Lecturer in Tool & Die Engineering in Technical Education Department (Polytechnic Colleges)

Category No.095/2025

(Total Mark - 100)

Module I Mathematics (10 Mark)

Linear equations, soluctions- Gauss elimination , Eigen value and eigen vectors, Partial derivatives, chain rule, total derivatives

Double integrals (cartesian), change of coordinates, homogeneous linear equations, second order - Euler cauchy equation

Solution of partial differential equation by direct method, One dimensional wave equation, D'Alemberts' solution , one dimensional heat equation

Numerical method, Newton Raphson method, interplation, finite dirrerence, Nowton's backward and forward formula

Geometric modeling for CAD : Transformation of cartesian coordinates of multiple points in three dimensions, composit and inverse transformation, wireframe geometry, surface models, curves and surfaces, cubic curves, Bezier and B splines, NURBS

Module II Engineering basics (15 Mark)

Engineering Mechanics: Static force analysis, free body diagram, planar and non planar forces, Friction types and laws, two bodies in contact - ladder, wedge, screw, belt frictions

Energy Conversion systems

Electrical drives- selection of electric drives- induction motor, speed torque characteristics, power factor, speed control of motors

IC engines- types, ICeningine components and functions- cylinder, connecting rod, crankshaft, fly wheel, cross head, cam shaft

Hydraulic machines - Centrifugal pumps, positive displacement pumps - gear pump, vane pump, screw pump, lob pump and charactristics.

Module III Continuum Mechnaics (15 Mark)

Fluid Mechanics : Physical properties of fluid - Newton's law of viscosity, fluid statics- forces on fluid interacting surfaces, pressure and head concept, Fluid kinematics- types of flow, Renold's numner, Fluid dynamics- momentum and energy equation - Navier Stokes equation, Beruauli's equation and application

Strength of materials : Classification of materials, load, stress, strain, true stress and logarithmic strain, material properties, yield stress, shear force and bending moment of simpply supported, cantilever beams, Design of shafts with direct, bending and torsional loads, design and representation of welded joints

Module IV Mechanisms and Machine tools (10 Mark)

Kinematic link, pair and mechanisms, four bar chain, veleocity analyis, acceleration analysis, coriolis component of acceleration, types of gear trains, speed calulation of gear trains, epycyclic gear trains, interference consideration

in gear selection. Cams and followers types and veloctiy calculation, balancing or rotating masses in multple planes. Vibration of machines, free and forced vibration - mathematical modeling.

Mechanism used in lathe, indexing mechanism, halfnut mechanism, speed selection in thread cutting. Mechanisms used in milling machine - indexing head, universal indexing mechanisms, shaper mechanism - quick return mechanism, pawl and ratchet mechanism.

Module V Manufacturing Planning and Production Processes (15 Mark)

Production Management : Process planning and cost estimation - selection of processes and process variables for specific part, selection of tooling, Production planning and control, inventory management, economic order quantity, break even analysis

Metal cutting : Lathe operations – Plain turning, Taper turning, Thread cutting and other operations. Shaper, Slotter and Planer – work holding devices, specifications.Drilling machines – types – specifications – parts and its functions – Drill bit, types, nomenclature.Grinding and Grinding machine – cylindrical grinder and surface grinder, special purpose grinders – specifications – working – parts – functions.Milling Machines – Types – specifications – parts – functions – milling operations – conventional milling and climb milling, hard turning, machinability of materials

Metal casting: Melting processes and materials, solidification of metals, Iron carbon system,micro structure, Iron cementite and iron- graphite phase diagrams,pour temperature, steel casting, , Metallurgy of grey iron, sand casting, Effect of common alloying elements on the Fe-Fe3C and Fe-C diagrams,preperation and testing of sand, core sand preperation, Mechanisation of foundary, cetrifugal casting, centrifuging, flowability of metals.

Metal joining, welding process - arc welding, Shielded Metal Arc Welding (SMAW) or Stick Welding,GMAW- MIG & MAG Welding,Gas Tungsten Arc Welding (TIG),Flux Cored Arc Welding (FCAW), and Submerged Arc Welding (SAW). Electron beam welding, laser welding, friction stirr welding, ultrasonic metal welding. -Metallurgy of welding, Heat affected zone, dilution in welding, weldability of materials.

Metal forming: Theory of plasicity, Mechanism of plastic deformation, yield conditions of isotropic metals, Trescas and Von Mises criteria, Constitutive relations in elastic-plastic deformation, Hot and cold forming, recrystallisation, neucleation and grain growth, Rolling process, Roll seperation force calcualtion, Forging process, forge load calculation, Extrusion process, load calcuation, drawing process and drawing force calculation. Drawability of metals. Sheet metal processes - Piercing, Blanking, Lancing, extrusion, embossing, coining, bending, drawing, swaging, shaving, deep drawing - heat treatment of metals as pre and post forming - annealing, normalising, surface hardening.

Module VI Production tooling: (20 Mark)

Metal cutting tools Single point cutting Tool, nomenclature, design of single point cutting tool and work piece materials mechanism of tool cutting, chip formation, Types of chips, Tool life equation. Tool dynamometers - Power requirement of machining.

Multi point tools, grinding tools, Abrasives, Types, Types of bonds, selection of Grinding wheel, Specification of Grinding wheel, Work holding devices – mounting of wheel, truing and dressing of wheel, – Balancing of wheel

Milling cutters – Types – nomenclature – Tool material – specification – cutter holding devices – work holding devices

Drill bit specification, nomenclature, tool parameters, design of drill bits, nomenclature

of broach tool and design.

Cutting tool material properties, inserted tipped tools and insert material.

Press tools types and selection, Guide Plate Tool, Progressive Tool, Compound tool and Combination Tool Strip layout - % utilization.,Punches – Cutting and non cutting punches, hybrid punches – Load on punches – size determination – clearance, punch, die size, die block – solid, split, Strippers – types, box, fixed, travellers, stripping force for blanking and piercing – fool proofing – pilots – purpose – direct and indirect pilots – size – methods of piloting, Side Cutters – Functions, advantages Ejectors and Shedders – Functions and Types. Knockouts – Functions

Design of sand mold, riser and gating design, design of plastic injection molding dies,

Design of fixtures, location principles used for jigs and fixtures, 3-2-1 principle, locating devices, use of Tool makers button, flexible tooling - reconfigurable tooling.

Module VII Manufacturing automation and industrial inspection (15 Mark)

Industrial automation Types of automation - Fixed, programmable and flexible, CNC progamming for finishing cuts for two and three axes machines, use of canned cycle and macros. CNC accessories ATC, pallets and tool magazines. Distributed or direct numerical control.

Low cost automation - Pneumatics and hydraulic circuit for multiple cylender actuators.

Hydraulic circuit design - power pack, time delay circuits, selection of hydraulic cylinders.

Computer aided engineering, finite elements methods, manufacturing simulation.

Industrial inspection - Limits fits tolerance, Linear measurements & Angular measurements – surface plate, angle plate, 'V' Block, Straight edge, Combination set, universal surface Gauge, Feeler Gauge – Bevel protractor, sine bar, slip gauge. Measurement of tapered recess whose angle is very small, Gauges – limit gauges, Go and No go gauges, Plug gauge, Snap gauge, Ring gauge – advantages and limitations, Dial Gauge – profile projector, Comparator – Mechanical, electrical and electronic, optical comparator, pneumatic comparator, Coordinate measuring machine- measurement of geometric features

Surface finish – Evaluation of surface roughness – CLA and RMS value – method of measuring surface finish – flatness test, parallelism test Calibration – need – requirements – annual calibration programme – calibration of Vernier calliper, Vernier height gauge, depth gauge, dial gauge, limit gauges, slip gauges, Surface plate.

Statistical quality control, acceptance sampling, control charts variables and attributes.

Industry 4.0 Computer integrated manufacturing, Flexible manufactruing system, cloud manufacturing, supply chain management, enterprise resource planning, total quality management, Product lifecycle management, intelligent manufacturing systems.

NOTE: - It may be noted that apart from the topics detailed above, questions from other topics prescribed for the educational qualification of the post may also appear in the question paper. There is no undertaking that all the topics above may be covered in the question paper.