

WORKSHOP SUPERINTENDENT/MECHANICAL ENGG./

PAPER -I

- 1. Engineering Mechanics:**  
Analysis of Force Systems, Friction, Centroid and Centre of Gravity, Trusses, Bending Moment and Shear Force diagrams, Kinematics and Kinetics of Rigid Bodies.
- 2. Mechanisms and Machines:**  
Velocity and Acceleration analysis, Cams and Followers, Gears and gear trains, Clutches, Brakes and Dynamometers, Flywheel and Governors, Brakes and Dynamometers, Balancing of rotating and Reciprocating Masses, Balancing of Multi Cylinder Engines, Free and Forced Vibration, Gyroscopic Stabilization, Whirling of Shafts.
- 3. Mechanics of Solids:**  
Stresses and Strains, Compound Stresses and Strains, Torsion of circular Shafts, Slope and Deflection, Unsymmetrical bending, Curved Beams, Thin and Thick Cylinders, thin Spheres, Helical and Leaf Springs, Buckling of Columns.
- 4. Design of Machine Elements:**  
Design for Static and Dynamic Loading, Theories of failures, Fatigue, Design of Rivetted, Welded and Bolted Joints, Shafts, Gears, Bearings, Clutches and Brakes.
- 5. Engineering Materials:**  
Crystal Systems and Crystallography, Crystal Imperfections, Phase Diagrams, Iron Carbon Equilibrium Diagram, Heat Treatment, Ferrous and Non Ferrous Metals and Alloys, Mechanical Properties and Testing.
- 6. Manufacturing:**  
Metal Casting, Metal joining, Metal forming, Mechanics of Metal cutting, Machining and Machine Tool Operations, Unconventional Machining, Limits, Fits and Tolerances, Inspection: Surface Roughness and its measurement; Comparators, Computer Integrated Manufacturing, Flexible Manufacturing Systems, Jigs and Fixtures.
- 7. Industrial Engineering:**  
Production Planning and Control, Inventory Control, Operations Research, CPM and PERT.

## 8. Mechatronics and Robotics:

Microprocessors and Micro Controllers, Architecture, Programming, Computer Interfacing, Programmable Logic Controllers, Sensors and Actuators, Piezoelectric Accelerometers, Hall Effect Sensors, Optical Encoder, Resolver, Inductosyn, Pneumatic and Hydraulic Actuators, Stepper Motor, Control System, Mathematical Modelling of Physical Systems, Control Signals, Controllability and Observability. Robotics : Robot Classification, Robot Specification, Notation, Direct and Inverse Kinematics, Homogeneous Co-ordinates and Arm Equations of four Axis SCARA Robot.

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**PAPER –II**

**1. Thermodynamics:**

Thermodynamic Systems and Processes, Properties of Pure Substances, Concepts and Applications of Zeroth, First and Second Law of Thermodynamics, Entropy, Availability and Irreversibility, detailed Analysis of Thermodynamic Cycles, Ideal and Real gases, Fuels and Combustion.

**2. Fluid Mechanics:**

Basic Concepts and Properties of Fluids, Manometry, Fluid Statics, Buoyancy, Equations of Motion, Bernoulli's Equation and Applications, Viscous Flow of incompressible fluids, Laminar and turbulent flows, Flow through pipes and head losses in Pipes, Isentropic and Adiabatic Flows, Normal Shock Waves.

**3. Heat Transfer:**

Modes of Heat Transfer, Steady and unsteady heat Conduction, Thermocouple time constant, critical thickness of insulation, Heat Transfer from Fins, Momentum and energy Equations for Boundary Layer flow on a Flat Plate. Free and Forced convection Radiative heat transfer, Stefan-Boltzmann law, Shape Factor, Black and Grey Body radiation, heat exchanger, Boiling and Condensation, Heat Exchanger Performance Analysis, LMTD and NTU-Effectiveness Methods.

**4. Energy Conversion:**

SI and CI engines, Performance Characteristics and Testing of IC Engines, Fuels, Combustion Phenomena in SI and CI Engines, Carburetion and Fuel Injection Systems, Emission and Emission Control. Reciprocating and Rotary Pumps, Pelton wheels, Francis and Kaplan Turbines, velocity Diagrams, Impulse and Reaction Principles, Steam and Gas Turbines, Rankine and Brayton Cycles with regeneration and reheat, High Pressure Boilers Drafts, Condensers. Unconventional Power Systems Including Nuclear, MHD, Biomass, Wind and Tidal Systems. Utilization of Solar Energy, Reciprocating and Rotary Compressor; Theory and applications, Theory of Propulsions, Pulsejet and Ramjet Engines.

**5. Environmental Control:**

Vapour Compression, Vapour Absorption, Steam jet and Air Refrigeration Systems, Properties of Refrigerant and their Nomenclature, Psychrometric Properties and Processes, Psychrometric Relations, Use of Psychrometric chart, Load Estimation, Supply Air Conditions, Sensible Heat Factor, Air Conditioning; System Layout, Comfort Chart, Comfort and Industrial Air Conditioning.

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