundu
3. Finite Element Methods - Abel & Desai

ME 705 (B) AEROSPACE ENGINEERING

Module I

The atmosphere: characteristics of troposphere, thermosphere, ionosphere, pressure – temperature- density variations in the international standard atmosphere, correction of charts, the standard atmosphere.

Review of basic fluid dynamics: continuity, momentum, and energy equations for compressible and incompressible flows, static, dynamic and stagnation pressure

Module II

Application of dimensional analysis: 2D viscous flow over bodies, 2D airfoils, nomenclature and classification, pressure distribution in viscid and real flows, circulation theory of air foils, centre of pressure and aerodynamic centre, 2D air foil characteristics, aspect ratio, induced drag, calculation of induced drag from momentum considerations, skin friction and form drag

Module III

Aircraft engines: thrust equations- thrust power, propulsive power, propulsive efficiency, principle of turbo jet engines, engine performance characteristics.

Propellers - Blade element theory, propeller coefficients and charts.

Module IV

Aircraft performance: flight envelops, v-n diagrams for maneuvers, straight and level flight, gliding and climbing, rate of climb, service and absolute ceilings, gliding angle and speed of flattest glider take off, landing performance and length of run way required, range and endurance of aero planes, charts for piston and jet engine aircraft, aircraft instruments (brief description only) Qualitative ideas of static stability.

Module V

Principles of wind tunnel testing: open and closed types of wind tunnels, wind tunnel balances, pressure and velocity measurements, supersonic wind tunnels (description only) elementary ideas on space travel, rocket engines, calculation of each orbiting and escape velocities ignoring air resistance and assuming circular orbit.

Note: Standard Atmospheric tables permitted in the exam hall.

Reference:

1) Introduction to flight : John D Anderson, McGraw Hill
2) Aircraft performance selection & Design : Francis J Hale, John Wiley & Sons
3) Mechanics of flight : A C Kermode
4) Aero dynamics for Engg. Students : Houghton & Brock
5) Aerodynamics : MAV Piercy
6) Aerodynamics : Dommesch

ME 705 (C) STATISTICAL QUALITY CONTROL

Module I

Fundamentals of the theory of probability: objectives and applications; variable and attributes, fundamentals concepts; patterns of variation, frequency distribution; cells and cell boundaries, cumulative frequency distribution, the normal distribution, average, measure of dispersion, statistical concept of universe.

Binomial distribution, mean and standard deviation, Poisson distribution as an approximation to the binomial, use of tables for solving Poisson problems.

Module II

Shewhart's control charts for variables: X bar and **R** charts, relationship between sample parameters and universe parameters, control limits for **X bar** and **R** charts, examples of processes in control, examples of processes out of control, process capability

Control chart for fraction defective: necessary steps for selection of sub groups, choice between **p** chart and **np** chart, control limits, charts showing control and lack of control, sensitivity of the **p** chart.

Control charts for defects: control limits for **c** charts; preparation and use of **c** charts.

Module III

Acceptance sampling : lot by lot acceptance using single sampling by attributes, operating characteristics curves, producer's risk, consumer's risk, AOQL, LTPD, quality protection, selection of sampling plans, choice of sampling plans to minimize average total inspection, ATI curves, double and sequential sampling plans, concept of AQL

Module IV

Life testing and reliability: concept & definition of reliability, analysis of life test, failure distribution- probability of equipment failure, conventional model, failure rate, MTBF, OC curves ,exponential reliability function, series, parallel, and combinational reliability, redundant system, maintainability, and availability.

Module V

Modern concepts in quality control: Quality circles, zero defect concept, total quality management, quality organizations, ISO 9000 series and its features.

Reference:

1) E.L.Grant : Statistical Quality Control, (McGraw Hill)
2) L. Srinath : Reliability
3) Mahajan : Statistical Quality Control

Note : SQC tables to be permitted in the exam hall.

ME 705 (D) FLEXIBLE MANUFACTURING SYSTEMS

Module I

Types of production systems : Joy shop, batch and mass production – Batch production of medium and large sized units – conventional systems – functional layout – problems handling – in process inventory – scheduling for batch production.

Module II

Need for flexibility : Modern concepts – JIT production – pre requisites for JIT production systems – Japanese experience – product and operational flexibility through computerization.

Module III

Group Technology: Formation of part families and machine cells – early attempts like Opitz coding, PFA – Graph throretic formulation of the GT problem – 0 – 1 matrices and concurrent formation of part families and machine cells – Clustering methods – Modern algorithms.

Module IV

Manufacturing cells – machining, tooling and programming – Economic justification of FMS – Establishing the viability of FMS – Flexible automation in machining and work piece flow – choice of machinery and software for specific products.

Module V

Design and implementation of FMS – part oriented planning – part family formation from multivariate attributes – system structuring and layout – Designs for specific cases.

References:

1) Flexible Manufacturing Systems – H.J. Warnecke & R. Steinhilper Springer – Verlag
2) FMS – Methods and Studies - A.Kusiak, North Holland
3) Cluster Analysis - Anderberg, Academic press.
4) International Journal of Production Research – 1981 to 1995 (various issues).
5) Production and Operations Management – E.S. Buffa.

ME 705 (E) COMPOSITE MATERIALS

Module I

Introduction - classification and characteristics of polymer matrix and metal matrix composites - mechanical behaviour of UD composites - longitudinal strength and stiffness - transverse strength and stiffness - failure modes - short fiber composites

Module II

Manufacturing and testing methods - production of various fibers - matrix materials and surface treatments - fabrication of composites - fabrication of thermosetting resin matrix composites - fabrication of thermoplastic-resin matrix composites/short fiber composites - fabrication of metal matrix composites - fabrication of ceramic matrix composites - carbon-carbon composites

Module III

Machining aspects of composites - experimental characterization of composites - uniaxial tension - compression and shear tests - determination of interlaminar and fracture toughness - damage identification through non-destructive evaluation techniques - ultrasonic, acoustic emission and X-radiography

Module IV

Analysis of orthotropic lamina - Hooke's law for orthotropic materials - stress-strain relations and engineering constants - specially orthotropic lamina - relation between engineering constants and elements of stiffness and compliance matrices - restrictions on elastic constants - stress-strain relationships for generally orthotropic lamina - transformation of engineering constants - strengths of orthotropic lamina - typical design application examples

Module V

Analysis of laminated composites - strain and stress variation in a laminate - synthesis of stiffness matrix construction and properties of special laminates - symmetric laminates - unidirectional, cross-ply and angle-ply laminates - quasi-isotropic laminates - determination of laminae stresses and strains - laminate analysis through computers - typical design application examples

Reference:

1) Agarwal B.D. & Broutman L.J., *Analysis and Performance of Fiber Composites*, John Wiley
2) Gibson R.F., *Principle of Composite Material Mechanics*, McGraw Hill
3) Schwartz M.M., *Composite Materials Handbook*, McGraw Hill, Inc.
4) Jones R.M., *Mechanics of Composite Materials*, McGraw Hill, Inc.
5) Tsai S.W., *Introduction to Composite Materials*, Technomic Publishing Company
6) Chawla K.K., *Ceramic Matrix Composites*, Chapman & Hall.

ME 707 THERMAL ENGINEERING LAB

Determination of flash and fire points of fuels and oils

Viscosity of fuels and oils and its variation with temperature

Determination of Calorific values of fuels

Performance of simple journal bearings

Valve timing diagrams of I.C. engines

Performance test on Petrol and Diesel engine

Forced convection heat transfer for tube flow

Performance test on air compressors

Test on air conditioning equipment and refrigeration equipment.

Note: Students must present the laboratory records duly certified by the teacher to the Head of the Department before commencement of the semester examinations.

ME 802 MACHINE DESIGN-II

Module I

Design of Clutches : Friction clutches, uniform wear and uniform pressure assumptions, centrifugal clutches.

Brakes : Design of internal expansion elements, assumptions, design of external contraction elements, band type brakes.

Belt and chain drives : flat belts, V-Belts, roller chain.

Module II

Design of Gears : Spur, helical, bevel and worm gears-tooth loads, design stresses, basic tooth stresses, stress concentration, overload factor, velocity factor, bending strength of gear teeth, Buckingham equation for dynamic load, surface durability, surface strength, heat dissipation, gear material, design for strength and wear.

Module III

Bearings and lubrication: types of lubrication, viscosity, journal bearing with perfect lubrication, hydrodynamic theory, design factors, bearing load, bearing dimensions, journal bearing design. Ball and roller bearings- bearing life, static and dynamic capacity, selection of bearings with axial and radial loads, bearing materials used. Thrust bearings, lubrications, seals, shaft and housing details.

Module IV

Product design for manufacturing : general design recommendations for rolled sections, forgings, screw machine parts, turned parts, machined round holes, parts produced on milling machines, welded parts, castings etc., Modification of design for manufacturing easiness for typical products – preparation of working drawings for manufacture of parts with complete specifications including manufacturing details like tolerance, surface finish.

Note: Complete design of gears , bearings and belts requires more time. Hence modules restricted to four.

TEXT BOOKS

1) J.E.Shigley : Mechanical engineering design, McGraw Hill, International student edition.
2) Bhandari : Design of machine elements (TMH)
3) V.I.Doughtie : Design of machine elements – McGraw Hill and A. Vallance, International student edition.
4) Siegel, Maleev: Machine design of machines-International and Hartman text book Co.
5) J.Myatt : Machine design, McGraw Hill
6) James G.Bralia : Handbook of product design for manufacturing McGrawHill

Hand books allowed for examination:

1) Dr. K. Linghaigh and Prof. B.R. Narayana Iyengar : Design Data Hand Book Vol. I & II
2) P.S.G. Tech : Design Data Hand Book
3) Mahadevan & Balaveera Reddy : Design Data Hand Book

ME 803 REFRIGERATION AND AIR CONDITIONING

Module I

Principles of refrigeration-unit of refrigeration - capacity - coefficient of performance (COP) - refrigeration systems - Carnot refrigeration cycle - steam jet refrigeration - thermoelectric refrigeration - vortex tube - pulse tube - air refrigeration cycle boot strap & boot strap evaporating cooling - thermodynamic analysis of Bell-Coleman cycle

Module II

Vapour compression system - theoretical and practical cycles - simple and multi pressure systems - thermodynamic analysis - vapour absorption system - principle of operation of aqua - ammonia and lithium bromide - water systems - Electrolux system - comparison between vapour compression and absorption systems - refrigerants - thermodynamic, physical and chemical properties of refrigerants - selection criteria of refrigerants

Module III

System components - compressors - reciprocating compressors - single and multistage compressors - work of compression - effect of clearance - effect of inter cooling - optimum pressure ratio - efficiencies - rotary compressors - screw type and vane type compressors - hermetic, semi hermetic and open compressors - condensers - water cooled and air cooled condensers - evaporative condensers - expansion devices - capillary tube - constant pressure expansion valve - thermostatic expansion valve - float valves - evaporators - natural convection and forced convection coils - flooded evaporators - direct expansion coils

Module IV

Psychrometry - psychrometric properties and processes - determination of air entering conditioned space - air conditioning systems - summer, winter and year-round-year air conditioning systems - central and unitary systems - human comfort - comfort chart and limitations - effective temperature - factors governing effective temperature

Module V

Design considerations - cooling load calculation - various heat sources - solar load - equipment load - infiltration air load - duct heat gain - fan load - moisture gain through permeable walls and fresh air load - design of air conditioning systems - duct design - air distribution systems - heating systems - heat pump - noise and noise control

Reference:

1) Stoecker, *Refrigeration and Air Conditioning*, Tata McGraw Hill
2) Dossat, *Refrigeration and Air Conditioning*
3) Jordan & Priester, *Refrigeration and Air Conditioning*, Prentice Hall
4) Arora, *Refrigeration and Air Conditioning*, Tata McGraw Hill
5) Norman Harris, *Modern Air Conditioning Practice*, McGraw Hill.

ME 804 (A) METAL FORMING

Module I

Basic laws and theories of plasticity - stress space - yield criterion of metals - Von-Mises yield criterion - tresca criterion - representation of the criteria in stress space - yield surface - subsequent yield surfaces - experimental investigations of the yield criteria - basic considerations of plasticity theory - simple models of material behavior - Levy-Mises stress strain relations

Module II

Prandtl-Reuss stress strain relations - experimental verification - plastic potential theory - plastic work - maximum work hypothesis - stability postulates - isotropic and kinematic hardening - plastic flow - temperature and strain rate effects in plastic flow

Module III

Processes - drawing and extrusion - process classification - lubrication - temperature effects - analysis of the processes of drawing and extrusion of wire and strip through friction less dies and dies with friction - production of seamless pipe and tubes - analysis - residual stresses in rods - wires - tubes, deep drawing

Module IV

Classification of rolling processes - hot rolling - cold rolling - rolling of bars and shapes - analysis of rolling process in conditions of plane strain - classification of forging process - open die forging - closed die forging - analysis of forging process in conditions of plane strain - forging allowances and tolerances - sheet metal forming, shearing, blanking, bending and stretch forming

Module V

Slip line field theory - incompressible two-dimensional flow - slip lines - equilibrium equations referred to slip lines - Henkeys theorem - hodographs - simple slip line field analysis in extrusion - compression of block between parallel plates - strip load on semi-infinite body - lower and upper bound theorems with proofs and applications

Text books

1) Oscar Hoffman & George Sachs, *Introduction to Theory of Plasticity for Engineers*, McGraw Hill
2) Dieter G.E., *Mechanical Metallurgy*, McGraw Hill
3) Johnson W. & Mellor P.B., *Plasticity for Mechanical Engineers*, D Van Nostrand Co. Ltd.
4) Chen W.F. & Han D.J., *Plasticity for Structural Engineers*, Springer Verlag

ME 804 (B) PROPULSION ENGINEERING

Module I

Fundamentals of propulsion: Types of propulsive devices- Air screw, Turbo prop, Turbo jet, Ram jet, Pulse jet, Ram rocket, and Rocket engines- Comparative study of performance characteristics.

Module II

Jet Propulsion: principle of reaction, calculation of thrust and thrust horse power, propulsion efficiency, thermal efficiency, transmission efficiency, and overall efficiency of turbo jet engines.

Module III

Analysis of turbo jet engine cycle: performance characteristics of a turbo jet engine, diffuser efficiency, compressor efficiency, turbine efficiency, nozzle efficiency, equilibrium, running condition, thrust augmentation methods.

Module IV

Rocket Propulsion: General operating principles of rocket motors, performance parameters for rocket motors and their relationship, Rocket equation, Altitude gain, simple problems.

Module V

Chemical rockets : classifiction and characteristics of solid and liquid propellants, typical grain shapes, liquid propellant feed systems and injectors, ignitors, combustion process, nuclear, solar and electrical rockets.

Note: Gas tables permitted in the exam hall.

Reference:

1) Rocket Propulsion Elements : G P Sutton
2) Air craft and missile propulsion : Zucrow
3) Propulsion Systems : Hosny
4) Gas Turbines & Jet and Rocket Propulsion : ML Mathur & Sharma
5) Fundamentals of Compressible Flow : S.M. Yahya.

ME 804 (C) OPERATIONS RESEARCH

Module I

Linear Algebra : Review of the properties of matrices and matrix operations, partitioning of matrices, vectors and Euclidean spaces, unit vectors, sum vectors, linear dependence, bases, spanning set, rank, product form of inverse, simultaneous equations, basic solutions, point sets, lines and hyper planes, convex sets, extreme points, fundamental theorem of linear programming.

Module II

Linear Programming : Fundamentals Theorems of Linear programming, Mathematical formulation of the problem, Assumption of Linear programming, graphical Method.

Simplex Method – Slack & surplus variables, basic feasible solution, reduction of a feasible solution to basic feasible solution, artificial variables, optimality conditions. Charnes 'M' Method, two phase method.

Module III

Transportation Problems : Definition of a transportation model, North-west Corner Rule, Least Cost or Matrix Minima Method, Vogel's approximation method, Degeneracy in Transportation problem.

Assignment Problems :

Theorems of Assignment problem, Zero assignments, Unbalanced problems.

Comparison with Transportation Models.

Module IV

Game Theory : Von Neuman's theorem, saddle points, pure and mixed strategies, formulation of primal and dual LP problems for mixed strategies, dominance, graphical solutions.

Module V

Queueing Theory : Basic structures of queueing models, exponential and poisson distribution, Kendall's Notation, Queueing models – M/M/1 and M/M/K.

Simulation : Definition, Simulation Models – Monte-Carlo Simulation, Application of Simulation, Advantages and limitations of Simulation.

Text books

1. Operations Research, Goel and Mittal, Pragti Prakasan, Meerut
2. Operations Research, Kanti Swarup, Gupta and Manmohan, Sultan Chand and Sons Publishers, New Delhi.
3. Operations Research , S Kalavathy , Vikas Publishing House
4. Introduction to operational research , C. R. Kothari Vikas Publishing House
5. Resource Management , N.G. Nair

ME 804 (D) HYDRAULIC AND PNEUMATIC POWER CONTROL

Module I

Introduction to fluid power, Fluid power systems, Hydraulic fluids and their properties, Hydraulic and pneumatic ISO symbols for different circuit elements.

Fluid pumps and motors, Hydraulic cylinders and rams, Different types of sealing arrangements, Hydraulic accumulators and circuits, Hydraulic intensifiers, Fluid reservoirs, Fluid filters, Fluid power plumbing.

Module II

Pressure control valves – Spring loaded safety valve, spring loaded relief valve, compound relief valve, electrically operated relief valve, Pressure reducing valve, counter balance valve, sequence and unloading valve, Hydraulic pressure switch, flow control valves, compensated and non-compensated flow control valve, flow control valve circuits, Direction control valve, cheque valve, diversion valve, four way valve, diversion valve, four way valve, solenoid operated valve.

Module III

Servo systems, components, relief valve function servo type direction control valves, oil pilot two stage actuation, feed back circuits. Design consideration of hydraulic circuits, Industrial hydraulic circuits, Pressure regulating speed control, Accumulator circuits, Booster and intensifier circuits, motion synchronising circuits, meter-in, meter-out and bleed off circuits.

Module IV

Introduction to pneumatics, generation of compressed air, classification of compressors, their working principles, drying of compressed air, oil free compressed air, pneumatic cylinders, air motors – comparision with other types of motors, pneumatic valves and basic pneumatic circuits, Hydro Pneumatics, Fluidics and fluid logics.

Module V

Principles of pneumatic circuit design, will depandent, travel depandent, time depandent circuits, step travel diagram, fault finding and preventing – Maintenance of hydraulic and pneumatic circuits, Functional diagram in pneumatic circuit design, movement diagram, cascade system of pneumatic circuit design, Karnaugh – Veitch map for pneumatic circuit, K-V diagram, pneumatic circuit with K-V diagram, simple control problems, electrical controls in pneumatic circuits.

Text books:

1. John Pippenger and Tyler Hicks – “Industrial Hydraulics”, McGraw Hill Ltd.
2. S.R. Majunder “Pneumatic Systems-Principles and Maintenance” Tata McGraw Hill Publishing Co. Ltd.
3. Andrw Parr “Hydraulics and Pneumatics” – Jaico Publishing House

Reference:

1) CMTI Machine Tool Design Hand Book – Tata McGraw Hill Company
2) James F. Thorpe – “Mechanical System Components” Hyn and Bacon Publishers, Boston.
3) Bruce E. Mccord “Designing pneumatic control circuits” Marcel Dekker Inc New York.
4) Pelter Rohner “Industrial Hydraulic Control” John wiley Brisbone.

ME 804 (E) MATERIALS MANAGEMENT

Module I

Introduction: Scope and objectives, functions of Materials management

Procurement: Purchase procedure, buying techniques, tender, purchase order, vendor rating.

Receipt&Issue : Receiving procedure, Issue of materials ,FIFO & LIFO systems

Storage: Location and layout of stores, store records-bin cards, store ledger, codification of materials.

Selective control techniques of inventory – Numerical problems in ABC analysis.

Module II

Inventory Theory : objectives of keeping inventory, structure of inventory problems and their analysis, relevant cost.

Static inventory problems under risk : general characteristics, Christmas tree problem, total cost matrix, opportunity cost matrix, cost of risk, mathematical formulation of discrete and continuous cases, imputation of costs.

Module III

Dynamic inventory problems under certainty: general characteristics, optimal lot size models with constant demand and infinite delivery rate with and without back ordering, quantity discount, optimal lot-size model with varying demand, multiple items from one supplier, optimal policy curve

Module IV

Dynamic inventory problems under risk: general characteristics, basic kinds of inventory control systems – demand probability distribution – approximate methods to find optimal P & Q systems of inventory, Switching matrices, Optimal selling policy with fluctuating prices.

Module V

Material requirement planning: master production schedule, bill of materials, inventory stock, files, MRP process, logic and computational procedure using simple example. Lotsizing using L4L &EOQ.

International Trade Practices-Bill of Lading, Bill of Entry, Letter of Credit &Insurance

References :

1) A.Deb : Materilas Management-Academic Publishers, Calcutta, India.
2) Starr & Miller : Inventory control – theory and practive – Prentice Hall of India.
3) Operations Management : G Monks, Mc Graw Hill

ME 801 PRODUCTION TECHNOLOGY

Module I

Kinematics of Machine Tools: Selection of range of speeds and feeds, layout of speeds, graphical representation of speed and structural diagrams, ray diagrams for machine tool gear boxes, speed chart, speed box design, feed chart, feed box design, gearing diagram, stepped and step less regulation of speeds, feed and speed mechanisms in lathe, milling and drilling machines.

Module II

Non-traditional machining processes**:** Principles, machining unit, process characteristics and applications of Electro Discharge Machining, Electro Chemical Machining, Abrasive Jet Machining, Ultrasonic Machining, Electron Beam Machining, Laser Beam Machining, and Plasma Arc Machining-capability analysis of non traditional processes.

Module III

Powder Metallurgy**:** Definition and basic concept of the powder metallurgy process, powder manufacture, characteristics of metal powders, mixing and blending, compacting, pre-sintering, sintering, hot pressing, secondary P/M operations like infiltration, impregnation, sizing, properties of P/M products, product applications, advantages & disadvantages.

Module IV

Hydraulic operation of Machine Tools: Elementary ideas of fluidics-classification of fluidic elements, types of fluid logic elements, logic states, circuits, hydraulic valves, flow, pressure and direction control valves, JIC symbols, elementary control circuits, oil hydraulic circuits of shaping, drilling and grinding machines.

Module V

Estimation and Costing: estimation and costing in foundry shop, sheet metal shop, welding shop, and machine shop- simple examples in lathe, drilling, milling, shaping and grinding machines.

References:

1) Boothroyd : Fundamentals of Metal Machining and Machine Tools
2) Sen & Battacharya : Principles of Machine tools- New central book agency Culcutta
3) N K Mehta: Machine tool design & Numerical control
4) Sharma : A text book of production engineering (S Chand & Co)
5) Dalela : Manufacturing Science & Technology Vol II (Ummesh Publication)
6) Pandey & Shah : Modern machining processes (Tata McGraw Hill)
7) Koeingberg : Machining Science & their application (Pergamon Press)
8) Jones : Production Engineering (Jig and Tool Design)
9) Donaldson: Tool Design, Mc Graw Hill
10) ASTME : Fundamentals of Tool Design
11) Ernst : Oil Hydraulic power and its industrial applications, McGraw Hill
12) CMTI : Machine Tool Design Hand Book
13) Jagadish Lal : Hydraulic Machines
14) Bangan & Sharma : Mechanical Estimating & Costing
15) B.J. Ranganath : Metal Cutting and Tool Design, Vikas Publishing House