

કાર્યપાલક ઇજનેર(યાંત્રિક)નુ સીલેબસ

- (૧) સામાન્ય જ્ઞાન(૧૦૦ માર્ક્સ)
ગુજરાતી વ્યાકરણ(ઘોરણ-૧૦ સુધીનુ)
અંગ્રેજી વ્યાકરણ(ઘોરણ-૧૦ સુધીનુ)
તથા રીજનીંગ અને લોજીક
- (૨) ટેકનીકલ પેપર-૧ (૨૦૦ માર્ક્સ)
- (૩) ટેકનીકલ પેપર-૨ (૨૦૦ માર્ક્સ)

Syllabus of Mechanical Engineering for Executive ENGINEER Post

Paper-1

Fluid Mechanics: Fluid properties; fluid statics, manometry, forces on immersed surfaces, Center of pressure, Buoyancy, Elements of stability of floating bodies; control-volume analysis of mass, momentum and energy; fluid acceleration; differential equations of continuity and momentum; Bernoulli's equation; Measurement of flow rate and Pressure drop, viscous flow of incompressible fluids; boundary layer; Elements of boundary layer theory, Integral approach, Laminar and turbulent flows, Separations; flow through pipes, head losses in pipes, bends etc. Flow over weirs and notches, Open channel flow, Hydraulic jump, Dimensionless numbers, Dimensional analysis, Similitude and modelling, Irrotational and incompressible, Kinematics and Dynamics of fluid.

Hydraulics Machines: Reciprocating, Centrifugal and axial flow Compressors, Multistage compression, Reciprocating and Rotary pumps, Pelton wheel, Kaplan and Francis Turbines, velocity diagrams, Impulse and Reaction principles, All other elements of Hydraulic elements. Operation and control of hydraulic elements.

Thermodynamics: Thermodynamic systems and processes; properties of pure substance; Zeroth, First and Second Laws of Thermodynamics; Entropy, Irreversibility and availability; Carnot cycle. irreversibility and availability; behaviour of ideal and real gases, properties of pure substances, calculation of work and heat in ideal processes; analysis of thermodynamic cycles related to energy conversion. Analysis of thermodynamic cycles related to energy conversion: Rankine, Otto, Diesel and Dual Cycles; ideal and real gases; compressibility factor; Gas mixtures.

Heat and Mass Transfer: Modes of heat transfer, one dimensional steady and unsteady conduction, Composite slab and Equivalent Resistance, Heat exchangers, Heat dissipation from extended surfaces, Empirical correlations for heat transfer in laminar and turbulent flows and for free and forced Convection, Overall heat transfer coefficient, Thermal boundary layer over a flat plate, Black body and basic concepts in Radiation, Fundamentals of diffusive and connective mass transfer.

Refrigeration and Air Conditioning: Vapour compression refrigeration, Refrigerants and Working cycles, Compressors, Condensers, Evaporators and Expansion devices,

Other types of refrigeration systems like Vapour Absorption, Vapour jet, thermo electric and Vortex tube refrigeration. Psychometric properties and processes, Comfort chart, Comfort and industrial air conditioning, Load calculations and Heat pumps. Psychometry, Sensible heating and cooling, controls, Duct design, Heat pump and Refrigeration cycles and systems, Charts and application to air conditioning Effective temperature, comfort indices, Load calculations and Solar refrigeration.

IC Engine: Cycles and IC Engines, Basic concepts, Open/Closed systems, Claperyron and real gas equations, Application to non-Flow and Flow processes, Turbo-prop and Rocket engines, Engine Cooling, Lubrication system, Performance characteristics and testing of IC Engines; Fuels; Emissions and Emission Control, Flue gas analysis, Measurement of Calorific values, Conventional and Nuclear fuels, Elements of Nuclear power production, Two stage compressor, C-I and S,I, Engines, Pre-ignition, Detonation and Diesel-knock, Fuel injection, Carburation and Supercharging/turocharging.

Power Plant Engineering: Rankine and Brayton cycles with regeneration and reheat, Fuels and their properties, Flue gas analysis, Boilers, steam turbines and other power plant components like condensers, air ejectors, electrostatic precipitators and cooling towers – their theory and design, types and applications; Reheat, Regeneration, Efficiency, Governance, Energy transfer, Coupling, Power transmission, Steam generators Fire-tube and water-tube boilers, Various types of steam and gas Turbines, Velocity diagrams, Partial admission, Performance, Flow of steam through Nozzles and Diffusers, Wetness and condensation. Nuclear Power Plant.

Renewable Sources of Energy: Solar Radiation, Solar Thermal Energy collection - Flat Plate and focusing collectors their materials and performance. Solar Thermal Energy Storage, Applications – heating, cooling and Power Generation; Solar Photovoltaic Conversion; Harnessing of Wind Energy, Bio-mass and Tidal Energy – Methods and Applications, Working principles of Fuel Cells.

Measurement and Metrology: Measurement methods and error, Measurement of pressure, temperature, flow and other properties, Calibration, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; form and finish measurement; alignment and testing methods; tolerance analysis in manufacturing and assembly.

PAPER-2

Engineering Mechanics: Free body diagrams and equilibrium; trusses and frames; virtual work; Kinematics and dynamics of particles and of rigid bodies in plane motion, including impulse and momentum (linear and angular) and energy formulations; impact. Analysis of System of Forces, Friction, Centroid and Centre of Gravity, Dynamics;

Engineering Materials: Structure and properties of engineering materials, stress strain diagrams for engineering materials, Common applications of various materials, Defects in crystalline materials, Basic Crystallography, Alloys and Phase diagrams, Heat Treatment, Ferrous and Non Ferrous Metals, Non metallic materials, Basics of Nano-materials, Mechanical Properties and Testing, Corrosion prevention and control, NDT Techniques in Condition Monitoring.

Strength of Materials: Stress and strain, stress-strain relationship and elastic constants, Mohr's circle for plane stress and plane strain, thin cylinders; shear force and bending moment diagrams; bending and shear stresses; deflection of beams; torsion of circular shafts; Euler's theory of columns; strain energy methods; thermal stresses. Combined stresses, thick-and thin-walled pressure vessels, Struts and columns, Strain energy concepts and theories of failure, Beams : Bending moment and shear force diagram, bending stresses and deflection of beams, Shear stress distribution, Torsion of shafts, helical springs, Stress and strain in two dimensions, Principal stresses and strains, Mohr's construction, linear elastic materials, stress-strain relations, isotropy and anisotropy, uniaxial loading, thermal stresses,

Theory of Machines: Types of Kinematics Pair, Mobility, Inversions, Kinematic Analysis, Velocity and Acceleration Analysis of Planar Mechanisms, CAMs with uniform acceleration and retardation, cycloidal motion, oscillating followers; Vibrations –Free and forced vibration of undamped and damped SDOF systems, Transmissibility Ratio, Vibration Isolation, Critical speeds and whirling of shafts. Gears – Geometry of tooth profiles, Law of gearing, Involute profile, Interference, Helical, Spiral and Worm Gears, Gear Trains- Simple, compound and Epicyclic; Dynamic Analysis – Slider – crank mechanisms, turning moment computations, balancing of Revolving & Reciprocating masses, Gyroscopes –Effect of Gyroscopic couple on automobiles, ships and aircrafts,

Governors. Balancing of single and multicylinder engines, Linear vibration analysis of mechanical systems, Machine Vibration, Data acquisition, Fault Detection, Vibration Monitoring, Field Balancing of Rotors, Noise Monitoring,

Design: Design for static and dynamic loading; failure theories; fatigue strength and the S-N diagram; principles of the design of machine elements such as bolted, riveted and welded joints, cotters, keys, splines, threaded fasteners, joints formed by interference fits, shafts, power transmission elements-gears, belt, rope, rolling and sliding contact bearings, brakes and clutches, couplings and power screws. Design of IC engine components and Machine tool components. Failure concepts and characteristics-Reliability, Failure analysis, Wear and Debris Analysis, Computer aided Design, Finite Element Analysis.

Metal Casting: Sand Casting, Design of patterns, moulds and cores; solidification and cooling; riser and gating design, design considerations all types of Metal Casting, Centrifugal Casting, Die casting, investment casting etc., melting furnaces, Casting Defects.

Joining: Physics of welding, brazing and soldering; adhesive bonding; Different types of welding processes, Principles of Gas, Arc, Shielded arc Welding; Weldability: Metallurgy of Welding, Advanced Welding Processes, Welding defects. Design considerations in welding.

Forming: Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy.

Machining and Machine Tool Operations: Machine tool -Lathe, Milling, Drilling, Grinding, Boring Gear Manufacturing, Production of flat surfaces, etc., Automats. Mechanics of machining, single and multi-point cutting tools, tool geometry and materials, tool life and wear; Tool Life & Machinability; Measurement of cutting forces, economics of machining; principles of non-traditional machining processes; principles of work holding, principles of design of jigs and fixtures.

Advance Manufacturing: Computer Controlled Manufacturing Systems-CNC, DNC, FMS, Basic concepts of CAD/CAM and their integration tools. Group Technology.

Production Planning and Control: Forecasting models, aggregate production planning, scheduling, materials requirement planning.

Inventory Control: Deterministic and probabilistic models; safety stock inventory control systems. Inventory control ABC analysis, EOQ model, Work measurement,

Quality Management: - Quality analysis and control ,Materials requirement planning, Job design, Job standards, Single server queueing model,

Operations Research: Linear programming, simplex and duplex method, transportation, assignment, network flow models, simple queueing models, PERT and CPM. Value Engineering : Value analysis for cost/value,