Syllabus for Entrance Examination

M.Tech in Water Engineering and Management

Engineering Mathematics- Linear Algebra: Matrix algebra; Systems of linear equations; Eigen values and Eigen vectors. Calculus: Functions of single variable; Limit, continuity and differentiability; Mean value theorems, local maxima and minima, Taylor and Maclaurin series; Evaluation of definite and indefinite integrals, application of definite integral to obtain area and volume; Partial derivatives; Total derivative; Gradient, Divergence and Curl, Vector identities, Directional derivatives, Line, Surface and Volume integrals, Stokes, Gauss and Green's theorems. Ordinary Differential Equation (ODE): First order (linear and non-linear) equations; higher order linear equations with constant coefficients; Euler-Cauchy equations; Laplace transform and its application in solving linear ODEs; initial and boundary value problems. Partial Differential Equation (PDE): Fourier series; separation of variables; solutions of onedimensional diffusion equation; first and second order one-dimensional wave equation and two-dimensional Laplace equation.

Geotechnical Engineering- Soil Mechanics: Origin of soils, soil structure and fabric; Three-phase system and phase relationships, index properties; Unified and Indian standard soil classification system; Permeability - one dimensional flow, Darcy's law; Seepage through soils - two-dimensional flow, flow nets, uplift pressure, piping; Principle of effective stress, capillarity, seepage force and quicksand condition; Compaction in laboratory and field conditions; One dimensional consolidation, time rate of consolidation; Mohr's circle, stress paths, effective and total shear strength parameters, characteristics of clays and sand.

Foundation Engineering: Sub-surface investigations - scope, 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, method of slices and Bishop's method; Stress distribution in soils - Boussinesq's and Westergaard's theories, pressure bulbs; Shallow foundations - Terzaghi's and Meyerhoff's bearing capacity theories, effect of water table; Combined footing and raft foundation; Contact pressure; Settlement analysis in sands and clays; Deep foundations - types of piles, dynamic and static formulae, load capacity of piles in sands and clays, pile load test, negative skin friction.

Fluid Mechanics: Properties of fluids, fluid statics; Continuity, momentum, energy and corresponding equations; Potential flow, applications of momentum and energy equations; Laminar and turbulent flow; Flow in pipes, pipe networks; Concept of boundary layer and its growth. Hydraulics: Forces on immersed bodies; Flow measurement in channels and pipes; Dimensional analysis and hydraulic similitude; Kinematics of flow, velocity triangles; Basics of hydraulic machines, specific speed of pumps and turbines; Channel Hydraulics - Energy-depth relationships, specific energy, critical flow, slope profile, hydraulic jump, uniform flow and gradually varied flow

Hydrology: Hydrologic cycle, precipitation, evaporation, evapo-transpiration, watershed, infiltration, unit hydrographs, hydrograph analysis, flood estimation and routing, reservoir

capacity, reservoir and channel routing, surface run-off models, ground water hydrology - steady state well hydraulics and aquifers; Application of Darcy's law.

Irrigation: Duty, delta, estimation of evapo-transpiration; Crop water requirements; Design of lined and unlined canals, head works, gravity dams and spillways; Design of weirs on permeable foundation; Types of irrigation systems, irrigation methods; Water logging and drainage; Canal regulatory works, cross-drainage structures, outlets and escapes. Groundwater Hydrology.

Water and Waste Water: Quality standards, basic unit processes and operations for water treatment. Drinking water standards, water requirements, basic unit operations and unit processes for surface water treatment, distribution of water. Sewage and sewerage treatment, quantity and characteristics of wastewater. Primary, secondary and tertiary treatment of wastewater, effluent discharge standards. Domestic wastewater treatment, quantity of characteristics of domestic wastewater, primary and secondary treatment. Unit operations and unit processes of domestic wastewater, sludge disposal.

Principles of surveying: Errors and their adjustment; Maps - scale, coordinate system; Distance and angle measurement - Levelling and trigonometric levelling; Traversing and triangulation survey; Total station; Horizontal and vertical curves. Photogrammetry - scale, flying height; Remote sensing - basics, platform and sensors, visual image interpretation; Basics of Geographical information system (GIS) and Geographical Positioning system (GPS).

Hydraulics

Dimensional and Model Analysis: Dimensional analysis and its utility. Buckingham's pi-theorem and Raleigh's method and their application to fluid flow problems. Dimensionless parameter in fluid flow and their relevance. Similarities. Application of dynamic similarity to model investigations. Scale ration for distorted model. Laminar flow: Flow through circular pipes, flow through parallel plates, and coaxial cylinders. Power absorbed in Viscous Flow, Concept of friction factor, Measurement of viscosity. Reynolds's number and its significance. Boundary Layer: Boundary layer along a thin plate and its characteristics, laminar and turbulent boundary layer, laminar sub- layer. Displacement, energy and momentum thickness, separation of boundary layer and control. Drag and lift. Turbulent Flow: Nature of turbulent flow and its origin. Reynolds's stress, Pandtl's mixing length hypothesis. Momentum integral equation, Hydro dynamically smooth and rough boundaries. Establishment of laminar and turbulent flow in a pipe. Velocity distribution for turbulent flow in smooth and rough pipes. Friction factor in smooth and rough pipes. Moody's diagram, Colerbrooks equation. Pipe flow: Hazen William & Darcy Weisbasch equation. Minor and major losses. Hydraulic gradient and total energy line. Pipes in series and parallel. Concept of equivalent length. Dupuits equation. Siphon, Water hammer, Two & Three reservoir problem. Pipe network. Hardy cross method. Time of emptying a reservoir through a pipe. Power transmission through pipes. Pumps: Reciprocating Pumps, working principal of both double and single pump. Indicator diagram. Frictional loss. Centrifugal pump, their advantages over reciprocating pump. Classification of Centrifugal pump. Operation of centrifugal pump in series and parallel. Turbine: General layout of hydroelectric power plant, Impulse and reaction Turbines, efficiency of turbines, classification based on discharge, Head and specific speed, unit power, unit discharge.