

## Indicative Syllabus

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| <b>Post Code</b>                         | 009   |
| <b>Name of Post</b>                      | Junior Engineer (Plant) (Mechanical)- Trainee   |
| <b>Minimum Educational Qualification</b> | Regular Diploma in Mechanical Engineering from AICTE/ UGC approved University/ Institute. |

- Theory of Machines and Mechanisms:** Machines, Concept of simple machines, Four bar linkage and link motion, Lifting machines, Pulleys, Cams and Followers, Flywheels and Governors, Fluctuation of energy, Power Transmission, Types of drives- Belt, Chain, Rope, Gear drives and their comparison, V-belts and Flat belts, Chain Drives, Gear Drives, Type of gears and gear trains, gear profile and gear ratio calculation, Rope drives; Flywheel and Governors — Principles, function, applications, classification/ types, Brakes, Dynamometers, Clutches & Bearings — function, types, construction, working, Plate clutch, centrifugal clutch, Conical clutch, Diaphragm clutch, brakes, Riveted joint, Bearings- Simple pivot, collar bearing, conical pivot, Friction in collars and pivots, Methods of lubrication.
- Engineering Mechanics and Strength of Materials:** Forces, Equilibrium of Forces, Stress, Strain and their nature, Mechanical properties of common engineering materials, Stress-Strain Diagram, Factor of Safety, Stress and Strain in bodies of uniform section and composite sections, Thermal Stress, Strain Energy or resilience, strain energy due to gradually applied load, suddenly applied load, impact/ shock load, Elastic limit and elastic constants, Shear force and bending moment, Types of beams, Types of load, Shear Force and Bending Moment diagrams, Torsion, Simple bending and Deflection of Beams, Bending stress, modulus of section, moment of resistance, safe load, safe span, Torsion in circular shafts, Springs- classification, deflection, stiffness, Columns and Struts, Buckling of columns - Euler's and Rankin's theories, Thin walled pressure vessels.
- Thermal Engineering:** Properties of Pure Substances: P-V & P-T diagrams of pure substance like H<sub>2</sub>O, Introduction of steam table with respect to steam generation process; definition of saturation, wet & superheated status. Definition of dryness fraction of steam, degree of superheat of steam. H-s chart of steam (Mollier's Chart); Laws of Thermodynamics- Zeroth law, concept of work and heat, Definition of stored energy & internal energy, 1st Law of Thermodynamics of cyclic process, relationship between heat transfer, work transfer and change in internal energy, Concept of conservation of mass and control volume, Non Flow Energy Equation, Flow Energy & Definition of Enthalpy, Conditions for Steady State Steady Flow; Steady State Steady Flow Energy Equation. Limitation of first law; 2nd Law of Thermodynamics- Definition of Sink, Source Reservoir of Heat, Heat Engine, Heat Pump & Refrigerator; Thermal Efficiency of Heat Engines & co-efficient of performance of Refrigerators, reversible process, factors which make a process irreversible, Kelvin-Planck & Clausius Statements of 2nd Law of Thermodynamics, Absolute or Thermodynamic Scale of temperature, Clausius inequality, Entropy, Entropy change calculation of ideal gas processes. Carnot Cycle & Carnot Efficiency; PMM2 - definition & its impossibility.
- Internal Combustion (I.C.) Engines:** Air standard Cycles for I.C. engines, Carnot, Otto and Diesel cycles with P-V and T-S diagrams, Advantage of I.C. Engines, Classification, I.C. Engine Components and their functions, Materials used for component parts, Four Stroke and Two Stroke engines, S.I. and C.I. Engines, Valve timing, Port timing. I.C. Engine systems – Fuel system, Cooling System, Ignition System, lubricating system, Governing System, Performance of I.C. Engines, Power and Thermal Efficiencies, Heat Balance.
- Rankine cycle of steam:** Simple Rankine cycle plot on P-V, T-S, h-s planes, Rankine cycle efficiency with & without pump work.

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6. **Boilers:** Function and use of Steam Boilers, Classification, Specifications, Fire Tube & Water Tube Boilers, Mountings & Accessories, Steam Traps and Separators, Actual evaporation, Equivalent evaporation, Factor of evaporation, Boiler Horse Power and Boiler efficiency, Draught systems- natural and forced.
7. **Steam and Gas Turbines:** Steam Turbines – Classification, Impulse and Reaction turbines, Principles of working, Work done, efficiencies, compounding, Bleeding, re-heating, Governing of Steam Turbines- Throttling, by-pass and Nozzle control, Turbine components, Steam Condensers- components and construction features, Steam Nozzles. Gas Turbines - Air-standard Brayton cycle; p-v and T-S diagrams; Classification: open cycle gas turbines and closed cycle gas turbines; comparison with reciprocating I.C. engines and steam turbines. Applications and limitations; General lay-out, P-V and T-S diagrams and working.
8. **Air Compressors & their cycles:** Functions of air compressor, uses of compressed air, Types– reciprocating, rotary, centrifugal, axial flow, vane type; single stage and multi stage compressors.
9. **Refrigeration & Air Conditioning:** Various refrigeration cycles, representation of cycles in P-V, T-S and P-H diagrams, Vapour Compression System, Vapour Absorption System, COP, Refrigerants, Principle of a Refrigeration Plant; Air Conditioning- Psychrometry; Room Air Conditioning; Central Air Conditioning.
10. **Fluid Mechanics:** Properties & Classification of Fluids; Ideal & real fluids, Newton’s law of viscosity, Newtonian and Non-Newtonian fluids, compressible and incompressible fluids; Dynamics of ideal fluids; Bernoulli’s equation, Total head; Velocity head; Pressure head; Application of Bernoulli’s equation. Fluid Statics: Pressure at a point. Measurement of Fluid Pressure: Manometers, U-tube, Inclined tube. Fluid Kinematics: Types of fluid flow, Path line and Stream line, Flow through pipes- laminar & turbulent flow, external & internal flow, continuity equation. Measurement of Flow rate- Basic Principles; Venturimeter, Pilot tube, Orifice meter. Notches and Weirs, Channels.
11. **Hydraulic Machinery:** Hydraulic Turbines - classifications, selection of turbine, construction and working principles, performance, operational features. Pumps- classification, centrifugal and reciprocating pumps, construction and principles of working, operational features, performance, applications.
12. **Manufacturing Engineering:** Classification of Steels: Mild Steel & Alloy Steel, Heat treatment of steel, Welding - Arc Welding, Gas Welding, Resistance Welding, Special Welding Techniques, i.e., TIG, MIG, etc., (Brazing & Soldering), Welding Defects & Testing; NDT, Foundry & Casting methods, Moulding processes, defects, different casting processes, Forging, Extrusion, etc, Metal cutting principles, cutting tools, Basic Principles of machining with (i) Lathe (ii) Milling (iii) Drilling (iv) Shaping (v) Grinding Machines, tools & manufacturing processes. Jigs & Fixtures- difference, types; Cooling processes- types of cutting fluids and coolants, properties and applications of lubricants.