RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS FOR SCREENING TEST FOR THE POST OF

ASSISTANT DIRECTOR, INDUSTRIAL SAFETY MUSEUM & TRAINING CENTRE, (FACTORIES & BOILERS DEPARTMENT)

CHEMICAL ENGINEERING

Process Calculations and Thermodynamics: Laws of conservation of mass and energy, use of tie components, recycle, bypass and purge calculations; degree of freedom analysis. First law of thermodynamics and its application to close and open systems, Second law of thermodynamics, Entropy, thermodynamic properties of pure substances: equation of state and departure function, properties of mixtures, partial molar properties, fugacity, excess properties and activity coefficients, phase equilibria: predicting VLE of systems, chemical reaction equilibria.

Fluid Flow Operation: Fluid statics, Newtonian and non-Newtonian fluids, Bernoulli equation and its applications, Orifice and Venturi meter, impulse momentum equation and its application, friction factors, energy balance, dimensional analysis, shell balances, flow through pipeline systems, flow meters, pumps and compressors, packed and fluidized beds, elementary boundary layer theory.

Heat Transfer: Conduction, convection and radiation, heat transfer coefficients, steady and unsteady heat conduction, boiling, condensation and evaporation, types of heat exchangers, evaporators and their design.

Mass Transfer: Fick's laws, molecular diffusion in fluids, mass transfer coefficients, film, penetration and surface renewal theories, momentum, heat and mass transfer analogies, stagewise and continuous contacting and stage efficiencies; HTU and NTU concepts design and operation of equipment for distillation, absorption, leaching, liquid-liquid extraction, drying, humidification, dehumidification and adsorption.


**Mechanical Operation:** Particle size and shape, Measurement and analysis, Screening and screen analysis- Screen effectiveness, working principle of industrial screening equipments, Shape factor, Selectivity index, Size reduction, Principal of comminution, Crushing, Grinding, Pulverization, Ultra fine grinding, Grindability, Crushing laws.

**Plant Design and Economics:** Design code, Design pressure, Design temperature of cylindrical and spherical shells under internal and external pressures, Process design and sizing of chemical engineering equipment such as compressors, heat exchangers and Boilers; principles of process economics and cost estimation including total annualized cost, cost indexes, rate of return, payback period, discounted cash flow, optimization in design,

**Chemical Technology:** Inorganic chemical industries; sulfuric acid, NaOH, fertilizers (Ammonia, Urea, SSP and TSP); natural products industries (Pulp and Paper, Sugar, Oil, and Fats); polymerization industries; polyethylene, polypropylene, PVC and polyester synthetic fibers, Formation and Evaluation of Crude Oil, Testing of Petroleum Products.

**Environmental Technology:** Classification of air pollutants, Primary and Secondary pollutants, Source of air pollution, Atmospheric Dispersion: Meteorology, Adiabatic lapse rate, Atmospheric stability, Inversion – types of inversion, maximum mixing height, Atmospheric classes, Plumes and types of plumes under different atmospheric condition, plume rise, Particulate Pollutant: Particulate pollution and control equipment, centrifugal collector, Electronic precipitators, Bag filter and Scrubber, Characteristic of water and waste water, Oxygen Demand, BOD, NBOD, CBOD, Primary Treatment by Sedimentation, Flocculation, Coagulation, Filtration, Disinfections, Waste water treatment, Biological (secondary) waste water treatment, Advance treatment methods.

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**Pattern of Question Papers:**

1. Objective Type Paper
2. Maximum Marks : 100
3. Number of Questions : 100
4. Duration of Paper : Two Hours
5. All Questions carry equal marks
6. There will be Negative Marking
7. The candidate has to choose either Chemical Engineering or Electrical Engineering or Mechanical Engineering.

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ELECTRICAL ENGINEERING


6. Generation of electrical energy using thermal, hydro, nuclear and diesel based power plants, concept of cogeneration, non-conventional sources of energy, load factors and load curves, load forecasting, electricity tariffs, power factor
improvement, Renewable Energy Sources & their Prospects, power generation scenario in India.


10. BJT and FET configurations and characteristics, Transistor at low frequencies, Analysis of a transistor amplifier circuit using h-parameters, Biasing circuits. Introduction Op-Amp, differential amplifier, adder, subtractor, integrator, differentiator circuit using OP-Amp, voltage to current and current to voltage converter, Instrumentation amplifier, log and anti-log amplifier, the peaking amplifier, sample and hold circuit. Introduction to Basic comparator, Schmitt trigger, Clippers and Clampsers, Voltage to frequency and frequency to voltage

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MECHANICAL ENGINEERING


2. STEAM POWER ENGINEERING: Carnot, Rankine, Modified Rankine, Reheat and Regenerative cycles. Classification and working of various low pressure and high pressure boilers. Boiler accessories and mountings. Safety standards as per IBR code. Steam Turbines: impulse and reaction turbines, velocity diagrams and thermodynamic analysis. Compounding and governing of turbines.


5. STRENGTH OF MATERIALS: Stress and strain, Thermal stresses, Elastic constants, Shear force and bending moment diagrams, Principal planes and stresses, Mohr’s circle, Theories of failures, Shear and bending stresses, Deflection of beams, Torsion of shafts, Columns and struts, Strain Energy.


7. THEORY OF MACHINES: Kinematics Links, pairs, chains and mechanisms. Inversions of four bar, single and double slider crank chains. Straight line and steering gear mechanisms, Gear and gear trains. Belt, rope and chain drive. Clutches and


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