Ph.D. (in Civil Engineering) Entrance Examination, 2022

Geotechnical Engineering
Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Seepage through soils – two – dimensional flow, flow nets, uplift pressure, piping, capillarity, seepage force; Principle of effective stress and quicksand condition; Compaction of soils; One- dimensional consolidation, time rate of consolidation; Shear Strength, Mohr's circle, effective and total shear strength parameters, Stress-Strain characteristics of clays and sand; Stress paths. Sub-surface investigations - Drilling bore holes, sampling, plate load test, standard penetration and cone penetration tests; Earth pressure theories - Rankine and Coulomb; Stability of slopes – Finite and infinite slopes ; Stress distribution in soils – Boussinesq's theory; Pressure bulbs, Shallow foundations – Terzaghi's and Meyerhoff's bearing capacity theories

Water Resources Engineering
Properties of fluids, fluid statics; Continuity, momentum and energy equations and their applications; Potential flow, Laminar and turbulent flow; Flow in pipes; Forces on immersed bodies; Hydrologic cycle, infiltration, unit hydrographs, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy's Law.

Environmental Engineering
Basics of water quality standards – Physical, chemical and biological parameters; Water quality index; Unit processes and operations; Engineered systems for solid waste management (reuse/ recycle, energy recovery, treatment and disposal). Particle Fluid Mechanics as applied to the settling of Type I and II suspensions. Design and operation of Sedimentation Tanks. Coagulation and Flocculation. Hydraulics of Filtration, Design and Operation of Filter Units. Disinfection Methods. Ion exchange and Adsorption. Water Softening, Manganese and Iron Removal. Wastewater Treatment – Preliminary, Primary and Secondary Treatment Units. Aerobic and Anaerobic Processes. Purpose, theory and design of aeration units. Sludge treatment and disposal. Wastewater treatment by septic tank, wastewater stabilization ponds, aerated ponds and oxidation ditches.

Transportation Engineering
Geometric design of highways: Introduction; highway cross section elements; sight distances; design of horizontal alignment; design of vertical alignment. Traffic engineering & control; Traffic characteristics, traffic engineering studies; traffic flow and capacity; Principles of design of road intersections – Simple layouts; design of Parking facilities; Objectives, classification and uses of traffic signs and markings. Desirable properties and testing of highway materials: Soil, stone aggregates, bituminous materials and mixes; Portland cement and cement concrete: desirable properties, tests, requirements for different types of pavements. Factors influencing the design and performance of pavements, Design of flexible & rigid pavements as per IRC. Causes of failures in flexible & rigid pavements, Construction & Management of various roads.

Structural Engineering
System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Frictions and its applications; Centre of mass; Free Vibrations of undamped SDOF system; Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Simple bending theory, flexural and shear stresses; buckling of column, combined and direct bending stresses.