

# **RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER**

## **SYLLABUS FOR COMPETITIVE EXAMINATION FOR THE POST OF ASSISTANT CONSERVATOR FOREST & FOREST RANGE OFFICER GRADE I<sup>st</sup> FOR (FOREST DEPARTMENT)**

### **OPTIONAL SUBJECT - MECHANICAL ENGINEERING**

- 1. Theory of Machines :** Kinematic analysis of mechanisms, Instantaneous centre of rotation, straight line mechanisms, steering mechanisms, Hooke's Joint, brakes and dynamometers, Cams, Governors, Gears and Gear trains, fly wheel and turning moment diagram, Friction (types), Laws of friction, Inclined plane, Ball & roller bearings, single and multiplate clutches, Balancing of rotating and reciprocating masses, Gyroscopic motion, vibration analysis of free, damped and forced vibration of single degree of freedom, Vibration isolation and transmissivity.
- 2. Materials Science :** Crystal structure, space lattice, Miller indices, Imperfection in crystals, mechanism of plastic deformation, Theory of work hardening and recrystallization, concept of creep, fatigue and fracture, Phase diagrams, Heat treatment of steels, Plain carbon steel, alloy steels, effect of alloying elements in steel, composition, application and properties of common engineering materials.
- 3. Machine Design and Mechanics of Solids :** Factor of safety, Stress-strain relations, Theory of fatigue, Endurance limit, Concept of fracture in ductile and brittle metals, Creep behaviour in metals, Stress and strain in two dimensions, Principal stresses and strains, isotropy and anisotropy, Uniaxial loading, thermal stresses, Bending moment and shear force diagrams, bending stresses and deflection of beams, Shear stress distribution. Torsion of shafts, helical springs. Combined stresses, Struts and columns, Fits, Tolerances and limits.
- 4. Manufacturing Science :** Principle of arc and gas welding, Brazing and Soldering, hot and cold working of metals, Geometry of single point cutting tool, types of chips, Taylor's tool life equation, Recent machining methods-EDM, ECM and ultrasonic. Application of lasers and plasmas, NC & CNC machines.

**5. Industrial Engineering :** Type of business, public corporations and co-operative societies. Forms of organization, management structure, work study and productivity, motion study, time study, theory of work sampling, Material handling: functions, engineering & economic factors, Production Planning and Control, Forecasting-moving average, exponential smoothing, Operations scheduling; assembly line balancing. Breakeven analysis, CPM& PERT, Material Management, Planning and Programming, Inventories, lot size, lead time, re-order point, wages payment system, Value engineering, JIT and MRP, Labour legislation, Industrial Relations.

**6. Thermodynamics :** Basic concepts of thermodynamics, Properties of pure substances, First law of thermodynamics applied to closed and open systems, Second law of thermodynamics, Carnot cycle, entropy, Second law analysis of engineering systems, Availability, Otto cycle, Diesel cycle, Brayton cycle with modifications, Carnot and Rankine cycle, reheat and regenerative cycles.

**7. I.C. Engines, Fuels and Combustion :** Spark Ignition and compression ignition engines, two stroke and four stroke engines, mechanical, thermal and volumetric efficiency. Combustion process in S.I. and C.I. engines, pre-ignition, detonation and knocking in S.I. and C.I. engines. Octane and Cetanenumber. Carburation and Fuel injection, Engine emissions and control, Solid, liquid and gaseous fuels, stoichiometric air requirements and excess air factor, cooling and lubrication of engines.

**8. Heat Transfer :** Conduction: One- dimensional steady state heat conduction, Heat conduction through composite walls, Critical thickness of insulation, Heat transfer from finned surfaces, fin efficiency and effectiveness. Convection: Free and forced convection, Dimensional analysis, Heat transfer correlations, Hydrodynamic and thermal boundary layers, boundary layer equations and their solutions for flat plates and pipes.

Radiation: Planck's distribution law, Radiation properties, Kirchoff's law, diffuse radiation, Lambert's law, Intensity of radiation, Heat exchange between two black surfaces, Heat exchange between gray surfaces, radiation shield, Electrical analogy.

Boiling and Condensation: different regimes of boiling heat transfer, Correlations of boiling heat transfer, Film wise and Drop wise condensation.

Heat Exchangers: Different types of heat exchangers, Logarithmic mean temperature difference and effectiveness for parallel flow and counter flow heat exchangers, Correction factor and fouling factor, Heat exchanger design by LMTD and effectiveness NTU methods.

**9. Fluid Mechanics and Fluid Machines :** Fluid Mechanics: Fluids and their properties, buoyancy and floatation, Kinematics and dynamics of fluid flow, dimensional analysis, laminar and turbulent flow, flow through pipes. Boundary layer phenomenon, Drag and Lift.

Fluid Machines: Centrifugal pumps: Manometric and overall efficiencies, specific speed, Hydraulic turbines: Basics and constructional details of Impulse and reaction turbines, specific speed, governing systems, draft tubes, cavitation.

**10. Refrigeration & Air-conditioning and Power Plant Engineering :** Refrigeration : Basic refrigeration and heat pump cycles, Air refrigeration system, Aircraft refrigeration, Vapour compression refrigeration, Vapour absorption system, Refrigerants, Refrigeration components and controls.

Air-conditioning: Psychrometric charts, Different air-conditioning processes, Air-conditioning systems and equipments, Selection of air-conditioner, Air-distribution, Human comfort and comfort chart, Different applications of refrigeration and air-conditioning.

Steam Power Plants: High pressure steam boilers and accessories, plant layout, Fuel handling and firing, ash, smoke and dust removal, Fluidized bed, Chimney and draught, Thermal pollution and control.

Hydro-electric power plants: Selection of site, Different layouts, Control in hydro-electric plants. Nuclear power plants: Nuclear reactions and fuels, Nuclear reactors, Safety measures.

Note :- **Pattern of Question Paper**

- 1. Objective type paper**
- 2. Maximum Marks : 200**
- 3. Number of Questions : 120**
- 4. Duration of Paper : Three Hours**
- 5. All questions carry equal marks.**
- 6. There will be Negative Marking.**