SYLLABUS: Junior Environmental Engineer in DPCC

Section-B **Subject specific** **-100 Marks**	**Water Resources Engineering:** Global Water Resources: Structure, properties and distribution of water; Water quality; Threats to water resources; Water conservation. Surface Water Resources: Hydrological cycle and water balance - precipitation, infiltration, evapotranspiration, runoff; Flow hydrographs; Unit hydrographs; Stage-discharge relationship; Reservoir capacity; Reservoir and channel routing; Surface run-off models; Surface water management; Rain water harvesting and storage. Groundwater Resources: Geologic formations as aquifers; Vadose and saturated zones; Confined and unconfined aquifers and their parameters - porosity, permeability, transmissivity and storage coefficient; Darcy's law and applications; Steady state well hydraulics. Irrigation: Types of irrigation systems and methods; Crop water requirements - Duty, delta, evapo-transpiration; Gravity Dams and Spillways; Lined and unlined canals, Design of weirs on permeable foundation; cross drainage structures. **Engineering Fluid Mechanics & Hydraulics:** Concepts of mechanics; Properties of fluids; Pressure measurement; Hydrostatic force on surfaces; Dimensional Analysis and Modelling; Buoyancy and flotation; Laminar and turbulent flow; Flow through pipes; Pipe networks; Boundary layer theory; Forces on immersed bodies; Flow measurement in channels and pipes; Kinematics of flow; Continuity, momentum and energy equations; Channel hydraulics - specific energy, critical flow, hydraulic jump, rapid and gradually varied flow; Design of lined and unlined channels. Hydraulic Machines and Hydro power - Various pumps, Air vessels, Hydraulic turbines – types, classifications & performance parameters; Power house – classification and layout, storage, pondage, control of supply. **Geo-technical Engineering:** Soil exploration - planning & methods, Properties of soil, classification, various tests and interrelationships; Permeability & Seepage, Compressibility, consolidation and Shearing resistance, Earth pressure theories and stress distribution in soil; Properties and uses of geo-synthetics. **Engineering Mechanics:** Units of measurements, System of forces, free-body diagrams, equilibrium equations; Internal forces in structures; Frictions and its applications; Centre of mass. **Solid Mechanics:** Bending moment and shear force in statically determinate beams; Simple stress and strain relationships; Simple bending theory, flexural and shear stresses, shear centre; Uniform torsion, Transformation of stress; buckling of column, combined and direct bending stresses. **Structural Analysis:** Statically determinate and indeterminate structures by force/ energy methods; Method of superposition; Analysis of trusses, arches, beams, cables and frames; Displacement methods: Slope deflection and moment distribution methods; Influence lines; Stiffness and flexibility methods of structural analysis. **Concrete Structures:** Working stress and Limit state design concepts. Design of beams, slabs, columns; Bond and development length; Prestressed concrete beams. **Steel Structures:** Working stress and Limit state design concepts. Design of tension and compression members, beams and beam- columns, column bases; Connections - simple and eccentric, beam-column connections, plate girders and trusses; Concept of plastic analysis - beams and frames. **Water & Wastewater Treatment and Management:** Water and wastewater quality parameters; Eutrophication and thermal stratification in lakes; River

	pollution - Oxygen sag curve. Water treatment methods - screening, sedimentation with and without coagulation, filtration, desalination, disinfection; Water distribution and storage Point and non-point sources of wastewater; Population forecasting methods; Design of sewer and storm water sewers; Sewer appurtenances; Preliminary, primary, secondary and tertiary sewage treatment; Sludge generation, processing and disposal methods; Sewage farming. Sources and characteristics of industrial effluents; Concept of Common Effluent Treatment Plants (CETP); Wastewater recycling and zero liquid discharge. Kinetics and reactor design: Mass and energy balance, Order and rate of reactions, Batch reactors, Completely mixed flow reactors, Plug flow reactors. **Air and Noise Pollution:** Structure of the atmosphere; Natural and anthropogenic sources of pollution; Atmospheric sources, sinks, transport; Indoor air pollution; Effects on health and environment; Air pollution: gases and particulate matter; Air quality standards; Primary and secondary pollutants; Criteria pollutants, ambient and source standards, air quality indices, visibility. Particulate pollutants: measurement and control methods; Control of particulate air pollutants using gravitational settling chambers, cyclone separators, wet collectors, fabric filters (Baghouse filter), electrostatic precipitators (ESP). Gaseous Pollutants: Measurement and control methods; Control of gaseous contaminants: absorption, adsorption, condensation and combustion; Control of sulphur oxides, nitrogen oxides, carbon monoxide, and hydrocarbons; Vapour-liquid and vapour-solid equilibria; Diffusion, Fick's law and interfacial mass transfer. Automotive emission controls, fuel quality, diesel particulate filters, catalytic convertors. Air quality management: Point, line and area sources; Inventory; Influence of meteorology - wind rose diagrams, stability, mixing height, topography, dispersion modelling, monitoring. Noise pollution: Sources; Health effects; Standards; Measurement and control methods. **Solid Waste Management:** Integrated solid waste management; Waste hierarchy; Rules and regulations for solid waste management in India. Municipal solid waste management: Sources, generation, characteristics, collection and transportation, waste processing and disposal (including reuse options, biological methods, energy recovery processes and landfilling). **Environmental Chemistry:** Principles of water chemistry: Water quality parameters and their measurement; Acid-base equilibria; Buffer solution; Carbonate system; Solubility of gases in water; Complexation, precipitation, and redox reactions; Inorganic and organic contaminants in water and their speciation. Atmospheric Chemistry: Composition of the atmosphere; Reactivity of trace substances in the atmosphere; Urban atmosphere—smog and particulate pollution; Chemistry of ozone formation; Chemistry of stratosphere.