Punyashlok Ahilyadevi Holkar Solapur University, Solapur

पुण्यश्लोक अहिल्यादेवी होळकर
सोलापूर विद्यापीठ

|| विद्यया संपन्नता ||

NAAC Accredited-2022
'B⁺⁺' Grade (CGPA 2.96)

Name of the Faculty: Science & Technology

Syllabus: Civil Engineering

Name of the Course: Entrance Examination – Paper II
(PET- 9)

(Syllabus to be implemented from June 2024)

Punyashlok Ahilyadevi Holkar Solapur University, Solapur

PET 9

Ph. D. Entrance Exam 2024

Syllabus

Section 1. Structural Engineering

Engineering Mechanics: Understanding system of forces, free-body diagrams, and equilibrium equations. Analysis of internal forces within structures. Applications of frictional forces. Study of the center of mass. Exploration of free vibrations in undamped SDOF systems.

Solid Mechanics: Examination of bending moment and shear force in statically determinate beams. Establishing simple stress and strain relationships. Introduction to simple bending theory, including flexural and shear stresses, and shear center. Discussion on uniform torsion, stress transformation, and buckling of columns. Analysis of combined and direct bending stresses.

Structural Analysis: Analysis of statically determinate and indeterminate structures using force/energy methods. Application of method of superposition. Study of trusses, arches, beams, cables, and frames. Introduction to displacement methods: slope deflection and moment distribution methods. Understanding influence lines and stiffness/flexibility methods of structural analysis.

Construction Materials and Management: Examination of construction materials: Structural steel - composition, material properties, and behavior. Study of concrete - constituents, mix design, short-term, and long-term properties. Exploration of construction management, including types of construction projects, project planning, and network analysis using PERT and CPM. Introduction to cost estimation techniques.

Concrete Structures: Understanding working stress and limit state design concepts. Design principles for beams, slabs, and columns. Examination of bond and development length. Introduction to prestressed concrete beams.

Steel Structures: Exploration of working stress and limit state design concepts. Design principles for tension and compression members, beams, beam-columns, and column bases. Study of connections: simple and eccentric, beam-column connections, plate girders, and trusses. Introduction to plastic analysis concepts in beams and frames.

Section 2: Geotechnical Engineering

Soil Mechanics: Understanding the three-phase system and phase relationships, including index properties. Overview of the Unified and Indian standard soil classification systems. Study of permeability: one-dimensional flow, two-dimensional flow, flow nets, uplift pressure, piping, capillarity, and seepage force. Exploration of the principle of effective stress and quicksand condition. Techniques for soil compaction and one-dimensional consolidation, including the time rate of consolidation. Analysis of shear strength using Mohr's circle, effective and total shear strength parameters, and stress-strain characteristics of clays and sands.

Foundation Engineering: Sub-surface investigations, including drilling boreholes, sampling, plate load tests, standard penetration tests, and cone penetration tests. Examination of earth pressure theories: Rankine and Coulomb. Analysis of slope stability using finite and infinite slopes, and Bishop's method. Stress distribution in soils based on Boussinesq's theory, including pressure bulbs. Study of shallow foundations using Terzaghi's and Meyerhoff's bearing capacity theories, and their effect on the water table. Design principles for combined footings and raft foundations, including contact pressure. Settlement analysis in sands and clays. Deep foundations: dynamic and static formulae, axial load capacity of piles in sands and clays, pile load tests, pile under lateral loading, pile group efficiency, and negative skin friction.

Section 3: Water and Environmental Engineering

Fluid Mechanics and hydraulics: Introduction to fluid properties and fluid statics. Application of continuity, momentum, and energy equations. Discussion on potential flow, laminar and turbulent flow. Analysis of flow in pipes, pipe networks, and the concept of boundary layer. Understanding lifts and drags phenomena. Examination of forces on immersed bodies. Techniques for flow measurement in channels and pipes. Introduction to dimensional analysis and hydraulic similitude. Study of channel hydraulics, including energy-depth relationships, specific energy, critical flow, hydraulic jump, uniform flow, gradually varied flow, and water surface profiles.

Hydrology and Irrigation: Overview of the hydrologic cycle and its components. Study of precipitation, evaporation, evapo-transpiration, watershed, and infiltration. Introduction to unit hydrographs, hydrograph analysis, reservoir capacity, flood estimation, and routing. Examination of surface runoff models and ground water hydrology, including steady-state well hydraulics and aquifers, with the application of Darcy's Law. Overview of irrigation systems and methods. Analysis of crop water requirements, including duty, delta, and evapo-transpiration. Study of gravity dams, spillways, lined and unlined canals, and design principles for weirs on permeable foundations and cross drainage structures.

Water and Wastewater Quality and Treatment: Introduction to water quality standards and parameters. Discussion on water quality index and unit processes and operations in water treatment. Overview of water distribution systems and drinking water treatment. Sewerage system design, wastewater quantity estimation, primary and secondary treatment methods, effluent discharge standards, sludge disposal, and the reuse of treated sewage.

Section 4: Transportation Engineering

Geomatics Engineering: Principles of surveying; Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Leveling and trigonometric leveling; Traversing and triangulation survey; Total station; Horizontal and vertical curves.

Transportation Infrastructure: Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments. Geometric design of railway Track – Speed and Cant. Concept of airport runway length, calculations and corrections; taxiway and exit taxiway design.

Highway Pavements: Highway materials - desirable properties and tests; Desirable properties of bituminous paving mixes; Design factors for flexible and rigid pavements; Design of flexible and rigid pavement using IRC codes

Traffic Engineering: Traffic studies on flow and speed, peak hour factor, accident study, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Traffic signs; Signal design by Webster's method; Types of intersections; Highway capacity.