JYOTHIS ACADEMY
Kottayam

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 *(Select Anyone group and Any three from that 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

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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., balancesheet, 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, ecommerce and integration tools like enterprise resource planning (ERP).

MECHANICS OF SOLIDS

Group A

Review of free body diagrams; Analysis of deformation unde-!" 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

Group A

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 10w 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 dnves, 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 (shotpeening, 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 sprints. 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.

REFRIGEREATION AND AIRCONDITIONING

Group A

Introduction to refrigeration and air-conditioning, methods of refrigeration-conventional and non-conventional, unit of refrigeration, COP and refrigeration efficiency.

Air refrigeration. Carnot. Bell Coleman, Brayton cycles, simple and bootstrap aircraft refrigeration systems.

Mechanical refrigeration. Carnot vapour refrigeration compression cycle, simple vapour compression cycle. Effect of sub-cooling and superheating on cycle performance, actual vapour compression cycle, multistage and cascade refrigeration, industrial refrigeration systems.

Vapour absorption refrigeration: Working principle, COP comparison between vapour absorption and vapour compression refrigeration systems, actual ammonia vapour refrigeration systems. Lithium bromide water absorption system, electrolux refrigeration system.

Group B

Steam jet refrigeration system: Principle and applications, performance, actual steam jet refrigeration. Vortex and pulse tube refrigeration, theory and operation.

Thermoelectric refrigeration: Thermoelectric elements, working principle and COP refrigerants, desirable properties of refrigerants, primary and secondary refrigerants, various refrigerants and their properties, alternatives to the chloro fluorocarbons.

Air-conditioning: Psychrometry, psychrometry chart and various psychometric processes, comfort and industrial airconditioning, effective temperature and comfort chart, unitary and central airconditioning systems.

Cooling and heating load calculations, design conditions, sensible and latent heat loads, sensible heat ratio, structural, electrical, infiltration and ventilation heat gains, occupancy heat gains, apparatus dew point, bypass and contact factors.

POWER PLANT ENGINEERING

Group A

Thermal power stations. Main components and working of power stations, thermodynamics cycles, fuel handling, combustion and combustion equipment, problem of ash disposal, circulating water schemes and supply of make up water. Choice of pressure of steam generation and steam temperature, selection of appropriate vacuum economiser, air preheater, feedwater heaters and dust collection. Characteristics of turbo alternators, steam power plant, heat balance and efficiency.

Boilers and steam generation, general classification, fire tube and water tube boilers, natural circulation and forced circulation boilers, high pressure, high temperature boilers, supercritical pressure boilers, boiler mounting and accessories, feed pumps, economisers, superheaters, air preheaters; boiler furnaces, heat generation rates, water walls.

Gas fired and fuel fired oil furnaces, pulverised fuel fired furnaces, burners for gas fired, fuel oil-fired and pulverised fuel fired furnaces, grate fired furnaces for solid fuels, feedwater pumps and pipings, boiler settings, estimation of air quantity requirement and draught systems, ID and FD fans.

Diesel power plants: Diesel engine performance and operation, plant layout, log sheets, selections of engine size.

Gas turbine plants: Plant layout, methods of improving output and performance fuel and fuel systems, methods of testing, open and closed cycle plants, operating characteristics.

Group B

Combined working of power plants: Advantages of combined working of different types of power plants, need for co-ordination of types of power plants in power systems, base load stations and peak load stations.

Hydroelectric plants: Penstocks, water turbines, specific speed, turbine governors, hydroplant auxiliaries, plant layout, automatic and remote control of hydroplants, pumped projects, cost of hydroelectric project.

Nuclear power plants: Elements of nuclear power plants, nuclear reactor fuel moderators, coolants, control.

Major electrical equipment in power plants: Generator and exciters, power and unit transformers, circuit breakers, protective equipment, control board equipment, elements of instrumentation.

Power station auxiliaries. Alternate power sources. Solar power, geothermal, tidal and wind power.

NON CONVENTIONAL ENERGY SYSTEMS

Group A

Introduction to non-conventional sources—Solar, bio-gas, wind, tidal, geothermal.

Basic bio-conversion mechanism; source of waste; simple digester; composition and calorific values of bio-gas.

Wind and tidal energy generation; Special characteristics; Turbine parameters and optimum operation; Electrical power generation from wind/tidal energy.

Energy from the sun: Techniques of collection; Storage and utilisation; Types of solar collectors; Selective surfaces; Solar thermal processes; Heating; Cooling; Drying; Power generation, etc.

Group B

Direct energy conversion methods: Photoelectric, thermoelectric, thermionic, MHD (magneto-hydrodynamics) and electro-chemical devices; Solar cells.

Photo voltaic; Amorphous semiconductors; Limitations of photovoltaics efficiency; Fuel cells; Peak load demands; Developments in fuel cells and applications.

Ocean thermal energy conversion; Geothermal energy-hot springs and steam injection; Power plant based on OTEC and geothermal springs.

Fusion energy: Control through fusion of hydrogen and helium. Energy release rates-present status and problems. Future possibilities.

Integrated energy packages using solar, biomass, wind, etc. Comparative study of nonconventional energy sources; Cost considerations and economics.

INTERNAL COMBUSTION ENGINES

Group A

Classification of engines according to fuels, cycle of operation and number of strokes, construction details, value arrangements, application of IC engines, review of air standard cycles, deviation of actual cycles from fuel-air cycles, various influencing factors.

Review of fuels for IC engines with particular reference to velocity, ignition quality and knock rating, variable compression ratio engines.

Air-fuel ratios and mixture requirements of SI engines, stoichiometric fuel air ratio, lean and rich mixture operation, optimum conditions, carburetors-principle, types and venturi, fuel orifice sizes, charge stratification and distribution.

Fuel-air requirement in CI engines. Methods of fuel oil distribution and injection. Types of injector systems in SI and CI engines. Flame front and normal combustion. Detonation in SI and knocking CI engines. Factors influencing detonation and knock. Comparative analysis. Ignition systems in SI and CI engines.

Group B

Engine friction and lubrication: Effect of engine variables, total engine friction, requirements of lubricants and lubricating systems.

Cooling systems: Gas temperature variation, heat transfer rates, piston and cylinder temperature, heat rejected to coolant, air and water cooling systems and components.

Two-stroke engines: Special features, scavenging systems.

Supercharging: Objects, effects on engine performance, supercharging limits, methods of supercharging with special .emphasis on turbochargers.

Engine testing and performance: Various performance parameters and their measurements.

Air pollution from engine exhaust, its measurement and control, principle constituents of engine, emission methods of control, modification of conventional engines, dual fuel and multifuel engines, stratified charged engines, sterlings engines, Wankel rotary combustion engine.

TURBOMACHINERY

Group A

Positive displacement and turbo machines. Basic principles of rotodynamic machines. Efficiency of turbo machines.

Flow through nozzles and blade passages: Steady flow through nozzles, isentropic flow; Effect of friction in flow passages; Converging-diverging nozzles; Flow of wet steam through nozzles; Diffusers.

Steam and gas turbines. Pressure and velocity compounding; Velocity diagrams; Degree of reaction; Utilisation factor; Reaction blanding; Analysis of flow through turbo machines; Energy equation; Momentum equation.

Fluid dynamic consideration: Theoretically obtainable work head; Profile losses. Clearance and leakage losses. Windage losses. Partial admission losses. Flow deviation, Diffuser performance. Design of blade passages. Cavitation in turbo machines.

Group B

Centrifugal compressors: Description and operation, energy transfer and relations, losses, adiabatic efficiency, effect of compressibility, performance characteristics, pressure coefficient, slip factor, surging, surge lines and stall line.

Axial compressor: Introduction, stage characteristics, blade efficiency, design coefficients, blade loading, cascade characteristics, three-dimensional flow considerations, supersonic axial flow compressor, performance characteristics.

Wind turbines: Power, energy and torque of wind turbines, coefficient of performance, energy production and capacity factor, turbine shaft power, torque at variable speeds.

Hydraulic turbomachines: Hydraulic turbines (Pelton wheel and Kaplan turbines), centrifugal and axial flow pumps, characteristics of hydraulic turbomachines.

Fans: Classification, fan laws.

Power transmitting turbo machines; Hydraulic coupling; Torque converters.

DESIGN OF MECHANICAL SYSTEMS

Group A

The essential inputs to a design engineer. Stages in design. Creative and evolutionary design. Problem formulation. Preliminary design and analysis.

Conceptual design: Alternative designs, feasibility analysis and design space, best design constraints, system integration, rational design.

Design process and design cycle. Design morphology.

Design data bases and design standards.

Selection of materials and processes. Accuracy, surface finish, tolerances, statistical nature of loads, part dimensions. Probabilistic design, factor of safety.

Detailed design of simple systems involving pressure vessels, fasteners, pins and welds.

Group B

Optimal design of machine elements and systems. Minimum weight and minimum cost design rigidity and strength.

Reliability of systems, failure rate and component life, MTBF, reliability considerations in design.

Static and dynamic analysis of engineering systems involving shafts, linkages, couplers, transmission devices, toothed elements, etc.

OPTIMIZATION - THEORY AND APPLICATIONS

Group A

Introduction to optimisation: Historical development. Engineering applications. Statement of an optimisation problem, classification and formulation of optimisation problems, optimisation techniques.

Classical optimisation methods: Single variable optimisation, multivariable optimisation with and without constraints.

Linear programming: Standard form of a linear programming problem (LPP), geometry of LPPs, related theorems, linear simultaneous equations, pivotal reduction, simplex method, revised simplex method, duality, decomposition, transportation and assignment problems.

Nonlinear programming (unconstrained): Uni-modal function, exhaustive search, bi-section and golden section methods, interpolation methods, random search methods, univariate method, gradient of a function, conjugate gradient, quasi-Newton and variable metric methods.

Group B

Nonlinear programming (constrained): Complex method* cutting plane method, method of feasible directions, transformation techniques, penalty function methods, convergence checks.

Geometric programming: Introduction to geometric programming, polynomial, unconstrained and constrained problems.

Dynamic programming: Introduction to dynamic programming, multistage decision processes, computational procedures, calculus and tabular methods.

ANALYSIS AND SYNTHESIS OF MECHANISMS AND MACHINES

Group A

Mechanisms and machines, kinematic pair, elements, chains and inversions, degree of freedom, movability, Grubler's criterion, four-link mechanisms,. Grashof's criteria.

Kinematic analysis, instantaneous centres, Kennedy theorem, velocity analysis using velocity difference and instantaneous centres, acceleration analysis, velocity and acceleration images.

Kinematic synthesis, graphical method using inversion and overlay, three-point synthesis problems, motion, path and function generation. Freudenstein's method of three point synthesis of four link mechanisms.

Dynamic force analysis of four-bar and slider crank mechanisms, turning moment and flywheel analysis.

Types of governors, characteristics of centrifugal governors, stability control of speed hunting of governors.

Group B

Balancing of rotating masses: Two balancing masses in two planes for complete dynamic balance. Determination of balancing masses, balancing of rotors, balancing of internal combustion engines, balancing of multicylinder inline engines, V-twin cylinder, multi-row W-engine and radial engine. Lanchester technique for balancing internal combustion engines with rotating eccentric weights.

Types of cam followers, selection of motion, displacement diagrams, cam profile determination.

Gears and gear trains, fundamental law of gearing, involute tooth profile, undercutting and interference. Minimum number of teeth, types of gears, simple, compound and epicyclic gear trains.

Gyroscopic action in machines, simple precession of a symmetrical rotating body.

DESIGN OF MACHINE TOOLS

Group A

Conceptualization of mechanical systems for prescribed scheme; Layout of machine tool elements; Introduction to machine tool drives and mechanisms; General principles of machine tool design.

Design of drive systems; Regulation of speed and feed; Kinematic structure of machine tool gear box; Hydraulic, mechanical and electrical speed regulation.

Design of machine tool structures: Material selection; Welded vs. cast structure; Static and dynamic stiffness; Choice of element sections and their design.

Group B

Analysis of spindles, bearings, slides and guides.

Control systems for machine tools.

Dynamics of machine tools: Machine tools as a closed loop system. Dynamic stability. Forced vibration and chatter in machine tools.

Concept of modular design; Concepts of aesthetic and ergonomics applied to machine tools; Acceptance tests and standardisation of machine tools.

COMPUTER AIDED ENGINEERING DESIGN

Group A

Computer aided design of engineering systems. Applications in modelling, analysis, design and manufacturing.

Computer graphics, raster graphics and interactiveness, pixels and graphic display in computers, windows and view-ports, lines and circles, graphic data storage and manipulation, hardware display, input and output devices.

Geometric transformations-two, three-dimensional and homogeneous transformations, rotation, translation, mirror, perspective, projections, etc.

Computer aided drafting. Introduction to Auto CAD-use of menus and icons, twodimensional drawings using auto CAD lines, circles, tangents, simple machine drawings, dimensioning, blocks and layers, editing and adding text to a drawing.

Advanced auto CAD-three-dimensional drawings. Curves, surfaces and solid models, customizing. Auto CAD, auto LISP.

Group B

Design of curves—PC, Beizer and B-spline curves, normal, tangent, curvature and torsion of curves. Blending of two curves.

Design of surfaces, tangent and normal planes. Curvature and twist, surface patches—PC, Baizer and B-spline, ruled and developable surfaces, swept and revolved surfaces.

Solid modeling—wire frame, constructive solid geometry (CSG) and boundary representation (B-rep); parametric instancing. Cell decomposition, spatial occupancy enumeration,
generalized sweep.

Mass property calculations—curve length, surface area, volume, centroid, mass, moment, etc.

Finite element analysis: Fundamentals of finite element analysis; discretization, mesh generation, pre and post processing and simple applications.

MC 431 MANUFACTURING SCIENCE

Group A

Deformation of metals, stress-strain curves, temperature and strain rate effects, ductility and toughness, plane-strain deformation, mechanism of plastic deformation, control of material properties—alloying and heat treatment.

Sand casting: Pattern materials and allowances, moulding materials, properties ol moulding sand, effects of moulding ingredients on mould properties, estimation of pouring time, mechanism of solidification, rate of solidification in an insulating mould, riser design and placement, residual stresses.

Elements of plasticity—yield criteria and flow rule, plastic instability. Analysis of forming processes—forging, rolling, extrusion, wire and strip drawing, using slab method, deep drawing, blanking and piercing. Lubrication and friction in metal forming.

Group B

Metal cutting: Mechanics of orthogonal cutting, chip formation in turning, shaping, planning, milling and drilling, evaluation of surface roughness in machining, heat generation, estimation of average tool temperature, tool wear mechanism and tool life testing, variables affecting tool life machining economics—estimation of cost and optimum cutting conditions.

Metal grinding: Basic mechanics of grinding process, forces and specific energy, grinding temperature—heat sources and estimation of average temperature, wheel wear mechanism, estimation of surface roughness.

Non-conventional machining: Classification of processes, mechanism of material removal and effects of process parameters in AJM, USM, ECM, EDM, LBM, EBM and PAM.

Welding and allied processes: Bonding process in welding, principles of solid-state welding, fusion welding, soldering and brazing, effects of process parameters, metallurgy of welding stress distribution and heat affected zone.

COMPUTER AIDED MANUFACTURING

Group A

Basic definitions of manufacturing systems: Definitions, design, planning and control.
Part design and CAD: Engineering design, design drafting and its interpretation, inspection and measurement. A brief history of CAD, CAD hardware and software. Fundamentals of geometric modeling. CAD data exchange.
Process engineering: Experience-based planning, process capability analysis, basic machining and other manufacturing process calculations, process optimisation.
Hard automation: Introduction to automated manufacturing, fixed automated manufacturing systems, workpiece handling hardware for automation and economics of automation.
Programmable logic controllers: Function of controllers, control devices, programmable logic controllers.
Data communication and local area networks in manufacturing: Fundamentals of data communication and local area networks.

Group B

Fundamentals of numerical control: Historical developments and principles of NC, classification of NC, NC part programming, manual and computer-assisted part programming.
Introduction to industrial robots: Power sources, actuators and transducers. Robot applications. Economic considerations of robotic systems.
Group technology: Introduction, coding and classification, benefits of group technology.
Process planning: Introduction, manual process planning, computer aided process planning,
variant and generative approaches, simple examples.

TOOL AND DIE DESIGN

Group A

Influence of tools and dies on quality, productivity and environment, tool design methods and procedures, tool making practices, tooling materials and treatment.

Jigs and fixtures. Basic principles of locating and clamping, development of fixture using locating, clamping, indexing tool setting elements, force analysis, standardisation of elements, illustrative examples of machining, welding, assembly and inspection fixtures.

Design of cutting tools and special tools (form cutters and broachers), tooling for CNC, introduction to modular fixtures and tools.

Group B

Die design: Design of sheet metal blanking, piercing, bending and deep drawing dies. Progressive die design.

Mould design. Introduction to die casting and injection mould design. General mould construction. Design of ejection, feed and cooling systems. Parting surface design. Side cores and side cavities. Product design for die casting and injection molding.

Cost estimation and cost benefit analysis.

MANUFACTURING AUTOMATION

Group A

Definition of automation, reasons for automating, pros and cons of automation.

Fundamentals of manufacturing and automation: Manufacturing operations and automation strategies, production economics.

High volume production systems: Detroit type automation, analysis of automated flow lines, assembly and line balancing, automated assembly systems.

Numerical control production systems: CNC, DNC and adaptive control.

Group B

Industrial robots: Robotics technology, robot applications.

Material handling and storage: Automated materials handling, automated storage and retrieval systems.

Flexible manufacturing systems (FMS): FMS workstations, material handling and storage systems, computer control systems, planning the FMS, analysis methods for FMS, applications and benefits.

Automated inspection and testing: Inspection and testing, statistical quality control, automated inspection principles and methods, sensor technologies for automated inspection, coordinate measuring machines, other contact inspection methods, machine vision and other optical inspection methods, and non-contact inspection methods.

PRODUCTION MANAGEMENT

Group A

Introduction. Concept of management, concept of a system, production system, production functions.

Organisation fundamentals. Guidelines for good practice, organisation structures, organisation charts, span of control, number of levels, number of executives, management functions.

Production economics: Kinds of costs, evaluation of capital investments. Capital budgeting, break-even analysis, make or buy decisions, evaluation of alternatives, discounted cash flow, equivalent comparison methods, depreciation.
Aggregate planning. Planning time horizons, inputs to aggregate planning systems, single and multistage aggregate planning systems, decision processes for aggregate planning—graphical method, linear decision rule, and linear programming method-Demand management. Time span for forecasts, forecasting system, forecasting methods-time series, casual and predictive forecasting methods, selection of a forecasting method.

Group B

Scheduling. Scheduling process scheduling for a multistage production system, sequencing production operations, Johnson's rule.
Facilities management. Plant location—factors influencing plant location, cost factors, plant location decision process, selection of a location for new facilities, evaluation of alternative regions and sub-regions. Plant layout-objectives, decision process, types of layouts, comparison of layouts. Line balancing and sequence analysis concepts. Materials handling devices for materials handling, basic considerations in the selection of materials handling system.
Human factor engineering: Methods analysis and works measurement, methods study, process analysis, operation process chart, operator process chart, motion study, principles of motion economy, motion analysis. Time study-types of studies, procedure for job time study, physical environment.
Quality management: Three aspects of quality, functional responsibility for quality in a manufacturing system, economics of quality assurance, quality control, QC decision variables, process control, control charts, acceptance sampling, single, double and sequential sampling plans, concept of total quality control (TQC).
Maintenance management: Maintenance functions, concept of reliability engineering, reliability improvement, preventive maintenance, preventive maintenance policy, repair policy, replacement decisions, queuing theory and its applications in maintenance.
Introduction to PERT/CPM.