

**Note :The Student is required to be conversant with all aspects of design of structures where ever applicable.**

### 1. Surveying: I&II

Introduction and Principles of surveying – Classification – Brief introduction to chain surveying – Chaining and ranging - Compass surveying – Prismatic compass only – Instruments – Bearing of survey lines – systems and conversions – Local attraction – Latitude and departure – Traversing – Traverse adjustment of closing errors.

Plane Table surveying – instruments and accessories – advantages and disadvantages of plane table surveying – methods – radiation, intersection, traversing, resection – Two and three point problems – errors in plane table surveying. Levelling – Definitions – Levelling instruments – Temporary and permanent adjustments – Booking – Reduction to levels – Correction for Curvature and refraction – Classification of levelling – Profile Levelling – Differential levelling – Reciprocal levelling – longitudinal and cross sectioning - Contours – Contour interval – Methods of contouring – uses. Theodolite surveying – Vernier theodolite – Temporary and permanent adjustments – Measurement of horizontal and vertical angles – Methods of repetition and reiteration – errors in theodolite surveying – elimination of errors - Area and volume computation – area from latitude and departure – Simpson’s rule and Trapezoidal rule. Tachometric surveying – Principles – Methods – Stadia system –Fixed and Movable hair methods – Methods with staff held vertical and normal – Analytic lens – Subtense bar – Tangential method.

II - The basics and elements of different types of curves on roads and their preliminary survey, Surveying applications in setting out of curves, buildings, culverts and tunnels, Introduction to different geodetic methods of survey such as triangulation, trigonometric levelling, errors in measurements and their adjustments in a traverse. Introduction to modern advanced surveying techniques involved such as Remote sensing, **Total station**, GPS, Photogrammetry etc. Course Content Curve setting – Horizontal curves - Elements of simple and compound curves – Methods of setting out – Reverse curve – Transition curve – Length of curve – Elements of cubic parabola, true spiral and cubic spiral – Vertical

curve – parabola – Setting out of buildings – culverts – tunnels. Triangulation – different networks – orders and accuracies – intervisibility and height of stations – signals and towers – Baseline measurement – instruments and accessories – tape corrections – extension of baseline – satellite stations – Reduction to centre. Trigonometrical levelling – Observations for heights and distances – Geodetic observations – Corrections for refraction, curvature, axis signal – Reciprocal observations. Errors – Types of errors – Theory of least squares – weighted observations – most probable value – computations of indirectly observed quantities – method of normal equations – conditioned quantities, method of correlates, method of differences – adjustment of simple triangle and quadrilateral network without central station. Electromagnetic distance measurement (EDM) – Principle – Types – **Total station** - Photogrammetry – Terrestrial and Aerial photographs – Photo interpretation – Stereoscopy - Remote Sensing – Principle – Idealized remote sensing system – Types – applications - Introduction to GPS – Segments – Principle of working – application.

## 2. ESTIMATION, COSTING AND VALUATION

Know the importance of preparing the types of estimates under different conditions, rate analysis and bill preparations. To study about the specification writing To understand the valuation of land and buildings Course Content Preparation of detailed estimates - Preparation of specifications report accompanying the estimate Approximate methods of Costing - types of estimate - costing for various structures - rate analysis - rate for material and labour - schedule of rates -data sheets - abstract estimate. Values and its kinds - Valuation - purpose- scope - methods - land and building method - Factors affecting the value of plot and building - depreciation - Valuation of residential building with case study.

## 3. Soil mechanics& Geotechnical Engineering

*Soil and its constituents, weathering of rocks and types of soils, Mineralogy of soil solids.*

### *Physical Properties*

Water content, void ratio, porosity, degree of saturation, specific gravity, unit Weight and their determination, Atterberg limits, sieve analysis, hydrometer and Pipette analysis, Stoke's law, grain size distribution.

**Soil Classification** Grain size classification, Bureau of soils, M.I.T., Unified, AASHTO and ASTM Classification systems. Textural Classification by triangular chart, united soil classification system, AASHTO soil classifications.

### **Permeability and Seepage**

Definition, Hydraulic gradient, Darcy's Law, Factors affecting permeability, Permeability of stratified soils, Laboratory and field determination of coefficient of permeability.

Seepage force, quick sand condition, flow nets, boundary conditions, graphical method of flow net construction, determination of quantity of seepage, two dimensional flow, Laplace Equation, seepage through earth dams, design of filters.

**Compaction:** Definition, Compaction fundamentals, Moisture density relationships,

Standard Proctor test and modified AASHO test for compaction, Factors affecting compaction, Compaction equipment, properties and structure of compacted soils, Specifications, field control and measurement of in-situ density, CBR test.

### **Vertical stresses in soils**

Definition, stresses caused by self weight of soil, Geostatic stresses, stresses caused by point loads and uniformly distributed loads: Boussinesq and Westergaard theories, Pressure bulb, stress distribution diagram on horizontal and vertical planes; stress at a point outside loaded area, Newmark's charts and

### **Soil Exploration**

Importance of soil exploration, soil exploration methods; probing, test trenches and pits, auger boring, wash boring, rotary drilling, Percussion drilling and geophysical methods, soil samples, Disturbed and undisturbed samples.

**Foundation** :Soil Type and structure – gradation and particle size distribution – consistency limits. Water in soil – capillary and structural – effective stress and pore water pressure – permeability concept – field and laboratory determination of permeability – Seepage pressure – quick sand conditions – Shear strength determination – Mohr Coulomb concept. Compressibility and

consolidation concept – consolidation theory – consolidation settlement analysis. Earth pressure theory and analysis for retaining walls, Application for sheet piles and Braced excavation. Bearing capacity of soil – approaches for analysis–settlement analysis – stability of slope of earth walk. Subsurface exploration of soils – methods. Foundation – Type and selection criteria for foundation of structures.

Design criteria for foundation – Analysis of distribution of stress for footings and pile – pile group action-pile load test. Ground improvement techniques.

#### 4. **Fluid Mechanics, Open Channel Flow and Hydraulic Machines:**

**Fluid Mechanics:** Fluid properties and their role in fluid motion, fluid statics including forces acting on plane and curved surfaces. Kinematics and Dynamics of Fluid flow: Velocity and accelerations, stream lines, equation of continuity, irrotational and rotational flow, velocity potential and stream functions. Continuity, momentum and energy equation, Navier-Stokes equation, Euler's equation of motion, application to fluid flow problems, pipe flow, sluice gates, weirs.

**Dimensional Analysis and Similitude:** Buckingham's Pi-theorem, dimensionless parameters. Laminar Flow: Laminar flow between parallel, stationary and moving plates, flow through tube. Boundary layer: Laminar and turbulent boundary layer on a flat plate, laminar sub layer, smooth and rough boundaries, drag and lift. Turbulent flow through pipes: Characteristics of turbulent flow, velocity distribution and variation of pipe friction factor, hydraulic grade line and total energy line. Open channel flow: Uniform and non-uniform flows, momentum and energy correction factors, specific energy and specific force, critical depth, rapidly varied flow, hydraulic jump, gradually varied flow, classification of surface profiles, control section, step method of integration of varied flow equation.

**Hydraulic Machines and Hydropower:** Hydraulic turbines, types classification, Choice of turbines, performance parameters, controls, characteristics, specific speed. Principles of hydropower development.

#### 5. **Building Construction & Engineering Materials:**

Masonry principles using Brick, stone, Blocks – construction detailing and strength characteristics, Types of plastering, pointing, flooring, roofing and construction features. Common repairs in buildings. Principles of functional planning of building for residents and specific use - Building code provisions. Basic principles of detailed and approximate estimating - specification writing and rate analysis – principles of valuation of real property. Machinery for earthwork, concreting and their specific uses – Factors affecting selection of equipment – operating cost of Equipment.

Construction Planning and Management: Construction activity – schedules- organization for construction industry – Quality assurance principles. Use of Basic principles of network – analysis in form of CPM and PERT – their use in construction monitoring, Cost optimization and resource allocation. Basic principles of Economic analysis and methods. Project profitability – Basic principles of Boot approach to financial planning – simple toll fixation criterions.

**Physical properties of construction materials** with respect to their use in construction –Steel, Cement, Stones, Bricks and Tiles; Lime, Cement, different types of Mortars and Concrete.

Specific use of ferro cement, fibre reinforced C.C, High strength concrete.

Timber, properties and defects - common preservation treatments. Use and selection of materials for specific use like Low Cost Housing, Mass Housing, High Rise Buildings.

- 6. STRUCTURAL ANALYSIS** –: The concept of analysis of indeterminate structures by various classical methods. Study the use of ILD for determinate structure. Concepts of moving loads and its effect on structures. Understanding the concept of equivalent UDL , the reversal of stress under live load Course Content Slope deflection method - analysis of indeterminate structures- Settlement. Moment distribution method - analysis of indeterminate structures - settlement of supports - sway. Energy methods - Kani's method - analysis of indeterminate structures - settlement of supports - sway. Moving loads for statically

determinate structures -single load - two point loads - several points loads - maximum bending moment and maximum shear force - equivalent u.d.l. - absolute maximum bending moment. Enveloping curves for maximum bending moment and maximum shear force and determination of equivalent UDL, ILD for shear, moment and reactions for statically determinate beams and pinjointed trusses - Reversal of stresses under live load.

The influence line concepts for indeterminate structures, Introduction to the methods of analysis of intermediate trusses for external loads, lack of fit and thermal effect. To study behaviour of arches and their methods of analysis. To know the concept and analysis of cable stayed bridge. To study the multi storey frames subjected to gravity loads and lateral loads Course Content Influence lines - Maxwell Betti's theorem - Muller Breslau's principle and its application. Influence lines for continuous beams and single bay, single storey portals with prismatic members. Analysis of plane truss with one or two redundants - trusses with lack of fit - Thermal stresses - Settlement of supports - Trussed beams. Theory of arches - Analysis of three hinged, two hinged and fixed arches - influence lines, rib shortening, settlement and temperature effects. Analysis of cables - Suspension bridges with three and two hinged stiffening girders - influence lines. Analysis of multistorey frames for gravity and lateral loads by approximate methods - Substitute frame - Portal and Cantilever methods.

- 7. Design of Concrete Structures:** The design concept of various structures and detailing of reinforcements. The design of underground and elevated liquid retaining structures. Study the design of material storage structures, the effect of temperature on concrete structures. Design of bridges subjected to IRC loading Course Content Earth Retaining structures - Retaining walls- types - cantilever and counterfort - design - drainage and other construction details. Liquid Retaining structure - Water tanks - types - square, rectangular, circular - Design of underground and elevated tanks - design of staging - spherical & conical roof for circular tanks. Material storage structures - Determination of

lateral pressure on side walls of bunker - Rankine's theory - design of bunker - design of circular silo using Jansen's theory. Environmental Structures - Chimneys - Principles and Design - Design of long columns. Transportation structures - Bridges - Slab bridge - Design of single span slab bridge - Tee beam bridge - Design of Tee beam bridge with stiffness - Tee beam bridge with cross girders. **Concept of mix design.** Reinforced Concrete: Working Stress and Limit State method of design— Recommendations of I.S. codes Design of one way and two way slabs, stair-case slabs, simple and continuous beams of rectangular, T and L sections. Compression members under direct load with or without eccentricity, Cantilever and Counter fort type retaining walls. Water tanks: Design requirements for Rectangular and circular tanks resting on ground. Prestressed concrete: Methods and systems of prestressing, anchorages, Analysis and design of sections for flexure based on working stress, loss of prestress. Design of brick masonry as per I.S. Codes

**Design of Steel Structures-** Concept of plastic analysis, The behaviour and design of compression member subjected to eccentric force and design of base plate To study the design of Gantry girder, welded plate girder, stiffeners and connections To calculate the wind forces on steel stacks as per IS 875 and design the self-supporting steel stacks including base plate and anchor bolts. Study the behaviour and design of light gauge steel sections Course Content Eccentrically loaded column - simple and compound section - lacings and battens - column bases – slab base – gusseted base – moment resistant base plate Welded plate girders – analysis and design using IS800-2007 - curtailment of flange plates –stiffeners – analysis and design of gantry girder Introduction to IS875 part (3) – assessment of wind load – analysis and design of steel stacks - functional and structural requirements - self-supporting and guyed stacks - base plate and anchor bolt Light gauge steel sections-types of cross section - Local and post buckling - Effective width concept Compression and Flexural members.

Structural Steel Design: Factors of safety and load factors. Riveted, bolted and welded joints and connections. Design of tension and compression member, beams of built up section, riveted and welded plate girders, gantry girders, stanchions with battens and lacings.

## 8. Water Supply & Sanitary Engineering

**Water Supply:** Predicting demand for water, impurities, of water and their significance, physical, chemical and bacteriological analysis, waterborne diseases, standards for potable water. Intake of water: Water treatment: principles of coagulation, flocculation and sedimentation; slow-; rapid-, pressure-, filters; chlorination, softening, removal of taste, odour and salinity.

**Sewerage systems:** Domestic and industrial wastes, storm sewage—separate and combined systems, flow through sewers, design of sewers. Sewage characterization: BOD, COD, solids, dissolved oxygen, nitrogen and TOC. Standards of disposal in normal watercourse and on land. Sewage treatment: Working principles, units, chambers, sedimentation tanks, trickling filters, oxidation ponds, activated sludge process, septic tank, disposal of sludge, recycling of wastewater. Solid waste: Collection and disposal in rural and urban contexts, management of long-term ill effects.

**Environmental pollution:** Sustainable development. Rawwastes and disposal. Environmental impact assessment for thermal power plants, mines, river valley projects. Air pollution. Pollution control acts

9. **Highway Engineering:** Principles of Highway alignments – classification and geometrical design elements and standards for Roads. Pavement structure for flexible and rigid pavements - Design principles and methodology of pavements. Typical construction methods and standards of materials for stabilized soil, WBM, Bituminous works and CC roads. Surface and sub-surface drainage arrangements for roads - culvert structures. Pavement distresses and strengthening by overlays. Traffic surveys and their applications in traffic planning - Typical design features for channelized, intersection, rotary etc – signal designs – standard Traffic signs and markings.





- **Structural Analysis**
- **Design of concrete Structures**
- **Design of Steel structures**
- **Structural Design**
- **Hydrology and Irrigation Engineering**
- **Water Resources Engineering**
- **Open Channel Flow**
- **Transport Engineering**
- **Environmental Engineering**