COURSE STRUCTURE & SYLLABUS OF BACHELOR OF TECHNOLOGY (B.TECH)

In

Civil

Course Structure

Second Year

Third Semester

Paper Code	Subject
BSC1	Mathematics III
BSC2	Water and Waste Water Engineering
BSC3	Hydraulics
BSC4	Transportation Engg
BSC5	Surveying-I

Syllabus

BSC1 : MATHEMATICS III

1. PARTIAL DIFFERENTIATION AND PARTIAL DIFFERENTIAL EQUATION

Introduction, Limit , Partial derivatives , Partial derivatives of Higher orders, Which variable is to be treated as constant, Homogeneous function, Euler's Theorem on Homogeneous Functions, Introduction, Total Differential Coefficient, Important Deductions, Typical cases, Geometrical Interpretation of $\frac{dz}{dx}, \frac{dz}{dy}$, Tangent plane to a surface, Error determination, Jacobians, Properties of Jacobians, Jacobians of Implicit Functions, Partial Derivatives of Implicit Functions by Jacobian, Taylor's series, Conditions for F(x,y) to be of two variables maximum or minimum, Lagrange's method of undermined Multipliers.

2. PARTIAL DIFFERENTIAL EQUATIONS

Partial Differential Equations, Order, Method of Forming Partial Differential Equations, Solution of Equation by direct Integration, Lagrange's Linear equation, Working Rule, Method of Multipliers, Partial Differential Equations non- Linear in p,q , Linear Homogeneous Partial Diff. Eqn., Rules for finding the complimentary function, Rules for finding the particular Integral, Introduction, Method of Separation of Variables, Equation of Vibrating Strain, Solution of Wave Equation, One Dimensional Heat Flow, Two dimensional Heat Flow.

3. FOURIER SERIES

Periodic Functions, Fourier Series, Dirichlet's Conditions, Advantages of Fourier Series, Useful Integrals, Determination of Fourier constants (Euler's Formulae), Functions defined in two or more sub spaces, Even Functions, Half Range's series, Change of Interval, Parseval's Formula, Fourier series in Complex Form, Practical Harmonic Analysis.

4. LAPLACE TRANSFORMATION

Introduction, Laplace Transform, Important Formulae, Properties of Laplace Transforms, Laplace Transform of the Derivative of f (t), Laplace Transform of Derivative of order n, Laplace Transform of Integral of f (t), Laplace Transform of t.f (t) (Multiplication by t), Laplace Transform of $\frac{1}{t}$ f(t) (Diversion by t), Unit step function, second shifting theorem, Theorem, Impulse Function, Periodic Functions, Convolution Theorem, Laplace Transform of Bessel function, Evaluation of Integral, Formulae of Laplace Transform, properties of Laplace Transform, Inverse of Laplace Transform, Important formulae, Multiplication by s, Division of s (Multiplication by 1/s), First shifting properties, second shifting properties, Inverse Laplace Transform of Derivatives, Inverse Laplace Transform of Integrals,Partial Fraction Method, Inverse Laplace Transform, Solution of Differential Equations, Solution of simultaneous equations, Inversion Formulae for the Laplace Transform.

5. NUMERICAL TECHNIQUES

Solution of Ordinary Differential Equations, Taylor's Series Method, Picard's method of successive approximations, Euler's method, Euler's Modified formula, Runge's Formula, Runge's Formula (Third only), Runge's Kutta Formula (Fourth order), Higher order Differential Equations.

6. NUMERICAL METHODS FOR SOLUTION OF PARTIAL DIFFERENTIAL EQUATION

General Linear partial differential equations, Finite-Difference Approximation to Derivatives, Solution of Partial Differential equation(Laplace's method), Jacobi's Iteration Formula, Guass-Seidal method, Successive over-Relanation or S.O.R. method, Poisson Equation, Heat equation(parabolic equations), Wave equation (Hyperbolic Equation).

BSC2 : WATER & WASTE WATER ENGINEERING

1. WATER SUPPLY ENGINEERING

Importance And Necessity Of Water Supply Schemes, Water Treatment, Importance And Reliability Of Water Works, Essentials Of Water Supply Engineering, Duties Of Water Works Engineers, Historical

2. QUANTITY OF WATER

General, Types Of Demands, Domestic Water Demand, Commercial And Industrial Demand, Fire Demand, Demands For Public Use, Compensate Losses Demand, Per Capita Demand, Design Period, Forecasting Population, Arithmetical Increase Method, Geometrical Increase Method, Incremental Increase Method, Decrease Rate Of Growth Method Or Decreasing Rate Method, Simple Graphical Method, Comparative Graphical Method, The Master Plan Method Or Zoning Method, Logistic Curve Method, The Apportionment Method, Fluctutaion In Demand Of Water, Factors Affecting The Water Demand

3. COLLECTION & CONVEYANCE

Intakes, Design Of Intakes, Types Of Intakes, Lake Intakes, River Intake, Reservoir Intake, Canal Intake, Conveyance Of Water, Open Channels, Aqueducts, Tunnels, Flumes, Pipes, Cast-Iron Pipes, Wrought Iron Pipes, Steel Pipes, Concrete Pipes, Cement-Lined Cast-Iron Pipe, Asbestos Cement Pipe, Copper And Lead Pipes, Wooden Pipes, Palstic Pipes, Vitrified Clay Pipes, Pipe-Joints, Spigot And Socket Joint, Expansion Joint, Flanged Joint, Mechanical Joints, Flexible Joint, Crewed Joint, Collar Joint, Joint For A.C Pipes, Laying Of Water Supply Pipes, Specifications For Laying And Jointiong Of Pipes, Hydrostatic Test, Disinfection Of Pipe Lines Before Use

4. WATER TREATMENT PROCESSES

General, Standards For Quality Of Treated Water, Objects Of Treatment, Considerations For Public Water Supply, Location Of Treatment Plants, Treatment Processes, Layout Of Treatment Plant, Labortory

5. DISTRIBUTION SYSTEM

General, distribution system, gravity system, pumping system, dual system, layout of distribution system, dead end or tree system, grid-iron system, circular or ring system, radial system, methods of supplying water, pressure in the distributin system, distribution reservoirs, capacity of the reservoirs, determination of storage capacity, types of reservoirs, earth reservoirs, masonry and r.c.c. Reservoirs, elevated reservoirs, stand pipes, elevated tanks, accessories of reservoirs

6. SANITARY ENGINEERING

General, Definitions Of Some Common Terms, Used In Sanitary Engineering, Sanitary Works, Aims And Objects Of Sewage-Disposal

7. SYSTEMS OF SANITATION

General, Methods Of Collection, Conservancy System, Merits And Demerits Of Conservancy Systems, Merits And Demerits Of Water Carriage System, Sewerage System, Merits And Demerts Of Separate System, Merits And Demerits Of Combined System, Comparison Of Separate And Combined Suystems, Merits And Demerits Of Partially Separate System, Patterns Of Collection Systems

8. QUANTITY OF SANITARY SEWAGE

General, Sources Of Sanitary Sewage, Factors Affecting Sanitary Sewage, Additions Due To Infiltration, Subtractions Allowance, Rate Of Water Supply, Population, Type Of Area Served, Effect Of Growth Of Populaton, Determination Of Quantity Of Sanitary Sewage, Variation In The Quantity Of Sewage, Seasonal And Daily Variation, Peak Rates Of Flow, Minimum Flow

9. DRAINS AND SEWERS

Open Drains, Drain Sections, Classification Of Drains, Sewer, Sewer Sections, Sewer Materials, Brick Sewers, Vitrified Clays Or Stoneware Pipes, Cement Concrete Pipes, Asbestos Cement Pipes, Cast Iron Pipes, Steel Pipes, Plastic Pipes, Miscellaneous Materials Used For Sewer Construction, Sewer Joints, Bandage Joint, Spigot And Socket Joint, Collar Joint, Flush-Joint, Filled And Poured Type Joints, Method Of Making Poured-Joints With Sulphur And Sand, Method Of Making A Filled Joint, Other Types Of Joints, Corrosion Prevention In Sewers, Protective Barriers, Modification Of Materisls, Other Preventive Measures

10. SEWER APPURTENANCES

General, Manholes, Drop Manholes, Lamp-Holes, Street Inlets, Flushing Tanks, Catch Basins Or Pits, Sand, Grease And Oil Traps, Inverted Siphon, Storm Water Relief Works, Ventilation Of Sewers, Design Of Overflows And Regulators, Desing Of Inverted Sysphon, Float Actuated Gates And Valves, Flap Gates And Flood Gates, Measuring Devices

11. CHARACTERISTICS AND EXAMINATION OF SEWAGE

General, characteristics of sewage, physical characteristics, chemical characteristics, biological characteristics, decomposition of sewage, examination of sewage, sampling of sewage, sampling of sewage, physical examination, chemical examination, solids, procedure of determining total and volatile solids, dissolved oxygen determinaton, biochemical oxygen demand (b.o.d.), b.o.d. Test, b.o.d. Rates, chemical oxygen demand (c.o.d), stability and relative stability, chilorides and sulphides, method for determination of chlorides, chlorine demand, nitrogen, ph-value, grease, oil and fat, biological tests

12. SEWAGE TREATMENT PROCESSES

General, Object Of Treatment, Degree Of Treatment, Period Of Design, Effluent Disposal And Utilisation, Types Of Treatments, Location Of Treatment Plants, Treatment Processes, Sewage-Treatment Plants, Layout Of Treatment Plants, Points To Be Considered In Design, Laboratory

13. SCREENING AND SKIMMING

General, Purpose Of Screening, Types Of Screens, Bar-Screens, Fine Screens, Communiters, Other Types Of Screens, Design Factors, Disposal Of Screenings, Removal Of Oil, Grease Etc, Floatation, Skimming Tanks, Disposal Of Skimmings

14. SEDIMENTATION

General, Characteristics Of Settleable Solids, Theory Of Sewage Sedimentaiton, Classification Of Sedimentation Tanks, Design Of Sedimentation Tanks, Standard Design Loading, Detention Period, Settling Efficiency Of Particles, Sedimentation Tanks, Sludge Removal, Method Of Obtaining Uniform Flow In Sedimentation Tanks, Grit Chambers, Designe Of Grit Chambers, Disposal Of Grit, Detritus Tanks

15. BIOLOGICAL TREATMENT

General, Principle Of Biological Treatment, Classificaltion Of Sewage Filters, Intermittent Sand Filters, Contact Beds, Trickling Filters, Types Of Trickling Filters, Construction Features Of Trickling Filters, Trickling Filter Opertion And Loading, High Rate Filters, Design Of Trickling Filters, Galler And Gotaas Equation, Recirculation, Recirculation Factor, Biofilters, Humus Tanks, Comparison Of Low Rate And High Rate Trickling Filters, Filter Site Troubles And Remedies

16. QUALITY OF WATER

Wholesome Water, Impurities In Water, Examivation Of Water, Collection Of Water Samples, Water Analysis, Physical Tests, Chemical Tests, Living Organism In Water, Biological Tests, Standards Of Water Quality

17. CHEMICAL PRECIPITATOIN

General, Situations When Used, Chemical Used, Handling And Storing Of Coagulants, Dosage Of Coaculants, Determination Of Optimum Coagulant Dose, Feeding Devices, Mixing And Flocculation, Sedimentation, Clarifiers, Efficiency Of Chemical Precipitation

BSC3 : HYDRAULICS

1. **INTRODUCTION**
   Introduction, Classification of Fluid, Fundamental Units, S.I. (International System of Units), Presentation of Units and their Values, Rules for S.I. Units, Liquids and their properties, Density of Water, Specific weight of Water, Specific Gravity of Water, Compressibility of Water, Surface tension of water, Capillarity of Water, Viscosity of Water.

2. **HYDROSTATICS**
   Introduction, Total Pressure, Total Pressure on an Immersed Surface, Total Pressure on a Horizontally Immersed Surface, Total pressure on a Vertically Immersed Surface, Total Pressure on inclined surface, Centre of pressure, Pressure on a curved Surface.

3. **EQUILIBRIUM OF FLOATING BODIES**
   Introduction, Archimedes Principle, Buoyancy, Centre of Buoyancy, Metacentre, Metacentric Height, Analytical Method for Metacentric Height, Conditions of Equilibrium of a floating Body, Stable Equilibrium, Unstable Equilibrium, Unstable Equilibrium, Neutral Equilibrium, Maximum Length of Vertically Floating Body, Conical Buoys Floating in Liquid, Experimental method for Metacentric Height, Time of Rolling (Oscillation) of a floating body.

4. BERNOULLI'S EQUATION AND ITS APPLICATIONS

Introduction, Energy of a liquid in Motion, Potential Energy of a liquid particle in Motion, Kinetic Energy of a liquid particle in Motion, Pressure Energy of a liquid particle in Motion, Total Energy of a liquid particle in Motion, Total Head of a liquid particle in Motion, Bernoulli's Equation, Euler's Equation for Motion, Limitations of Bernoulli's Equation, Practical Applications of Bernoulli's Equation, Venturimeter, Discharge through a Venturimeter, Inclined Venturimeter, Orifice Meter, Pitot Tube.

5. FLOW THROUGH ORIFICES

Introduction, Types of Orifices, Jet of Water, Vena Contracta, Hydraulic Coefficients, Coefficient of Velocity, Coefficient of Discharge, Coefficient of Resistance, Experimental Method for Hydraulic Coefficients, Discharge through a small Rectangular Orifice, Discharge through a large Rectangular Orifice, Discharge through a Submerged or Drowned Orifice, Discharge through a Wholly Drowned Orifice, Discharge through a Partially Drowned Orifice, Discharge through a Drowned Orifice under Pressure.

6. FLOW THROUGH MOUTHPIECES

Types of mouthpieces, Loss of a Head of a Liquid Flowing in a pipe, Loss of Head due to Sudden Enlargement, Loss of Head due to sudden contraction, Loss of Head at entrance to pipe, Discharge through a Mouthpiece, Discharge through an External mouthpiece, Discharge through an Internal mouthpiece (Re-entrant or Borda's mouthpiece), Discharge through a Convergent Mouthpiece, Discharge through a Convergent-divergent Mouthpiece (Bell-mouthpiece), Pressure in a mouthpiece, Pressure in an External mouthpiece, Pressure in an internal mouthpiece, Pressure in a Convergent Mouthpiece, Pressure in a Convergent-divergent Mouthpiece.

7. FLOW THROUGH SIMPLE PIPES

Introduction, Loss of Head in Pipes, Darcy's Formula for loss of Head in pipes, Chezy's Formula for Loss of Head in Pipes, Graphical Representation of Pressure Head and Velocity Head, Hydraulic Gradient Line, Total Energy Line, Transmission of Power through Pipes, Time of Emptying a Tank through a Long Pipe, Time of Flow from One Tank into Another through a Long Pipe.

8. UNIFORM FLOW THROUGH OPEN CHANNELS

Introduction, Chezy's Formula for Discharging through an Open Channel, Values of Chezy's Constant in the formula for Discharge through an Open Channel, Bazin's Formula for Discharge, Kutter's Formula for Discharge, Manning's Formula for Discharge, Discharge through a Circular Channel, Channels of Most Economical Cross-sections, Condition for Maximum Discharge through a Channel of Rectangular Section, Condition for Maximum Discharge through Channel of Trapezoidal Section, Condition for Maximum Velocity through a Channel of Circular Section, Condition for Maximum Discharge through a Channel of Circular Section, Measurement of River Discharge, Area of Flow, Simple Segments Method, Simpson's rule, Average Velocity of Flow, Floats, Pitot Tube, Chemical Method for the Discharge of a River.

9. VISCOUS FLOW

Viscosity, Newton's Law of Viscosity, Effect of Viscosity on Motion, Units of Viscosity, Effect of Temperature on the Viscosity, Kinematic Viscosity, Classification of Fluids, Ideal Fluid, Real Fluid, Newtonian Fluid, Non-Newtonian Fluid,Ideal Plastic fluid, Classification of Viscous Flows, Laminar Flow, Turbulent Flow, Reynold's Experiment of Viscous Flow, Reynold's number, Hagen-Poiseuille Law for Laminar Flow in Pipes, Distribution of Velocity of a Flowing Liquid over a Pipe Section, Loss of Head due to Friction in a Viscous Flow.

10. IMPACT OF JETS

Introduction, Force of Jet Impinging Normally on a fixed Plate, Force of Jet Impinging on an Inclined Fixed Plate, Force of Jet Impinging on a Curved Plate, Force of Jet Impinging on a Moving Plate, Force of Jet Impinging on a Series of Moving Vanes, Force of Jet Impinging on a Fixed Curved Vane, Force exerted ny a Jet of water on a series of vanes.

11. JET PROPULSION

Introduction, Pressure of Water due to Deviated Flow, Principle of Jet Propulsion, Conditions for maximum efficiency, Propulsion of Ships by water Jets, Propulsion of Ships Having Inlet Orifices at Right Angles to the Direction of its Motion (i.e. Orifices Amidship), Propulsion of Ships Having Inlet Orifices Facing the Direction of Flow.

12. WATER WHEELS
Introduction, Hydroelectric Power Plant, Heads of Turbine, Classification of Hydraulic Turbines, Water Wheels, Pelton

13. IMPULSE TURBINES
Introduction, Pelton Wheel, Runner and Buckets, Casing, Braking Jet, Work Done by an Impulse Turbine, Design of Pelton Wheels, Governing of an Impulse Turbine (Pelton Wheel), Other Impulse Turbines.

14. CENTRIFUGAL PUMPS
Introduction, Types of Pumps, Centrifugal Pump, Types of casings for the impeller of a Centrifugal Pump, Volute Casing (Spiral Casing), Vortex Casing, Volute Casing with Guide Blades, Work done by a Centrifugal Pump, Efficiencies of a Centrifugal Pump, Manometric Efficiency, Mechanical Efficiency.

15. PUMPING DEVICES
Introduction, Hydraulic Ram, Air Lift Pump, Rotary Pump.

16. HYDRAULIC SYSTEMS
Introduction, Hydraulic Press, Hydraulic Accumulator, Hydraulic Intensifier, Hydraulic Crane, Hydraulic Lift, Direct Acting Hydraulic Lift, Suspend Hydraulic Lift, Hydraulic Coupling, Hydraulic Torque Convertor.

BSC4 : TRANSPORTATION ENGINEERING

PART I

1. ROAD PLANNING:
Classification of Highways, Planning of a Highways, Fact Finding Surveys and Other Surveys, Reconnaissance, Preliminary Survey, Final Location Survey, Cross- section and Profiles, Surface Drainage Survey, Soil Investigation, Road Materials Investigation, Rights of Way Investigation, Bridge Sites, Survey Report, Annexure to the Survey Report, Phasing of Road Programme, Saturation System, Road Planning in India.

2. GEOMETRIC DESIGN OF HIGHWAY:
Introduction, Width of Formation, Right of Way, Width of Pavement, Camber, Gradient, Speed,Sight Distances, Curves and Their Radii, Road Cross –sections, Road- Rail Level Grossings.

3.LOW COST ROADS.
Introduction, Earth Roads, Kanker Roads, Garvel Roads, Traffic Bound Macadam, Water Bound Macadam Roads.

4.ROAD CONSTRUCTION MATERIALS:
Introduction, Crushed Rock Aggregate, Gravels , Sand , Slag, Requirements of a Good Road Aggregate, Aggregate Testing, Bituminous Materials, Specifications and Tests for Bituminous Materials , Cement Testing.

5. STABILISED ROADS.
Introduction, Stabilizers, Soil Stabilized Roads or Mechanical Stabilized Roads, Sand- Clay Roads, Gravel Surfaced Stabilized Roads, Soil- Lime-Pozzolen Stabilized Roads, Soil-Cement Stabilized Roads, Bitumen Stabilized Roads.

6. FLEXIBLE PAVEMENT:
Introduction, Type of Pavement, Structure of the Flexible Pavement, Group Index Method, California Bearing Ratio (C.B.R.) Method for the Design of Flexible Pavement.

7. BITUMINOUS ROADS.

Introduction, Types of Bituminous Pavements, Surface Treatment, Intermediate Type Surfaces, High-type Bitumen Pavement.

8.RIGID PAVEMENTS:
Introduction, Advantages of Cement Concrete Pavement, Disadvantages of Cement Concrete Pavement, Stressess in Cement Concrete Pavement, Concrete, Design of Concrete Pavement, The Sheets Formulas, The Westerguard Formulas, Picket's Equation, Kelly's Equation, Spanglar's Equation, Allowable Design Stress, Slab Thickness, Reinforcement in Concrete Slabs, Pavement Joints, Longitudinal Joints, Transverse Joints, Construction Equipment, Preparation of the Sub- grade and Sub-base, Forms, Concrete of Pavement.

9.DRAINAGE:
Introduction, Surface Drainage, Sub-Soil Drainage, Drainage of Marshy Soil, Bridges and Culverts, Causeways, Guidelines for the Design of Small Bridges and Culverts

10.TRAFFIC ENGINEERING:
Introduction, The Road Users and Their Characteristics, The Vehicles and Vehicular Characteristics, Road Characteristics, Traffic Census of Traffic Surveys, Traffic Volume Study, Cycle Variation in Traffic Volume, 30^{th} Highest Hourly Volume, Traffic Projection Factor, Origin and Destination Studies, Roadway Capacity , Road Parking and Studies, Parking Stalls , Parking Areas, Parking Lots and Parking Garages, Road Accidents and Studies , Traffic Regulation, Traffic –control Devices, Investigations, Clover-leaf, By- pass, Ribbon Development, Street and Highway Lighting.

PART II

11. HISTORY OF RAILWAYS IN INDIA:
Introduction, Development of Railways in India, Comparison of Roads and Railways ,Gauges.

12.ALIGNMENT SURVEY AND PROJECT REPORT:
Introduction, Track Alignment and Gradient, Survey for Track Alignment, Traffic Survey, Reconnaissance Survey, Preliminary Survey, Location Survey, Survey Dragings and Projects Reports.

13.PERMANENT WAY
Rails , Railway Sleepers, Ballast, Rail Fastenings and Fixtures.

14.RAILWAY POINTS AND CROSSINGS AND JUNCTIONS:
Introduction, Turnouts, Switches , Crossing, Design of Turnout , Types of Track Junctions, Design of Simple Junctions.

15.RAILWAY TRACK DRAINAGE:
Introduction, Importance of Drainage, Requirement of Drainage System, Drainage systems, Cross Drainage, Drainage Problems.

16.MAINTENANCE OF RAILWAY TRACK:
Introduction, Advantages of Good Maintenance, Daily Maintenance , Periodical Maintenance, Modern Railway Track, Maintenance of Track Alignment, Maintenance of Drainage, Maintenance of Track Components, Maintenance of Points and Crossings, Maintenance of Level Crossing , Maintenance Organization, Track Recording , Mechanical Maintenance, Mechanized Maintenance, Measured Shovel Packing, Directed Maintenance of Track, Inspection of Track- Track Recording and Track Tolerances

17.RAILWAY STATION YARDS AND EQUIPMENT:
Introduction, Site Selection, Types of Selections, Station Yard, Requirements and Amenities of a Railway Station, Level Crossing, Types of Equipment, Platform, Water Column, Triangle, Ashpit, Ashpan, Turntable, Buffer Stop, Catch Siding or Slip Siding, Scotch Block, Derailing Switch, Sand Hump, Fouling Marks, Cow Catcher, Weigh Bridge, Loading Gauges, End- Loading Ramp, Traverser, Cranes, Engine Shed.

PART III

18.INTRODUCTION:
General, Advantage of Tunnelling, Economics of Tunnelling.

19.TUNNEL SURVEYING:
Introduction , Initial Surveys, Setting Out of the Tunnel Centre- line on the Surface, Triangulations, Setting Out Inside Tunnels, Settings Out Steeply Inclined Tunnels, Transferring of Alignment Through Shafts, Curves, Adjustments at Meeting Points of Tunnels.

20.DESIGN OF TUNNELS:
Introduction, Rail-road Tunnels , Vehicular Tunnels, Rapid Transit Tunnel.

21.METHOD OF TUNNELING IN SOFT STRATA:
Introduction, Tunnelling in Firm Ground, Tunnelling in Soft Ground, Tunnelling in Running Ground, Shield Method of Tunnelling , Method of Supporting Roof and Sides in Multiple Drift Method.

22.METHOD OF TUNNELLING IN ROCK:
Introduction, Tunnelling Method, Sequence of Operation for Construction of Tunnel in Rocky Strata, Drilling, Blasting, Inspection and Handling Misfires.

23.SAFETY PRECAUTION IN TUNNELLING WORK:
Introduction, Safety Programme, Medical and Other Facilities, Electrical Installation and Lighting, Underground Excavation, Ventilation, Scaling and Mucking.

24.TUNNEL SHAFTS AND CAISSONS:
Introduction, Timber Shafts, Rock Shaft, Steel Lining for Shaft, Shaft by Caissons, Drop Shafts, Freezing Process for Shafts.

25.TUNNEL LINING:
Objects of Linings, Materials for Tunnel Linings,Design of Tunnel Linnings, Concrete Linings.

26.TUNNEL VENTILATION , DUST PREVENTION AND LIGHTING:
Object of Ventilation, Natural Ventilation, Mechnical Ventilation Methods, Ducts, Ventilation Shafts, Fans, Ventilation Buildings, Dust Control, Lighting, Mucking,

27.DESIGN OF TUNNELS CONVEYING WATER:
General, Design of Tunnels Conveying Water: Hydraulic Design, Design of Tunnel Supports.

BSC5 : SURVEYING - I

1. LEVELLING
Definitions of important terms in leveling, Instruments - Level Surface, Level Surface, Level line, Horizontal plane, Horizontal line, Vertical plane, Datum surface, Elevation of a point, Line of collimation, Axis of telescope, Axis of bubble tube, Vertical axis, Back sight, Fore sight, Intermediate sight, Change point, Height of instrument, Station point, Bench mark, Instruments – Level, Dumpy level, Wye level, Cooke's reversible level, Cushing's level, Tilting level. General features of levels, Levelling staff, Taking staff readings, Level tube, Sensitiveness, Testing and adjustment of levels, Temporary adjustments of level - Setting up of the instrument, Levelling the instrument, Elimination of parallax. Permanent adjustments of levels – Adjustment Precautions in leveling, Level field book, Simple Levelling, Series of differential leveling, Booking and reducing of levels, Plane of collimation method, Rise and fall method, Comparative merits of the methods of reduction, Specimen pages of a level field book, Field work in leveling, Differential leveling, Check leveling, Running of sections, Longitudinal section, Checking the levelling work, Profile Leveling, Profiles, Plotting the profile, Working profile, Cross Sections, Cross-sectioning by level and staff, Cross-sectioning by theodolite, Giving levels for construction at works, Curvature and refraction, Error due to curvature, Error due to refraction, Reciprocal leveling, Reciprocal Levelling. adjustments of

level circuits, Principle Of Reversion, Precision Of Differential Leveling, Hand Signals, Adjustment Of Dumpy Levels.

2. THEODOLITE SURVEYING

Measuring angles and directions, Introduction, setting up the theodolite - Cross Hairs, Transit theodolite, Levelling head, Limb or lower plate, Spindles, Upper plate, Standards of A-frames, Level tube, Compass, Telescope, Vertical circle, T-frame or index bar, Plumb-bob, Tripod, Types of compasses, Circular box compass, Trough compass, Tubular compass, care of the transit, reading transit verniers, *styles of graduations,* pointing the instrument, measurement of horizontal angles, closing the horizon, Conditions of perfect adjustments, Optics, Conjugate foci, Spherical aberration, Chromatic aberration, Types of surveying telescopes, Main parts of a telescope – Body, Objective, Eye piece, Erecting eye piece, Diagonal eye piece, Diaphragm, Parallax, Qualities of a telescope, Brightness or illumination of the image, Definition, Magnification, Size of field, Level tube, Sensitiveness of a bubble tube, Levelling up, Elimination of parallax, Measurements of angles, Inaccurate leveling, Using wrong tangent screws, Displacement or slip, Incorrect bisection of the observed points, Reading The Theodolite, measuring with a direction theodolite, Vernier reading, Measurement of horizontal angle by repetition, measuring angles by repetition, laying off an angle by repetition, Measurement of horizontal angle by reiteration, Measurement of horizontal angles by deflection angles, Measurement of horizontal angles by direct angles, Third method for prolongation of a straight line, Lining-in, BALANCINE –IN, Random line method for balancing-in, Laying horizontal angle by method of repetition, Locating point of intersection of two straight lines, Traversing or traverse survey by theodolite, Closed traverse survey by theodolite, Open or unclosed traverse survey be theodolite, Methods of traversing by theodolite, Traversing by direct observation of angles, Traversing by deflection angles, Traversing by direct observation of bearings, Linear measurements, Checks in unclosed traverse, Traversing by deflection angles, Traversing by direct observation of bearings of the survey lines, Traversing by direct angles, Direct method in which the telescope is transited, Comparison of all the three fast needle methods, Comparison of fast needle method with included angles method of traversing, Checks in closed traverse, Travversing by included angles, Balancing the traverse, Field problem, Equipment, Work and procedure, Traverse computations, Area of closed traverse from latitudes and double meridian distances (DMD), Permanent adjustments of a transit theodolite, Adjustments of the plate levels, Adjustment of line of sight, *Necessity,Test,* Adjustment of telescope level, Adjustment of the vertical index frame, General comments on adjustments, Adjustment of wye theodolite, Adjustment of plate level, Adjustment of line of collimation, Adjustment of horizontal axis, Adjustment of telescope level, Adjustment of index error, Tavistock Theodolite, Ideal requirements of a theodolite, Errors in non-adjustable parts of a theodolite and their elimination, Stability, Other sources of errors in theodolite work, Observational errors, Errors of manipulation, Natural errors, Circular movement of the theodolite, *Elimination of errors,* Eccentricity of verniers, Eccentricity of the horizontal circle, Errors of graduation, Errors of perpendicularity of planes of the circle to their respective axes, Error in desirable relationship between resolution and vernier least count, Error in desirable relationship between resolving power and sensitivity levels, Error in coincidence of the inner and outer axes of rotation, Omitted or missing measurements,

3. PLANE TABLE SURVEYING

Drawing board- Alidade , Accessories, Spirit level, Trough compass or circular box compass, U-frame or plumbing fork, Waterproof cover, Paper, Advantages of plane table survey, Disadvantages of plane table survey, Points to be borne in mind for plane tabling,, Setting up of the table, Levelling, Orientation, Orientation by back sighting, Orientation by magnetic needle, Centring, Testing and adjustments of plane table- Board, Methods of plane table survey, Radiation method of plane tabling, Intersection or triangulation method of plane tabling, Traversing method of plane tabling, Resection method of plane tabling, Three-point problem, Selection of station point S, Solution of three point problem method by trial and error method, Solution of three-point problem by Lehman's rules, Solution of three-point problem by mechanical method, Solution of three-point problem by graphical method, Bessel's method, Two-point problem, Errors in plane tabling, Instrumental errors, Errors of manipulation and sighting, Errors of plotting, Contouring by plane table, Slotted templates, Analytical methods,

****