

SYLLABUS FOR PRILIMINARY SCREENING TEST FOR RECRUITMENT TO THE POST OF LECTURER IN
MECHANICAL ENGINEERING FOR GOVT. POLYTECHNICS IN THE W.B.G.S.
UNDER THE TECHNICAL EDUCATION & TRAINING DEPARTMENT

Full Mark: 100

Time: 1hr. 30 mins

1. ELECTRICAL TECHNOLOGY

Electrical Units, and dimensions. Electro magnetism, Magnetic circuits, D.C.generators and motors, speed control. Starters. Electrical measuring instruments-principles of operation and construction.

2. MATHEMATICS

Function of a single variable: Successive differentiation. Rolle's theorem. Mean value theorems. Taylor's theorem and Maclaurin's series. Maxima and minima. Indeterminate forms. Tangent, normal and curvature.

Functions of several variables; limit and continuity. Partial derivatives. Differentials. Partial derivatives of a composite function. Implicit function. Jacobian. Taylor's theorem. Maxima and minima. Lagrange's method.

Reimann integration : Definition, Properties. Fundamental theorem of integral calculus. Improper integrals. Gamma and Beta functions.

Multiple integrals : Existence of integrals (statement only) Properties of double integral. Evaluation of double integral. Change of the order of integration and change of variables.

3. ENGINEERING MECHANICS

Laws of Coulomb's friction, equilibrium of rigid bodies, principle of virtual work, application of friction in machines, properties of surfaces, centre of mass, and centre of gravity, shear force and bending moment diagrams.

Introduction to elasticity, problems in uni-axial stress field.

Thin-walled beams, unsymmetrical bending, energy principles, Castigliano's theorems, curved beams, thick-walled cylinders under radial pressure. Lamé's equation, theories of failure.

Work-energy principle, momentum principle, central force motion.

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4. PHYSICS

Angular momentum and torque. Moment of inertia. Parallel and perpendicular axes theorem. Calculation of moment of inertia of some common solids. Rotational dynamics of a rigid body.

Newton's law of Gravitation. Calculation of gravitational field and potential of a spherical distribution of mass. Motion under a central force.

Kepler's laws.

5. THERMODYNAMICS

Microscopic & Macroscopic viewpoints in Thermodynamics; Fundamental concepts of system, control volume, state, properties, equilibrium, processes etc. Zeroeth Law; Survey of units & Dimensions; Forms of energy and energy interactions, heat & work;

Ideal & Real Gases; Equations of state; Compressibility Factor; Generalised compressibility chart; First Law of Thermodynamics for closed systems internal energy;

First Law for Control Volumes; Steady flow & unsteady flow applications.

Definitions of Heat Engine, Heat Pump, Thermal Efficiency, COP; Carnot Cycle.

Second Law of Thermodynamics; Statements and Corollaries; Entropy; Concept of Reversibility and irreversibility.

Second Law analysis of Control Volumes; Concept of Entropy Generation. Reversible work, availability & Irreversibility.

T-dS relations; Maxwell equations; Clapeyron Equation; Clausius-Clapeyron equation, Joule-Thompson Coefficient; Compressibility & expansion co-efficient.

6. MATERIALS & METALLOGRAPHY

Unit cells, packing efficiency and co-ordination number, bonds and bond energy, plastic deformation and mechanical testing of metallic materials.

Strengthening mechanism, heat treatment of steels, cast iron and carbon steels, important alloy steels, important non-ferrous alloys.

7. STRENGTH OF MATERIALS

Thin pressure vessels, torsion of circular shafts, close-coiled helical springs, stresses in beams due to bending and shear.

Deflection of beams, combined bending and torsion, concept of elastic stability with particular reference to buckling of columns. Strain energy.

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8. FLUID MECHANICS

Properties of Fluid, Classification of Fluid ideal and real fluids, Newtonian and Non-Newtonian Fluids. Compressible and Incompressible fluids.

Steady and Unsteady flow. Uniform and non-Uniform flow. Path line, Stream line and stream tube, One, two and three-dimensional flow. Continuity Equation-differential and integrated form. Rotational and Irrotational flow. Vortex motion. Laminar and Turbulent flow.

Darcy-Weisbach equation, Moody's diagram. Flow through non-circular ducts. Minor losses-heat losses at sudden expansions, sudden contractions and bends. Head losses in pipes in series and parallel, pipe line problems.

Dimensional Analysis, similarity etc. to sink and Doublet.

Review of Irrotational flow, flow around symmetrical bodies. Specific speed and classification of fluid machinery. Design methodology of axial and radial flow machines (pumps and fans).

9. DESIGN OF MACHINE ELEMENTS

Introduction to design. Factor of safety, calculation of allowable stress under various types of loading, stress-concentration, endurance diagram and design criteria.

Review of stress calculation in various situation-direct, bending and torsional loads and their combined effect. Buckling

Design of pin-joint, cotter-joint etc.

Transmission screws.

Screw-joints, pre-loaded bolts, etc.

Rivets and riveted joints, etc.

Design of weldments.

Key, shaft and axle.

Belt drive : Flat & V-belt, pulleys.

Coupling : rigid and flexible.

Toothed gear drive : Spur, straight, and helical tooth.

Gears for non-intersecting shafts : Bevel & Hypoid gears.

Brakes and clutches : Band & shoe brake, friction clutch, jaw clutch and centrifugal clutch.

Springs : Tension, compression, torsion and leaf springs.

10. DYNAMICS OF MACHINES

Gyroscopic motion, force analysis of machines-analysis of fly-wheels & governors.

Balancing of rotating and reciprocating masses.

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10. DYNAMICS OF MACHINES (CONTD.)

Vibration of spring-mass systems, introduction to vibrations of elastic bodies-transverse vibration of beams and critical speed of shafts, Torsional vibration with multiple discs.

11. I.C. ENGINES & GAS TURBINE

Principle of working; basic engine types; comparison of air standard cycles; air cycle analysis with variable specific heats; introduction to fuel air cycle analysis; actual cycles, mep; thermal efficiency.

Combustion calculations related to I.C.Engine fuels. Desirable characteristics for fuels for I.C.engine.

Mixture requirement for S.I.Engine; carburetion pressure drop-flow relation; fuel air-ratio; complete carburetor. Petrol injection. Ignition system in S.I.Engine-Battery, Magneto, and Electronic ignition systems; ignition timing and spark advance.

Fuel oil injection in C.I.Engine-requirements; fuel injection systems; injection pumps and nozzels.

Supercharging I.C.Engine-requirements; supercharging limits; Turbocharging. Scavenging of I.C.Engines-two stroke S.I. and C.I.Engines; scavenging parameters; ideal scavenging processes; actual scavenging; scavenging pumps.

12. MACHINE TOOLS

Machine tool design : Features of construction, function and principles involved in the design of machine tool elements : layout of speeds for various machine tool drives; hydraulic and electric drives; design of gear boxes for speed and feed changes; rigidity and vibration analysis of machine frames; columns, beds and spindles.

Economics of machine tool selection : economic tool life.
