Code: CE Civil Engineering

Engineering Mathematics

Linear Algebra: Matrices and Determinants, Systems of Linear Equations, Eigen Values and Eigen Vectors.

Calculus: Functions of Single Variable, Limit, Continuity and Differentiability, Mean Value Theorems, Evaluation of Definite and Improper Integrals, Partial Derivatives, Total Derivative, Maxima and Minima, Gradient, Divergence and Curl, Vector Identities, Directional Derivatives, Line, Surface and Volume Integrals, Stokes, Gauss and Green's Theorems.

Differential Equations: First Order Equations (Linear and Nonlinear), Higher Order Linear Differential Equations with Constant Coefficients, Cauchy's and Euler's Equations, Initial and Boundary Value Problems, Laplace Transforms, Solutions of One Dimensional Heat and Wave Equations and Laplace Equation.

Complex Variables: Analytic Functions, Cauchy's Integral Theorem, Taylor and Laurent Series.

Probability and Statistics: Definitions of Probability and Sampling Theorems, Conditional Probability, Mean, Median, Mode and Standard Deviation, Random Variables, Exponential, Poisson, Normal and Binomial Distributions.

Numerical Methods: Numerical Solutions of Linear and Non-Linear Algebraic Equations, Integration by Trapezoidal and Simpson's Rule, Single and Multi-Step Methods for Differential Equations.

Structural Engineering

Engineering Mechanics: System of Forces, Free-Body Diagrams, Equilibrium Equations; Internal Forces in Structures; Friction and its Applications; Kinematics of Point Mass and Rigid Body; Centre of Mass; Euler’s Equations of Motion; Impulse-Momentum; Energy Methods; Principle of Virtual Work.

Solid Mechanics: Bending Moment and Shear Force in Statically Determinate Beams. Simple Stress and Strain Relationship: Stress and Strain in Two Dimensions, Principal Stresses, Stress Transformation, Mohr's Circle. Simple Bending Theory, Flexural and Shear Stresses, Unsymmetrical Bending, Shear Centre. Thin Walled Pressure Vessels, Uniform Torsion, Buckling of Column, Combined and Direct Bending Stresses.

Structural Analysis: Analysis of Statically Determinate Trusses, Arches, Beams, Cables and Frames, Displacements in Statically Determinate Structures and Analysis of Statically Indeterminate Structures by Force/ Energy Methods, Analysis by Displacement Methods (Slope Deflection and Moment Distribution Methods), Influence Lines for Determinate and Indeterminate Structures.

Construction Materials and Management: Construction Materials: Structural steel - composition, material properties and behaviour; Concrete - constituents, short-term and long-term properties; Bricks and mortar; Timber; Bitumen. Construction Management: Types of construction projects; Tendering and construction contracts; Rate analysis and standard specifications; Cost estimation; Project planning and network analysis - PERT and CPM.

Concrete Structures: Concrete Technology- Properties of Concrete, Basics of Concrete Mix Design, Working Stress and Limit State Design Concepts, Analysis of Ultimate Load Capacity and Design of Members Subjected to Flexure, Shear, Compression and Torsion by Limit State Methods. Basic Elements of Prestressed Concrete, Analysis of Beam Sections at Transfer and Service Loads. Losses in pre-stressed concrete members. Deflection of prestressed concrete simple beams.

Steel Structures: Analysis and Design of Tension and Compression Members, Beams, Beam- Columns, Column Bases. Connections-Simple and Eccentric, Beam-column Connections, Plate Girders and Trusses.

Geotechnical Engineering

Soil Mechanics: Origin of Soils, Soil Classification, Three-Phase System, Fundamental Definitions, Relationship and Interrelationships, Permeability & Seepage, Effective Stress Principle, Consolidation, Compaction, Shear Strength. One-dimensional consolidation; Shear strength; Mohr’s circle, Stress-Strain characteristics of clays and sand.

Foundation Engineering: Sub-Surface Investigations- Scope, Drilling Bore Holes, Sampling, Penetration Tests, Plate Load Test. Earth Pressure Theories, Effect of Water Table, Layered Soils. Stability of Slopes - Infinite Slopes, Finite Slopes. Foundation Types-Foundation Design Requirements. Shallow Foundations-Bearing Capacity, Effect of Shape, Water Table and Other Factors, Stress Distribution, Settlement Analysis in Sands & Clays. Deep Foundations, Pile Types, Dynamic & Static Formulae, Load Capacity of Piles in Sands & Clays, Negative Skin Friction.

Water Resources & Environmental Engineering

Fluid Mechanics and Hydraulics: Properties of Fluids, Principle of Conservation of Mass, Momentum, Energy and Corresponding Equations, Potential Flow, Applications of Momentum and Bernoulli's Equation, Laminar and Turbulent Flow, Flow in Pipes, Pipe Networks. Concept of Boundary Layer and its Growth. Uniform Flow, Critical Flow and Gradually Varied Flow in Channels, Specific Energy Concept, Hydraulic Jump. Forces on Immersed Bodies, Flow Measurements in Channels, Tanks and Pipes. Dimensional Analysis and Hydraulic similitude. Kinematics of Flow, Velocity Triangles and Specific Speed of Pumps and Turbines.

Hydrology: Hydrologic Cycle, Precipitation, Evaporation, Watershed concepts, Infiltration, Hydrograph analysis, Unit Hydrographs, Flood Estimation, Reservoir Capacity, Reservoir and Channel Routing. Well Hydraulics, 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, Cross Drainage Structures.

Design of Weirs on Permeable Foundation. Types of Irrigation System, Irrigation Methods. Water Logging and Drainage.

Water & Waste Water Engineering: 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, Sludge Disposal, Effluent Discharge Standards. Domestic Wastewater Treatment, Characteristics of Domestic Wastewater, Primary and Secondary Treatment Unit Operations and Unit Processes of Domestic Wastewater.

Air Pollution: Types of Pollutants, their Sources and Impacts, Air Pollution Meteorology, Air Pollution Control, Air Quality Standards and Limits.

Municipal Solid Wastes: Characteristics, Generation, Collection and Transportation of Solid Wastes, Engineered Systems for Solid Waste Management (Reuse/ Recycle, Energy Recovery, Treatment and Disposal).

Noise Pollution: Impacts of Noise, Permissible Limits of Noise Pollution, Measurement of Noise and Control of Noise Pollution.

Transportation & Geomatics Engineering

Transportation Infrastructure: Highway alignment and engineering surveys; Geometric design of highways - cross-sectional elements, sight distances, horizontal and vertical alignments; Geometric design of railway track; Airport runway length - calculation and correction, taxiway and exit taxiway design.

Highway Pavements: Highway materials - (Aggregate & bitumen) - desirable properties and quality control tests; Design factors for flexible and rigid pavements; Design of flexible pavement using IRC: 37-2018; Design of rigid pavements using IRC: 58-2015;

Traffic Engineering: Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, statistical analysis of traffic data; Microscopic and macroscopic parameters of traffic flow, fundamental relationships; Control devices, Traffic signs, signal design by Webster's method; Types of intersections and channelization; Highway capacity and level of service of rural highways and urban roads.

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).

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