

Mechanical Engineering

Compulsory Subjects

IC 402 Engineering Management

MC 403 Mechanics of Solids

MC 404 Mechanics of Fluids

MC 405 Thermal Science and Engineering

MC 406 Manufacturing Technology

MC 407 Design of Machine Elements

Optional Subjects (*Any three from any one Group*)

Group I Thermal Engineering

MC 411 Refrigeration and Air-conditioning

MC 412 Power Plant Engineering

MC 413 Non-conventional Energy Systems

MC 414 Internal Combustion Engines

MC 415 Turbo-machinery

Group II Engineering Design

MC 421 Design of Mechanical Systems

MC 422 Optimization — Theory and Applications

MC 423 Analysis and Synthesis of Mechanisms and Machines

MC 424 Design of Machine Tools

MC 425 Computer Aided Engineering Design

Group III Manufacturing Engineering

MC 431 Manufacturing Science

MC 432 Computer Aided Manufacturing

MC 433 Tool and Die Design

MC 434 Manufacturing Automation

MC 435 Production Management

ENGINEERING MANAGEMENT**Group A****Management and Organisations**

Management process: Definition, planning organizing, directing, controlling, coordinating, types of management.

Organisation Definition, planning, design and development, types of organizations.

Management planning and control: Classical, new classical and modern principles. General Management, scientific management, engineering, management, systems management.

Planning: Procedures, resources and constraints, objectives, goals, policies and procedures.

Control: Setting of reference or standards, appraisal or evaluation, monitoring and controlling, types of control.

Human resource planning and management, selection, recruitment, training, retraining, skill development, competence development, promotion and career development, participative management, trade unions, and collective bargaining,

Management of Physical Resources

Plant: site selection procedures, factors affecting selection. Layout-types and relative merits and demerits, Maintenance-Objectives, different types of associated decisions, strategies for effective maintenance, computer applications.

Material : Functions, objectives, planning and control including inventory models with or without storage costs, price break (excluding dynamic and probabilistic considerations). Different classes of inventory. Material Requirement Planning (MRP).

Group B

Financial management: Introduction to standard forms of financial statements, i.e., balance-sheet, profit and loss, and income statement. Fixed and current asset items. Fixed and current liability items. Linkage of two successive balance-sheets through income or profit and loss statement. Funds flow statement. Financial ratios and their implications.

Managerial economics: Concepts, theory of production, marginal productivity and cost. Introduction to theory of firm.

Quality management: Quality definition, quality planning, quality control and quality management, Total quality management, ISO 9000 systems, simple quality control techniques like control charts and acceptance sampling.

Marketing management consumer behavior, market research, product design and development pricing and promotion.

Project management: Introduction. Concept of a project, project management concepts, project simulation, cost or project and means of financing, economic evaluation criteria of the

project, project implementation, project planning, scheduling and monitoring, project control (PERT, CPM techniques including crashing). Project evaluation.

Information technology and management. Role of information, management information system and decision support system, Information technology-introduction to e-business, e-commerce and integration tools like enterprise resource planning (ERP).

MECHANICS OF SOLIDS

Group A

Review of free body diagrams; Analysis of deformation under axial loading. Simple shear and pressure.

Statically determinate and indeterminate cases. Forces and moments transmitted by simple beams.

Mechanics of deformable solids, stress and strain, transformation of stress and, strain, Mohr circle diagram, equilibrium equations and compatibility conditions.

Material properties and their testing: Elastic, inelastic, plastic and viscoelastic material behaviour. Fatigue and creep. Concepts of ductility, hardness, toughness and their quantification. Tensile and impact tests.

Group B

Stress-strain-temperature relations. Generalised Hooke's law and thermal strains.

Equations of elasticity. Solutions of thin and thick cylinders and rotating disks.

Stresses in beams. Torsion of circular shafts and thin walled sections. Deflection of helical springs.

Yield criteria, energy methods, basic elasticity equations.

MECHANICS OF FLUIDS

Properties and classifications of fluids. Fluids statics, buoyancy.

Scalar and vector fields, Reynolds transport theorem.

Continuity and momentum equations, momentum theorem, Bernoulli's equation and their applications.

Constitutive relation for a Newtonian fluid. Navier Stokes equations, exact solutions for flow between parallel plates, rotating cylinders, Couette flow and Poiseuille flow.

Application of viscous flows through pipes, Correlation of friction factor.

Laminar boundary layer, boundary layer equations Blasius solution over a flat plate, wall shear stress. boundary layer thickness, boundary layer control.

Group B

Separation; momentum integral method.

Turbulent flow; mixing length models; Skin friction coefficient in a turbulent boundary layer.

Compressibility flow; Nozzles and diffusers; Shocks; Effect of friction and heat transfer.

Potential flows.

Experimental methods for flow and velocity measurements.

THERMAL SCIENCE & ENGINEERING

Group A

System, property, work and heat interactions, zeroth law, first law of thermodynamics, application of first law to closed systems and flow processes.

Thermodynamic properties of fluids.

Second law of thermodynamics, Carnot cycle, temperature scale, Clausius inequality, entropy increase, availability.

Thermodynamic property relations. Clapeyron's equation.

Power and refrigeration cycles. Operating principles and essential components of vapour power cycles. IC engines and gas turbines.

Thermodynamics of mixtures, psychrometry.

Group B

Conduction: One-dimensional steady and unsteady state problems, fins, multidimensional problems.

Convection: External flows, boundary layer flow on heated flat plate.

Thermally and hydro-dynamically fully developed flow through a pipe, turbulence flow, Dittus Boelter's and Sieder state correlation.

Natural convection, condensation and boiling. Heat exchangers, LMTD and e-NTU method.

Radiation: Fundamental concepts, black body radiation, surface emission, surface properties, Kirchoff's law, view factor, black body radiation exchange.

MANUFACTURING TECHNOLOGY

Group A

Introduction. Manufacturing cycle. Manufacturing processes and their selection. Engineering materials and their selection.

Casting: Patterns, gating system design, riser design, product design, defects, inspection techniques. Other casting processes: investment casting, die casting, centrifugal casting and continuous casting. Basic design considerations in casting.

Metal forming: Plastic deformation, hot and cold working. Forming operations-rolling, extrusion, drawing processes, sheet metal operations, load estimations for homogeneous deformation. Sheet metal die design. High velocity forming processes.

Heat treatment processes.

Processing of plastics: Extrusion, injection moulding, blow moulding, rational moulding, thermo-forming and compression moulding. Basic design considerations, rapid prototyping, stereo lithography technique.

Powder metallurgy processing: Production of metal powders, compaction and sintering processes. .

Group B

Metal cutting: Tool materials, tool geometry and nomenclature in ASA, ORS and NRS, cutting fluids, single and multipoint cutting operations, production of gears and screw threads, grinding and finishing processes, specification of grinding wheels.

Machine tools: Primary and secondary drives, guideway and slideways, structure. Introduction to NC, CNC and DNC machining.

New machining methods: Process capabilities and limitations of AJM, USM, WJM, ECM, ECG, EDM, EBM and LBM processes.

Joining processes: Fusion welding processes, heat affected zone, testing of welded joints, solid state welding processes, brazing and soldering. Basic design considerations in welding. Process selection. Adhesive bonding. Mechanical fastening processes.

DESIGN OF MACHINE ELEMENTS

Group A

Mechanical systems and elements, overall design considerations, safety, ecological and societal considerations in design. Codes for design-Bureau of Indian Standards (BIS)-codes, design data handbook. Load, stress and critical sections in machine parts.

Materials, stress-strain curves of ductile and brittle materials, cast iron, steel, non-ferrous alloys and plastics, hardness and surface properties of materials, material strength, factor of safety and allowable stress. Review of axial, bending, shear and torsional loading on machine components, combined loading, two- and three dimensional Mohr's circle. Stresses in curved beams, thick and thin shells under pressure.

Deflection and stability, beam deflection and column buckling. Euler's formula and Johnson's formula. Failures theories-maximum normal stress theory, maximum shear stress theory, and maximum distortion energy theory. Application to components made of brittle and ductile materials, stress concentration factor.

Cyclic loading and fatigue failures: Reverse bending, axial and torsion loadings, effect of stress concentration, fatigue life prediction-Miner's rule, effect of surface treatments (shot-peening, surface hardening) on fatigue life of components.

Design of threaded fasteners and power screws, thread forms and threaded fastener types and materials, power screws, bolt tightening and initial tension, static and group of bolts.

Rivets and welding: Loading, bending, direct shear, axial and bending.

Group B

Design of springs: Spring materials, helical compression and extension springs, design for fatigue, loading, leaf springs. Design of sliding bearings, bearing materials, fluid viscosity, hydrodynamic lubrication, Petroff's equation, Raimondi and Boyd chart. Heat dissipation.

Rolling elements bearings: Types, catalogue information (Timken and SKF bearings), bearing life radial and thrust loads. Selection of bearings. Spur, helical and worm gears, gear tooth profile, gear geometry, module, contact ratio, gear train, gear tooth bending strength, gear tooth surface fatigue analysis, gear material.

Design of shafts, keys, pins and splines, shaft couplings. Cotter and pin joints, pipe joints, gaskets, seal and packing, cylinder joints, flanged joints.

Clutches and brakes: Single and multiple plate clutch, constant wear and constant pressure theories for plate clutches, materials, shoe drum brakes, internal and external shoe brakes.

Power transmission elements: Belts and chain drives, design of flat and V-belts.