भारतीय प्रौद्योगिकी संस्थान गोवा
गोवा अभियांत्रिकी महाविद्यालय परिसर, फार्मागुड़ी, फ़ोंडा – 403401, गोवा

Indian Institute of Technology Goa
Goa College of Engineering Campus, Farmagudi, Ponda – 403401, Goa

IITGoa/RECT/2023/01/JE-C/562 Date:18/10/2023

NOTICE

Date of Written Test: 18/11/2023
Syllabus for Written Test for Selection for The Post of Junior Engineer-Civil, PL 06, Group-B

1. Environmental Science and Engineering- Components of Earth System: all spheres and outer space. Ecological concepts and natural Resources: Ecological perspective and value of environment, Environmental auditing, Biotic components, Levels of organizations in environment Ecosystem Process: Energy, Food chain, Environmental gradients, Tolerance levels of environmental factor. Natural Resources covering Renewable and Non-renewable Resources, Forests, water, minerals, Food and land. Energy, Growing energy needs, energy sources (conventional and alternative). Hydrological cycle, water balance, energy budget, precipitation, infiltration, evaporation and evapotranspiration. Environmental Pollution: water, air, land, soil, marine, nuclear. Environmental Issues: Climate change, Global warming, Acid rain, Ozone layer depletion, Sustainable development, Bio gas, Natural gas, Biodiversity, Urban problems related to energy, water scarcity, Water conservation, rain water harvesting, artificial recharge, watershed management, carbon trading, carbon foot print, National Ambient Air quality Standards, Noise standards, Vehicle emission standards. Drinking water standard (IS 10500), Water Quality Criteria and wastewater effluent standards. Water treatment plant: various stages and it's process. Solid waste management: Biomedical, hazardous and e-waste, Environmental Impact Assessment, Environmental policies and acts

2. Mechanics of Materials- Direct Stress: Load, Stress, Principle of St. Venant, Strain, Hooke's Law, Modulus of Elasticity, Composite bars in tension and compression, temperature stresses in composite rods, statically indeterminate problems. Shear Stress: Shear stress, Complementary shear stress, shear strain, modulus of rigidity. Two dimensional stress and strain systems: Principal stresses, Maximum shear stresses, Analysis of stresses, Mohr's stress circle. Principal strains and principal axes of strain measurement, calculation of principal stresses from principal strains, Analysis of strains, Mohr's strain circle. Shear force and Bending moment: concentrated load and uniformly distributed load on simple supported and cantilever beam. Simple bending of beams: Theory of pure bending of initially straight beams, Distribution of normal and shear stresses, Composite beams. Torsion in solid and hollow circular shafts, Twisting moment, strength of solid and hollow circular shafts, strength of shafts in combined bending and twisting, closed coil helical spring. Introduction to theories of failure: Maximum normal stress theory, maximum normal strain theory, maximum shearing strain theory, maximum strain energy theory, maximum distortion energy theory, maximum octahedral shearing stress theory. Thin cylinders and spheres: Stresses in thin cylinders and spherical shells under internal pressure, wire winding of thin cylinders. Buckling of Columns: Short and long columns, eccentric loading of columns, core of the section, Euler's theory of initially straight columns with various end conditions, Columns with initial curvature. Combined bending and direct stress.

3. Civil Engineering Materials and Construction- Bricks: Methods of bricks manufacture, testing of bricks Cement: Classification, chemical composition, hydration, tests for cement. Concrete: Composition, water- cement ratio, workability. Stairs: Terms used, types of stairs, essential requirements, wooden stairs, concrete stairs, and metal stairs. Doors and Windows: Types, materials used. Masonry arches: Terms used types of arches, stability, line of thrust, depth of arch at the crown. Cavity walls: Purpose, method of construction. Fire resistive construction: Fire resistive construction, fire resistance of common building materials, protection for girders and columns, firefighting appliances. Plastering: Materials for plastering, methods of plastering, defects in plastering and remedy. Painting and decoration: Oil painting and Varnishing, enamel painting, Washes and distemper, defects in painting. Damp prevention: causes, effects, different methods of prevention of dampness. Stone: Indian building stones, their properties and uses, methods of querying Glass: Varieties of glass, decorative glass, door and window glazing. Timber: Preservation and seasoning of timber Foundation: Brief idea on various types of foundation. Repair of building: Annual and special repair of buildings, Maintenance of buildings, Types of cracks in Building, Types of building Joint.

4. Surveying -Concept of surveying: Definition of surveying, classification, principle, accuracy Linear measurement: Different methods of direct measurement instrument for chaining, ranging, chaining on uneven sloping ground, errors in chaining, corrections. Chain surveying: Chain triangulation, survey station, lines, locating ground features, instruments for setting out basic problems in chaining, obstacles in chaining. Compass surveying: Principles use of prismatic compass, measurement of bearings, conversion of bearings, local attraction, correction of compass traverse. Plane table survey: Principles, advantages and disadvantages, equipment, accessories and their uses,

Methods of plane table survey, two point and three point problems. Levelling: Types of levelling and their uses, permanent adjustment, curvature and refraction effects, Contouring: Characteristics and uses of contours, methods of contouring. Theodolite survey: application in height and distance measurements, permanent adjustment of transit theodolite, methods of repetitions and reiterations. Curve setting: Simple circular curve setting by chain, tape & theodolite Introduction to total station Minor survey instruments: box-sextant, planimeter, pantagraph, their working principles and uses.

Application of Theodolite Surveying – Tacheometry, Height & distance, Curve setting problems (Compound, Reverse & Transition), Traversing & Triangulation survey: Principle, Planning & Methods. Geodesy. Photogrammetric Surveying – Principle, Scale, Number of Photographs, Deduction of distance & height, Elements of Astronomical survey, Solution of problems dealing with celestial triangle. Principles of Remote Sensing & Geographic Information System, Application to Civil Engineering. Electronic distance measurement, Total Station, Global Positioning System.

5. Fluid Mechanics- Basics: Physical properties of fluids, Density, specific weight, Specific volume, Specific gravity, Compressibility, Elasticity, Surface tension, Capillarity, Vapour pressure, Viscosity, Ideal and real fluids, Concept of shear stress, Newtonian and non-Newtonian fluids. Fluid statics: Pressure-density-height relationship, Manometers, Pressure on plane and curved surface, Centre of pressure, Buoyancy, Stability of immersed and floating bodies, Fluid masses subjected to uniform accelerations. Fluid kinematics: Steady and unsteady, uniform and non-uniform, laminar and turbulent flows and enclosed flows, Definition of one-, two- and three-dimensional flows, Stream-lines, streak-lines, and path-lines, Stream-tubes, elementary explanation of stream-function and velocity potential, Basic idea of flow nets. Fluid dynamics: Basic equations: Equation of continuity; One-dimensional Euler's equation of motion and its integration to obtain Bernoulli's equation and momentum equation. Flow through pipes: Laminar and turbulent flow in pipes; Hydraulic mean radius; Concept of losses; Darcy-Weisbach equation; Moody's (Stanton) diagram; Flow in sudden expansion and contraction; Minor losses in fittings; Branched pipes in parallel and series, Transmission of power; Water hammer in pipes (Sudden closure condition). Definition; Uniform flow; Chezy's, Kutter's and Manning's equations; Channels of efficient cross section. Flow in Open Channels: Specific energy, Critical flow, Discharge curve, Application of specific energy, Specific force, Classification of Surface profiles, Back water & draw down curves, Flow transition in open channels. Measurements: Hook gauge; Point gauge; Pitot tube; Current meter; Venturi meter; Orifice meter; Orifices and mouthpieces; Notches and weirs.

6. Structural Analysis-Introduction to statically determinate/ indeterminate structure with reference to 2D and 3D structures, free body diagram of structure, introduction to kinematically determinate/indeterminate structures with reference to 2D and 3D structures, degree of freedom. B.M. and S.F. diagrams for different loading on simply supported beam, cantilever and overhanging beams. B.M. shear and normal thrust of three hinged arches. Suspension Cables: Three hinged stiffening girders. Deflection of statically determinate beams: Integration method, Moment area method, Conjugate beam method. Deflection of statically determinate beams by energy methods-strain energy method, castiglianos theorems, reciprocal theorem, unit load method, Deflection of pin-jointed trusses, Williot-Mohr diagram. B.M. and S.F. diagrams for statically indeterminate beams – propped cantilever and fixed beams. Application of three moment theorem to continuous and other indeterminate beams. ILD for determinate structures for reactions at supports, S.F. at given section, B.M. at a given section, Maximum shear and maximum bending moment at given section, Problems relating to beams, three hinged arch, suspension cables and roof truss.

Introduction to Force and Displacement methods of structural analysis, Analysis of continuous beam and plane frame by slope deflection method and moment distribution method. Analysis of continuous beam and simple portals by Kani's method, Analysis of two pinned and fixed arches with dead and live loads, suspension cable with two pinned stiffening girders. Plastic Analysis: Plastic modulus, shear factor, plastic moment of resistance, load factor, plastic analysis of continuous beam and simple rectangular portals, Application of upper and lower bound theorems. Matrix method of analysis: flexibility and stiffness method, Application to simple trusses and beam

7. Structural Design-Properties of concrete and reinforcing steel, Philosophy, concept and methods of reinforced concrete design, Introduction to limit state method: Limit state of collapse and limit state of serviceability. Application of Limit state method to rectangular beams for flexure, shear, bond and torsion. Design of doubly reinforced beams. Design of T-and L-beams. Design of one way and two way slabs, Design of staircases. Design of short and long columns with axial and eccentric loading, design of isolated column footing. Design principle of masonry structures: Brick and stone masonry. Design of masonry short and long walls, columns and retaining walls.

8. Water resources Engineering - Hydrologic cycle, availability of water on earth, importance of hydrology and its applications in engineering. Precipitation: Forms & types, measurement of rainfall, optimum number of rain gauge stations, consistency of rainfall data, presentation of precipitation data, mean aerial rainfall, depth–area duration curve, design storm, losses from precipitation, evaporation, infiltration. Run off: Computation, factors affecting runoff, Design flood: Rational formula, Empirical formulae, Stream flow: Discharge measuring structures, approximate average slope method, area-velocity method, stage-discharge relationship. Hydrograph; Concept, its components, Unit hydrograph: use and its limitations, derivation of UH from simple and complex storms, S-hydrograph, derivation of UH from S-hydrograph. Synthetic unit hydrograph: Snyder's approach, introduction to instantaneous unit hydrograph (IUH). Reservoir management: Fixation of reservoir capacity, Rippl's mass curve, sequent peak algorithm, allocation of storage space for various uses, reservoir sedimentation and tis control, determination of sediment yield at a reservoir site. Flood frequency analysis: Gumbel's method. Flood routing: Hydrologic channel routing, Muskingum equation, hydrologic reservoir routing: Modified Plus method, Flood control measures.

9.Geo-Technical Engineering- Introduction: Origin of soils, formation of soils, clay mineralogy and soil structure, basic terminology and their relations, index properties of soils. Soil classification: Particle size distribution, use of particle size distribution curve, Particle size classification, textural classification, HRB classification, Unified classification system, Indian standard soil classification system, Field identification of soils. Soil moisture: Types of soil water, capillary tension, capillary siphoning. Stress conditions in soil: Total stress, pore pressure and effective stress. Permeability: Darcy's law, permeability, factors affecting permeability, determination of permeability (laboratory and field methods), permeability of stratified soil deposits. Estimation of yield from wells. Seepage analysis: Seepage pressure, quick condition, Laplace equation for two –dimensional flow, flow net, properties and methods of construction of flow net, application of flow net, seepage through anisotropic soil and non-homogenous soil, seepage through earth dam. Soil compaction: Compaction mechanism, factors affecting compaction, effect of compaction on soil properties, density moisture content relationship in compaction test, standard and modified proctor compaction tests, field compaction methods, relative compaction, compaction control. Soil consolidation: Introduction, spring analogy, one dimensional consolidation, Terzaghi's theory of one dimensional consolidation, consolidation test, determination of coefficient of consolidation. Shear strength of soils: Mohr's stress circle, theory of failure for soils, determination of shear strength (direct shear test, tri-axial compression test, unconfined compression test, van shear test), shear characteristics of cohesion less soils and cohesive soils. Stabilization of soil: Introduction, mechanical stabilization, cement stabilization, lime stabilization, bituminous stabilization, chemical stabilization, thermal stabilization, electrical stabilization, Introduction to modern methods of stabilization

10. Steel structures- Philosophy, concept and methods of design of steel structures, structural elements, structural steel sections, Bolted Connections, Failure of Bolted Joints, Specifications for Bolted Joints, Analysis and design of bolted connections, Welded connections, Welding Processes and defects, Design of fillet welds, Failure of welds, Design of tension members. Design of compression members, Types of Buckling, Design of axially loaded compression member, Design of Columns Lacing, Design of Column battening, Design of Column Slab base, Design of Column Gusseted base, Design of Moment Resisting base plates, Design of Foundation Bolts. Design of beams, Lateral stability of beams, Lateral torsional buckling, Bending strength of beams, Shear strength of beams, Web buckling, Web crippling, Design of rolled beams, Plate girder, Design of plate girder, Plastic section modulus, Design of a Welded plate girder, Design of Gantry girder. Design of Roof trusses, Selection of the type of trusses, Loads and Load combinations in roof trusses, Design procedure, Design of component members in a roof truss.

11. Design of Steel Structure - 1. Types of steel sections and their properties 2. Design and detailing of bolted connections 3. Design and detailing of welded connections 4. Design and detailing of tension members 5. Design and detailing of compression members 6. Design and detailing of lacing and battening system 7. Design and detailing of slab base and gusseted base 8. Design and detailing of beams and plate girders 9. Design and detailing of roof truss 10. Detailing of framed and bracket connections.

Sd/-

Registrar i/c