

**I. Water Resources:**

Quality & demand of water, factors effecting demand, Population forecast

**II. Surface Sources & Intake works – Classification & conduits**

**III. Water Treatment**

Characterisation and drinking water standards; Treatment of water – Screening, Plain sedimentation and with coagulation. Filtration- Slow sand, Rapid sand and Pressure Filters;

**IV. Water Treatment (Contd)**

Disinfection, Softening & other miscellaneous treatments of water; Water borne diseases,

**V. Distribution system:**

Different types of pipe line networks; Layout of Pipe Lines, Pipe joints & fittings, valves; Design, Methods of distribution, distribution reservoirs

**VI. Sewage and Drainage:**

Quantity of Sewage and Storm water, Design of sewers and Water drains; Plumbing and house drainage

**VII. Sewer Appurtenances and Sewage Treatment:**

Layout, Septic tank, Imhoff tank, Pumping of sewage

**Books References:**

- i. GARG S. K. : Water Supply
- ii. GARG S. K. : Sanitary Engineering
- iii. CPHEEO Manual on Water Supply and Treatment
- iv. CPHEEO Manual on Sewerage and Sewage Treatment
- v. Birdie : Water Supply & Sanitary Engg

**I. Introduction:**

History and development of Indian Railways, Water transportation and Air transport, Advantages and disadvantages of each.

**II. Railway Engineering:**

Location surveys and alignment, Permanent way, Gauge, Coning of Wheels, Function of Rails, Type of Rail sections, wear on Rails, Rail Failures, Rail flaw detection, Creep of Rails, Rail Joints, Function of sleepers, Types of sleepers, sleeper density, Ballast, Rail Fixtures and Fastenings, Formation and Subgrade, Failures in rail embankment and measures.

**III. Geometric Design of Rail Tracks:**

Cross-sectional Elements of a railway tract, Horizontal curves, Super-elevation or Cant, Equilibrium Cant, Cant deficiency, Cant Excess, Negative superelevation, Gradients, Vertical Curves. .

**IV. Points and Crossings, Junctions, Stations and Railway Yards:**

Turnouts, Points and switches, Crossings, Type of Crossings, track junctions, Design of a turnout, Design of diamond crossing and cross-over, Functions and Requirements of a Railway Station, Types of Stations, Function of Station Yards, Sidings

**V. Signaling, Interlocking and Track Resistances:**

Object and Principles of signaling, classification of signals, Necessity and functions of interlocking, Traction and Tracting Resistances, Hauling Capacity of a Train

**VI. Airport Engineering:**

Aircraft characteristics, Runway, Taxiway, Aprons, Terminal Area

**VII. Docks & Harbour:**

Types, breakwaters, docks, wharves, quays, transit sheds, navigational aids.

**References:**

- i. Chandra and Agrawal : Railway Engineering
- ii. Saxena and Arora : A Text Book of Railway Engineering
- iii. M.M. Agarwal, Railway Engineering, Prabha & Co. 2007
- iv. Khanna S.K. and Aurora, M.G. Airport Planning and Design
- v. Oza and Oza, Elements of Dock and Harbour Engineering

**I. Curves and Curve Setting:**

Introduction: Necessity, types of curves, applications

Simple curves – Degree of curve, methods of curve setting, Obstacles in curve setting

Compound curve, Reverse curve, Transition curve, Vertical curve

**II. Triangulation:**

Scope, classification, inter-visibility, satellite station, eccentricity of signals, base line and its extension

**III. Theory of Errors:**

Terms, Laws of weights, M.P.V. & M.P.E., adjustment of geodetic triangle with central station, adjustment of level line

**IV. Geodetic Levelling:**

Scope, curvature & refraction corrections, axis-signal correction, Single angle observation, reciprocal levelling

**V. Electronic Distance Meter:**

Scope, electromagnetic waves, phases of waves, types of waves, distance by transit time and phase difference, carrier waves, different EDM instruments, Total station

**VI. Astronomy:**

Terms- Celestial sphere, Zenith, Nadir, Horizon, Vertical circle, Latitude, Longitude, Altitude, Azimuth, Right Ascension, Declination, Hour angle, Ecliptic. Different co-ordinate systems, Spherical triangle, Time – sidereal time, apparent time, mean solar time, equation of time, determination of azimuth, latitude longitude

**VII. Hydrographic Surveying**

Scope, applications, methods of sounding, three point problem

**References :**

KANETKAR T. P. : Surveying and Leveling (Vol. II)

ARORA K. P. : Surveying Vol. II

**I. Site Investigation and subsoil exploration:**

Methods of soil exploration; Planning a subsoil exploration: Number of boreholes and depths of exploration for various types of works; Field Tests: Standard penetration test; Dynamic and Static cone penetration tests; Vane shear test; Soil samplers & collection of soil samples

**II. Stress Distribution in Soil Media and Settlement :**

Stress Distribution: Boussinesq's and Westergaard's equations, Pressure distribution diagram, Newmark's influence chart; Contact pressure below foundations –Steinbrenner's coefficients Settlement of foundations : Elastic, Consolidation and Creep settlements; Total and Differential settlements; Rate of settlement, I. S. Code limitations for different structures Settlement calculation from consolidation characteristics and using N-values

**III. Bearing capacity:**

Terminology: Ultimate and Safe Bearing Capacities; Allowable Bearing Pressure Gross and Net Bearing Capacities; Net Soil pressure for a specified settlement; Bearing capacity from equations of Terzaghi, Skempton, Brinch Hansen and Meyerhoff; I. S. Code of Practice; Bearing capacity from N-values; Effect of ground water table Plate Load test: Procedure, Limitations and determination of permissible bearing capacity for footings in sand and clay soils

Eccentrically loaded footings – useful width concept

**IV. Shallow Foundations:**

Type of foundations: Isolated and combined footings; Rafts foundations Proportioning of footings for even settlement

**V. Pile Foundation:**

Types of piles; Pile construction; Load carrying capacity of piles : Dynamic and static Formulae; Elastic analysis of single axially loaded pile; Group action and efficiency; Underreamed pile foundation; Introduction to Laterally loaded piles and Batter piles Negative skin friction – cause and prevention of n s f effect on piles; factor of safety of pile subjected to negative skin friction Pile load tests : ultimate, routine, vertical and horizontal; permissible settlement

**VI. Machine Foundations:**

Soil dynamics, Mass-spring system; Mass-system with damping; Natural frequency of foundation soil systems; Machine Foundations: Types of Machines and Machine Foundations Vibration isolation: Types and Methods of Isolation

**VII. Caissons:**

Shapes and Types of wells or caissons, their advantages and disadvantages; components of a well foundation; Depth of well foundation and bearing capacity; Forces acting on a well foundation. Well sinking: operation and problems; Drilled caissons; Pier foundations

**References :**

- i. VENKATRAMIAH C. : Geotechnical Engineering
- ii. GARG S. K. : Soil Mechanics and Foundation Engineering
- iii. BRAHMA S. P. : Foundation Engineering
- iv. BOWLES J. F. : Foundation Analysis and Design