

## **B. Tech. in CIVIL ENGINEERING**

### **Syllabus of Paper – 1**

#### **MECHANICS OF SOLIDS**

Concept of Stress and strain, Definition of stress, stress tensor, normal and shearing stresses in axially loaded members, stress-strain relationship ; Generalized Hooke's Law, Poisson's ratio, relationship between E, G, K and  $\nu$ , stress-strain diagram for uniaxial loading, working stress. Analysis of Axially Loaded Members, Composite bars in tension and Compression, temperature stresses in composite rods, statically indeterminate problems, Transformation of Plane stress and Plane strain, principal stresses and principal planes, Mohr's circle of stress, principal strains and principal axes of strain, Mohr's circle for strain, Strain rosettes, determination of principal strains from strain measurements, calculation of principal stresses from principal strains; Stresses in thin cylinders and thin spherical shells, wire winding of thin cylinders; Torsion of Circular shafts and Helical Springs, strength of solid and hollow circular shafts, design of circular members in torsion, close coiled helical springs ; Members subjected to flexural loads, shear force and bending moment diagrams for cantilever and simply supported beams, elastic curve. ; Theory of simple bending, bending stresses in beams, shearing stresses in beams, composite beams, Slope and deflection of beams by integration method and moment area method; Euler's theory for compression members; short struts with eccentric loading, Kern of rectangular and circular sections.

#### **STRUCTURAL ANALYSIS**

Concept of determinate and indeterminate structures, determination of degree of indeterminacy in plane frame and continuous structures, determination of member forces in statically determinate pin-jointed space frames, deflection of pin-jointed plane trusses by Williot Mohr diagram; Rolling loads and influence line diagrams for simply supported beams, influence line for forces in members of Pratt and Warren trusses with parallel top and bottom chords ; Analysis of fixed and continuous beams by Moment-Area method, Conjugate beam method and theorem of three moments, Analysis of three-hinged and two-hinged arches, Spandrel braced arches ; Analysis of suspension cable bridges with three-hinged and two-hinged stiffening girders subjected to dead and live loads, influence line for horizontal thrust, bending moment, normal thrust and radial shear for arches and suspension bridges. Development of generalized slope deflection equations and its applications to beams and plane frames, Moment distribution method and its applications to continuous beams and plane frames including sway and inclined members

#### **MECHANICS OF SOIL**

Soil Properties and Classification: Formation of soils and types, Soil as three phase system. Soil consistency, sensitivity and thixotropy; Classification of soil; Soil Compaction: Principles, water content - dry unit weight relationships, optimum moisture content, maximum dry unit weight, factors affecting compaction. Effects of compaction on density, shear strength and permeability. Field compaction methods; Permeability: Soil - water systems - capillarity, flow, Darcy's law, permeability and tests for its determination, Permeability of stratified soils, estimation of permeability in the field, piping, quicksand condition, seepage, flow nets. ; Shear Strength of Soil: Coulomb's law, Mohr's stress circle, strength envelop and failure conditions. Direct and triaxial shear tests and unconfined compression tests, Effect of pore pressure; Soil exploration: Boring, Sampling, SPT and related corrections, stability of slopes.

## **REINFORCED CONCRETE DESIGN**

Introduction; Basic Material Properties; Basic Design Concepts - Working Stress Method (WSM), Ultimate Load Method (ULM), Limit States Method (LSM); Behaviour in Flexure; Design of Beams and One-way Slabs for Flexure; Design for Shear; Design for Torsion; Design for Bond; Serviceability Limit States: Deflection and Cracking; Design of Two-way Slab Systems; Design of Staircases; Design of Compression Members; Design of Footings and Retaining Walls; Detailing and Construction Practices.

## **FOUNDATION ENGINEERING**

Stresses in Soils: Boussinesq's Equation: Vertical Stress distribution on horizontal and vertical planes, Newmark's influence chart, Contact pressure distribution. Consolidation and Settlement Analysis: Equation of one dimensional consolidation. Coefficient of consolidation, coefficient of compression, compression index, pre-compression pressure. Over consolidation, Consolidation Settlement analysis. Basics of three- dimensional consolidation, Sand drains; Bearing Capacity and Analysis of Foundations –Shallow foundation: Terzaghi's bearing capacity equation, factors influencing bearing capacity. Bearing capacity for square, rectangular and circular footings. Bearing capacity under eccentric load on layered soil. Bearing capacity based on in-situ tests. Floating mat foundation. Pile Foundation- Load carrying capacity of a pile (Static and dynamic formulae), Pile group, Settlement analysis of pile; Earth Pressure, Retaining Structures and Sheet Pile Walls: Earth pressure Theories- Rankine Earth pressure theory, Coulomb's Earth pressure theory. ; Sheet pile walls: Pressure against sheet pile walls, cantilever and anchored bulk heads (free earth support method). Pressure against walls in large trenches; Soil Investigation: Conventional and Geo-physical methods of soil investigation. Model Stability of Slopes: Stability of infinite slopes, stability of finite slopes.

## **DESIGN OF STEEL STRUCTURES**

Materials, Structures and Specifications, Riveted, Bolted & welded Connections, Design of Tension and Compression Members, Design of Beams, plate girders and gantry girders, Design of industrial buildings; Design of slab and gusseted base.

## **ESTIMATION & CONSTRUCTION MANAGEMENT**

Methods of Estimation: Estimation of quantities for building, Sanitary and water supply works, Irrigation works, Road works; Specifications: General specification, Details specification for different building items; structural works, road works; Analysis of Rate: Analysis of rates for Earth work, Cement concrete, RCC, Brick work, plastering, etc.; Contracts: Different methods of carrying out work contract system, Contract document, Types of contract, measurement book. Method of tendering; Construction management: Project, Project development process, project evaluation, Finance, material and man power development, project management, Construction scheduling, Bar charts, activity times, Network analysis, elements of PERT and CPM.

## **Syllabus of Paper – 2**

### **CIVIL ENGINEERING MATERIALS AND CONSTRUCTION**

General civil engineering material performance requirements: strength, stiffness, durability, appearance. Concrete: Constituents, properties of fresh and hardened concrete, reinforcement, concrete mix design. Steel: properties of steel, steel grades, protection from corrosion and fire. Pavement materials: production, testing and applications. Geosynthetics: overview of available materials, geotextile functions and mechanisms. Timber, Masonry.

Building construction: Foundations – Shallow and Deep foundations; Stone and Brick Masonry; Reinforced concrete and reinforced brick work; Setting and laying out a building; Damp proofing of floors and walls; Doors and Windows; Staircase and escalators; Scaffolding and Formwork.

### **SURVEYING**

Introduction: classification of surveys; Linear measurements: Types of Chains and tapes, chaining and ranging, principles of chain survey, equipments, applications, errors and corrections, obstacles in chaining, - Electronic Distance Measurement (EDM); Angle and direction measurements: Measurement of bearing, Computation of angles from - Bearings, Designation of bearings, fore bearing and back bearing, Prismatic compass, Principles of compass survey, local attraction and corrections, compass traverse and adjustments ; Plane table survey: Equipments, working operations, different methods, advantages and disadvantages, Two point and Three point problems; Levelling: Principle, Levelling instruments, Dumpy level, booking and reducing levels, simple and differential levelling, profile and reciprocal levelling, methods of levelling, curvature and refraction corrections, bubble tube and its sensitiveness, levelling difficulties. Contouring: definition, contour interval, characteristics of contours, direct and indirect methods of contouring, interpolation of contours, uses of contour maps; Minor instruments: box sextant, planimeter, pentagraph, inclinometer, total station.

### **FLUID MECHANICS**

Physical properties of fluids- Compressibility, Elasticity, and Viscosity, Ideal and Real fluids, Concepts of shear stress, Newtonian and Non-Newtonian fluids, Pressure-density-height relationships, Pressure on plane and curved surfaces, Buoyancy, Stability of immersed and floating bodies, Free and forced vortex; Steady and unsteady, Uniform and non-uniform, Laminar and Turbulent flows, Free surface flows and Enclosed flows, Definition of one, two and three-dimensional flows, Velocity and Accelerations, Stream lines, Streak lines and Path lines, Stream tubes, Stream function and Velocity potential, flow nets, Circulation and Vorticity. Equation of continuity, One-dimensional Euler's equation of motion and its integration to obtain Bernoulli's equation, Momentum equation; Hydraulic mean radius, Concept of friction loss, Darcy-Weisbach equation Minor losses in pipe, Branched pipes in parallel and series, Transmission of power, Water hammer in pipes, Laminar flow in pipes-Hazen-Poiseuille's equation, Turbulent flow in pipes, Velocity distribution in pipes, Moody's diagram; Boundary layer thickness, Energy thickness, Laminar and turbulent boundary layer, separation of Boundary Layer. Momentum integral equation; Drag and Lift coefficient, Pressure drag and Friction drag characteristics on Sphere, Cylinder, and Disc, Circulation, Lift and Magnus effect, Lift Characteristics of air foils, Induced drag ; Open channel flow, Uniform flow, Chezy's, Kutter's and Manning's equation, Concept of specific energy, Critical flow, Point gauge, Pitot tube, Current meter, Venturi meter, Orifice meter, Orifices and Mouth pieces, Notches and Weirs.

## **TRANSPORTATION ENGINEERING**

Roadways: Introduction, Road development plans and programmes; Surveys: location surveys-principles of alignment; Geometric design: Cross-sectional elements, sight distance, Horizontal and vertical alignments, Pavement materials: Subgrade soil, Aggregates, Bituminous binders, Bituminous paving mixes; Flexible pavements design; Rigid pavement design; Drainage, evaluation and maintenance of highways; Traffic Engineering: Speed, Volume, Density, Relation among fundamental parameters, Traffic data collection, Capacity and level of service, Traffic control devices, Road markings, Parking, Roundabout and signalized intersection design; Bridges: Classification of bridges, Investigations and data collection for location of bridge site, Calculation of runoff under bridges, Determination of water way, Economic span, Bridge foundations, Piers and abutments, Superstructures, Loadings, Erection of bridge spans, Temporary bridges and causeways.

## **WATER RESOURCES ENGINEERING**

Hydrologic cycle, catchment area and watershed, Rainfall and its characteristics, Rain gauges, Non-Recording and Recording type, average rainfall over a catchments, Evapo-transpiration, Pan evaporation, pan coefficient, Infiltration, W-Index and  $\phi$  - Index; Hydrographs: Discharge formulae, characteristics of a Run off hydrograph, Unit hydrograph, S-hydrograph, Instantaneous hydrograph, synthetic Unit hydrograph, Duration Curve, Mass Flow hydrograph, Stream gauging, Flow rating curve, use of current meters for velocity measurement, Dye-dilution method of discharge measurement; Flood Control: Flood flows, Frequency studies, Statistical analysis for flood prediction, Method of flood control, Flood routing, Reservoir routing and Channel routing, River training works; Dock and Harbours: Natural and artificial Harbours, Selection of site, study of winds, tides and wave actions, Accretion and denudation, Principle of construction of Breakwaters, Quays and jetties, Wet and Floating Docks. Occurrence of Groundwater; Origin of Groundwater, Vertical Distribution of Groundwater, Zone of Aeration, Zone of Saturation, Specific Yield, Geologic Formations as Aquifers, types of aquifers, Storage Coefficient, Springs. Groundwater Movement: Darcy's Law, Permeability, Hydraulic Conductivity, Transmissivity, Tracer Tests, Auger Hole Tests, Pumping Tests of Wells.

## **ENVIRONMENTAL ENGINEERING**

General requirement for water supply , Quality and quantity of water, Domestic water quality standards; Sources of water and their yield, population forecast, Design period; Intakes, pumping and transportation of water; Physical, chemical and biological characteristics of water and their significance, water quality criteria, water borne diseases, Appurtenances of water treatment and distribution systems. DO and BOD in streams. Essentials of wastewater engineering, Quantities of wastewater and storm water, wastewater characteristics; Water and wastewater plumbing systems, Waste water collection and conveyance systems, Design of sewerage systems, Pumping of waste water. Air pollution and pollutants, air quality, ambient and atmospheric standards, Sampling and monitoring of air pollutants. Prediction of air pollution dispersion, air quality modelling; Solid and hazardous waste management-Generation, on-site storage, collection, separation, processing and disposal On-site storage methods, Collection systems-Vehicles, routing, route balancing and transfer stations, Processing methods, recovery and reuse of materials and energy, Disposal methods such as sanitary landfill, biological digestion etc. Introduction to solid and hazardous waste management, Collection techniques, equipment, costs and disposal, Engineering systems to minimize cost.

## **ADVANCED TRANSPORTATION ENGINEERING**

Railway; Introduction: History, Cross section and components of railway track, Problems of multi gauge system, wheel and axle arrangements, Coning of wheels, Train resistances, hauling capacity and tractive effort, Stresses in rail, sleepers, ballast and formation. ; Components of Permanent way : Rails - Types of rail section, wear and failure in rails, Creep, Rail joints, Rail fittings, check and guard rails, Sleepers – types and specifications, Ballast - specifications, Formation, drainage of track; Geometric design: Alignment, horizontal curves, super elevation, equilibrium cant and cant deficiency, Length of transition curves, Gradients and grade compensation, vertical curves; Points and crossing: Design and layout of turn-out, various types of track junctions and their configurations ; Signaling and Interlocking: Control of train movements, Signals, Principles of interlocking ; Airport: Air Transport Development, Aircraft characteristics, Airport planning and site selection, Obstruction and zoning laws - imaginary surfaces, approach zones and turning zones, Visual Flight Rules and Instrumental landing systems ; Geometric Design of Runways and Taxiways: Runway- orientation and configuration, Basic runway length and corrections, Geometric design elements, Taxiway design, Main and exit Taxiway, Separation clearance, Holding aprons, Typical airport layouts, Terminal building, gate position; Airport marking and lighting. ; Tunnel; Necessity, Tunneling vs open cut, Size and shape, Transfer of surface alignment tunneling in hard rock, soft soil and under water bodies- Use of shafts, shuttering and linings drainage and ventilation

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