

RAJASTHAN PUBLIC SERVICE COMMISSION, AJMER

SYLLABUS FOR SCREENING TEST FOR THE POST OF VICE PRINCIPLE/ SUPERINTENDENT, I.T.I., TECHNICAL EDUCATION DEPARTMENT

1 - CIVIL ENGINEERING

1 **Engineering Materials & Construction Technology :**

Selection of site for construction of various types of buildings. Requirements and design criteria for foundations; construction details of walls, masonry, floors, staircases, arches, roofs, doors and windows. Requirements for Fire Protection, Ventilation and Air Conditioning and Acoustics. Water supply and drainage. Building materials : Stones, bricks, cement, lime, paints and varnishes.

2 **Surveying :**

Generally adopted scales, chain and compass surveying; leveling; Temporary & Permanent adjustments of level instrument & Theodolite. Use of Theodolite, Tacheometry, Triangulation and Traversing; contours and contouring; Simple, Circular, compound and Transition curves and their setting outs. Theory of Errors and Survey adjustment. EDM Surveys, Photogrammetry and Basics of Remote Sensing.

3 **Soil Engineering :**

Classification of soil as per I.S. Code. Field identification tests for soils; water Content, specific Gravity, Void Ratio; Porosity, Degree of Saturation; Unit Weight, Density Index and their inter-relationship. Determination of various properties of soils, grain size distribution, Atterberg's/consistency limits, etc.

Soil permeability and its determination in the laboratory and field; Darcy's Law, Flow nets-its construction and uses.

Compaction and consolidation of soil and quality control, soil stabilization methods; New mark's chart and its uses.

Elements of shear strength parameters and their determination. Bearing capacity of shallow foundation, Earth pressures on retaining wall; Stability of slopes, Pile Foundations.

4 **Structural Mechanics :**

Stress and Strains, Elastic constants, Factor of Safety, Relation among elastic constants. Bending moment and shear force diagrams for cantilever, simply supported, overhanging, fixed & continuous beams subjected to static loads; concentrated, uniformly, distributed and uniformly varying loads. Theory of simple bending.

Deflection of cantilever, simple supported, fixed and continuous beams. Two and Three hinged arches.

5 **Steel Structures :**

Design of ordinary and plate girder beams, Design of members of Roof trusses, Rivetted and welded joints, Axially and Eccentrically loaded columns, Grillage, Gusseted & Slab base Foundation. Provisions of IS:800 and IS:875.

6 **Reinforced Concrete Structures :**

Provisions of latest IS:456, Design of beams singly and doubly reinforced, Design of shear reinforcement; Design of slabs simply supported, spanning in two directions and T-beam slabs, Flat Slabs. Design of columns axially and eccentrically loaded; Design of isolated and combined column footings; Design of simple RCC cantilevers and Retaining walls. Reinforcement in overhead & Underground water tanks. Limit state method for Design, Pre-stressed concrete.

7 **Fluid Mechanics, Hydrology and Irrigation :**

Hydraulic pressure at a point and its measurement, Buoyancy, conditions of equilibrium of floating bodies; fluid properties; Fluid Flow conditions; Bernoulli's Theorem; Navier-Stokes equation, Flow through orifices, Notches, and weirs; Laminar & Turbulent flow through pipes, flow through open channels, GVF, Hydraulic jump. Dimensional analysis & similitude, Hydraulic turbines & pumps.

Hydrograph Analysis, Abstractions (Interception, infiltration, evaporation, and Transpiration), Floods/Drought, Frequency Analysis, Gumbel's method, Groundwater Hydrology.

Reservoirs and Dams; overflow structures, Irrigation canals, Groundwater and well Irrigation; water-logging.

8 **Public Health Engineering :**

Per capita requirement of water for urban and rural areas; Forecast of population. Sources, water quality standards for public water supplies; various methods of purification; Distribution network with all the ancillaries; systems of drainage; Layout of sewerage systems; Flushing of sewers; sewage treatment; Rural sanitation. Environmental Management aspects.

9 **Highway and Bridges :**

Principles of highway planning; classification of Roads, Alignment, Geometric Design, Traffic Engineering; pavement design for flexible & rigid pavements; paving materials and highway construction, maintenance of different types of roads. Highway drainage and Arboriculture; Types of bridges; choice of type of bridge, Economical considerations of fixing spans, causeways & Culverts.

2 - ELECTRICAL ENGINEERING

Generation of emf and torque in rotating machines. d.c. motors and generators and their general characteristics, commutation, synchronous motors, alternators, three phase and single phase induction motor, equivalent circuits, starters, single-phase and three phase transformers, phasor diagram, losses, regulation and efficiency, auto transformers.

Steady-State-Analysis of d.c. and a.c. network, network theorems, network functions, Laplace techniques, transient response, three-phase networks, inductively coupled circuits, network synthesis.

Mathematical modeling of dynamic linear systems, transfer functions, open & close loop systems, signal-flow-diagrams, block diagrams, stability of control systems, time & frequency response.

Basic methods of measurement, standards, error analysis, indicating instruments, cathode-ray oscilloscope, measurement of voltage, current power, energy, resistance, inductance, capacitance, frequency, time and flux, current and potential instrument transformers, transducers, digital instruments.

Semiconductor devices and analysis of electronic circuits, single and multistage audio and radio small signal and large signal amplifiers, oscillators and feedback amplifiers, wave shaping circuits and time base generators, multi-vibrators and digital circuits, modulation and demodulation circuits, logic gates, combinational and sequential digital systems.

Power generation-thermal, hydro, nuclear and non-conventional, load curves, economic operation of power system, parameter, performance and analysis of different transmission lines, corona effect, bundle conductors, tariffs, basic ideas of power system stability, swing equation, equal area criterion, cable, grid substations, earthing, power system protection, relays, circuit breakers, symmetrical & non-symmetrical fault analysis, voltage & frequency control.

Conversion of a.c. to d.c. and d.c. to a.c. controlled and uncontrolled rectifiers, speed control techniques for drives, electrical heating, welding, illumination & traction systems.

Introduction to microprocessor, computer architecture, hardware & software, programming languages, internet.

3 - MECHANICAL ENGINEERING

Engineering Thermodynamics

Laws of Thermodynamics, Gas Power Cycles: Diesel, Otto, Dual combustion, Brayton, Sterling and Ericsson cycles; Vapour Power Cycle. Thermal efficiency and work ratio. Refrigeration Cycles/Processes: Brayton air refrigeration cycle, simple vapor compression cycle, Aqua-ammonia absorption system. Compressors: Introduction & Application, Classification, construction of single stage and multi-stage compressors, work done in single stage and multi-stage,

Manufacturing Technology

Press working of sheet metal: Types of presses and operations. Die materials, Construction details of die set. Machine tools and operations, Cutting tools: single point tool, cutting speed, feed and depth of cut. Capstan and Turret Lathes; boring and broaching machine. Indexing head; milling operations. Grinding; operations; Dressing; Truing and balancing of grinding wheels; selection grinding wheels, Coolants, Introduction to NC and CNC machines. Foundry technology, Welding technology

Fluid Mechanics & Machines

Basics of fluid mechanics, Buoyant force, stability of floating and submerged bodies, kinematics of Fluid flow, Dynamics of fluid flow, Dimensional Analysis and Dynamic Similitude, Viscous flow, turbulent flow, Concept of boundary layers, Analysis of pipe flow.

Impact of Free Jet, Homologous units, specific speed, theory of Turbomachines, efficiencies. Reaction, impulse and mixed flow turbines, their efficiencies, characteristics, and principles of governing. Draft tube, cavitation, water hammer and surge tanks.

Centrifugal and Reciprocating pumps, air vessels, operating characteristics of these pumps. Miscellaneous machines: Hydraulic accumulator, hydraulic press, lift, ram, coupling and torque converter.

Kinematics of Machines

Links and pairs; kinematics chains; Mechanisms and machines; Inversion; Absolute and relative motions; Instantaneous centres; Acceleration analysis; Cam profiles & different types of followers; cams with specified contours; Fundamental laws of gearing; Types of gears, Gears trains, Belts, rope and chain drives. Efficiency of power transmission

Dynamics of Machines

Concept of free body and its equilibrium; Static & Dynamic force analysis; Fluctuation of energy and speed; Fly wheels & governors. Balancing of rotating masses, Power Screw; Plate and Cone clutches; band and block brakes; Gyroscopic action and Gyroscopic torque.

Industrial Engineering

Introduction to Industrial Engineering & productivity, Functions of Management, Organizational Structure, Financial Management, Marketing Management, Personnel Management, Wage, Incentives & Payment Systems, Labor relations & Legislations, Cost & Cost Control.

Types of forecasting, Facilities Location & Layout Planning, Scheduling, routing, sequencing, Aggregate Production planning, Capacity planning, Inventory Control, Material requirement Planning, Manufacturing Resource Planning, Enterprise Resource Planning

Work Study: Methods study, time study, Work Measurement & Design. Ergonomic aspects in industrial design. Industrial Safety. Work & Job design, Job Evaluation & Merit Rating.

CPM and PERT

Mechanics of Solid

Concepts and analysis of stresses and strains; mechanical properties; ductile and brittle materials; members in uni-axial state of stress; Transformation of stresses, members subjected to axi-symmetric, torsional and flexural loads; deflection in beams, members subjected to combined loads; elastic stability of columns.

Machine Design

Design for strength, Stress concentration. Introduction of various design considerations like strength, stiffness, weight, cost, space etc; fatigue, design of welded joints, riveted joint, screwed joints, helical and leaf springs, shafts, brakes and clutches. Fatigue consideration in Design, Design of machine members subjected to combined steady & alternating stresses like Bolts and shafts, curved members like crane hooks, crankshafts, camshafts and connecting rod, gear tooth, sliding & journal bearings. Wear and dynamic load consideration..

Automobile Engineering

Transmission system, steering system, suspension systems, tyres, springs and shock absorbers, brakes and their actuators, ignition systems, Automotive pollution and its control strategies.

Turbo Machines

Gas Turbines, Cycles, inter cooling, reheating and reheat, compounding. Performance of Practical Gas Turbine Cycles, Compressor and turbine efficiencies. Heat exchanger simple cycle and series and parallel flow cycles, Centrifugal and Axial Flow Compressors.

Steam Turbines, Steam nozzles, Velocity diagrams, main blade dimensions, thrust; theoretical power and torque, special constructional features of steam turbines, Condensers: performance of condenser; vacuum efficiency.

Heat Transfer

Heat transfer processes; thermal conductivity of solids, liquids and gases; boundary conditions, one dimensional heat conduction, critical thickness of insulation; fins, Convection, appropriate nondimensional numbers; flow over flat plate; free and forced convection. Heat Exchangers: Different types of heat exchangers; arithmetic and logarithmic mean temperature differences; heat transfer coefficient for parallel, counter and cross flow type heat exchanger; effectiveness of heat exchanger. Thermal Radiation: Kirchoff's law; radiation intensity, heat exchange between two black bodies, between gray bodies.

Internal Combustion Engines

Ideal and actual cycles of operation, fuels, Combustion SI and CI engines, carburetors and fuel injection systems for SI engines, fuel injection systems for diesel engines, lubrication systems, cooling systems, supercharging, scavenging, engine performance, testing and exhaust emission characteristics, exhaust pollution, special engines and computer simulation of two stroke and four-stroke engines.

Refrigeration & Air-conditioning

Air Refrigeration & Heating System, air-craft air conditioning systems. Heat Pump cycle. Vapor compression refrigeration: Simple cycle, factors affecting performance of vapor compression cycle, actual vapor compression cycle. Suitability of refrigerants for different applications. Vapor Absorption Refrigeration System. Psychrometry and Psychrometric properties, relations, charts and uses, evaporative cooling, air washers and air cleaners, human comfort, factors affecting comfort. Solar Radiation: Distribution of solar radiation, passive heating and cooling of buildings. Ducting System

Power Plant Engineering

Steam Power Plants: Layout and site selections. Fuel storage and handling. Cooling towers. Diesel & Gas Turbine Power Plants: General layout, elements, fields of use, comparison with steam power plants. Comparison.

Nuclear Power Plants: Nuclear materials, waste disposal, fuels, coolants, moderating and reflecting materials, cladding materials, Disposal of nuclear waste, Nuclear reactors, location of nuclear power plants, comparison of nuclear plants with thermal plants. Enrichment, safety and control. Hydro-electric Power Plants, Power Plant Economics, performance and operating characteristics of power plants,

Product Design

Principles of modern design, Human factors in design and applied ergonomics. Product design methods. Legal issues in product design and design resources.

Operations Research

History of OR, General methodology of OR, Linear optimization models, simplex algorithms, duality; dual linear programming, Sensitivity; Integer programming, Assignment models, Transportation problems, Transshipment models, Theory of Games. Queuing Theory. Application to industrial problems.

Vibrations

Fundamentals of vibration: Free vibration, Forced vibration, single degree of freedom. Natural frequency, Principle of conservation of energy, Principles of virtual work. Damping. Forced vibrations: Harmonic excitation, Mechanical impedance, Critical speed, Vibration Isolation. Two degree of freedom systems.

Pattern of Question Paper :

- 1 Objective type question paper.
- 2 Maximum Marks – 100
- 3 No. of question – 100
- 4 Duration of paper – 2 Hours
- 5 All questions carry equal marks.
- 6 There will be negative marking.
- 7 The candidates are required to opt only one subject.
