Part I : Engineering Mathematics (Common to all Candidates)

i) Determinants and Matrices: Solving system of equations – Rank of the Matrix – Eigen values and Eigen vectors – Reduction of quadratic form to canonical form.

ii) Calculus and Differential Equations: Partial derivatives – Jacobians – Taylor's expansion – Maxima and Minima. Linear ordinary differential equations with constant coefficients – Simultaneous first order linear equations with constant coefficients. Formation of partial differential equation (PDE) – Solution of first order PDE – Solution of linear higher order PDE with constant coefficients.

iii) Vector Calculus: Double and triple integrations and their applications – Gradient, Divergence, Curl and Laplacian – Green's, Gauss divergence and Stroke's theorem.

iv) Functions of Complex Variables and Complex Integration: Analytic functions – Conformal Mapping – Bilinear transformation – Cauchy's integral theorem and integral formula – Taylor and Laurent Series – Singularities – Residues – Residue theorem and its applications.

v) Transforms: Laplace Transform – Inverse transforms – Application to solution of linear ordinary differential equations with constant coefficients. Fourier integral theorem – Fourier transform pair – Sine and Cosine transforms. Transform – Inverse Z–transform – Solution of difference equations using Z– transform.

vi) Numerical Methods: Solution of linear system by direct and iterative methods – Interpolation and approximation – Numerical Differentiation and Integration – Solving Ordinary Differential Equations.

vii) Applied Probability: Probability and Random variables – Standard Discrete and Continuous distribution – Moments – Moment generating function and their properties. Two Dimensional Random Variables – Covariance – Correlation and Regression.

Part – II : Basic Engineering & Sciences (Common to all Candidates)

i) **Applied Mechanics :** Law of Mechanics – Lame's theorem – Forces, Moments and Couples – Displacement, velocity and Acceleration – Friction – Moment of Inertia.

ii) **Mechanical Engineering :** Laws of thermodynamics – Open and closed systems – Equation of state – Heat and Work.

iii) **Physics :** Sound – Lattices – Ultrasonic flaw detector – X ray radiography – Interference Fringes – Planck's quantum theory – Laser and Fibre Optics.

iv) **Material Science :** Fracture – Magnetic and Dielectric materials – Conductor and Semi conductor materials – Ceramic and Super conductor materials.

v) **Civil Engineering :** Fluid Statics and Dynamics – Boundary Layer – Pumps and Turbines – Environmental Pollution.

vi**) Electrical Engineering :** Ohm's law – Kirchoff's law – A.C. circuits – D.C. machines – Transformers – Synchronous machines – Instrumentation.

vii**) Computers :** Computer organisation – Architecture – Arrays – Pointers – User defined function – C program.

viii) **Chemistry :** Adsorption – Chromatography – Chemical kinetics – Electrochemistry – Spectroscopy – Fuels and Combustion.

Part – III

1. Civil Engineering & Geo Informatics

i) Structural Engineering:

Mechanics : Stress Strain Relationships – Principal stresses and Principal strain in two dimension and three dimension. Composite Bars – Composite Beams – Elastic Constants. Beams and Bending – Shear Force and Bending Moment Diagrams – Flexural and Shear Stresses. Slope and Deflection of Beams. Thin and Thick Cylinders. Torsion. Theories of Failure – Unsymmetrical Bending – Curved Beams – Theories of Columns. Combined Direct and Bending Stresses.

Structural Analysis : Static and Kinematic Indeterminacy – Energy Principles – Deflection of pin jointed plane frames – rigid frames. Classical Method of Analysis of indeterminate structures (Slope deflection and Moment Distribution) – Matrix Method. Arches and Suspension Bridges – Influence Line for Determinate and Indeterminate Structures. Plastic Analysis of Structures.

Building Materials : Cement – Concrete – properties of ingredients Mix Design Quality Control Special Concrete – Concreting Methods Brick – Brick Masonry – Stone – Timber – Steel.

Concrete Structures : Design Methods – Limit State Design for beams, slabs, columns and footings – retaining walls – Water Tanks. Prestressed Concrete – Principles – Methods – Losses – Deflection – Design. Steel Structures : Steel Sections – Connections – Design of Tension and Compression Members – Beams, Column Bases – Plate Girders and Trusses.

ii) Soil Mechanics and Foundation Engineering :

Soil Mechanics : Nature of soil – phase relationships – Soil classification; Soil water – static pressure – effective stress principle; permeability – seepage; Stress distribution in soil – Consolidation (Terzaghi's one dimension consolidation theory); Compaction shear strength of soil – Mohr – Coulomb theory – determination of shear strength by different methods; Slope stability analysis – protection measures.

Foundation Engineering : Site investigation – scope and objectives – drilling techniques – depth and spacing of boreholes – sampling Techniques –
penetration tests (SPT and SCPT) – plate load test – selection of foundation; Foundation types – shallow foundation – bearing capacity (Terzaghis Theory and BIS formula) – allowable bearing pressure – bearing capacity from field tests – settlement of foundation – allowable settlement – Codal provisions; Design of foundations – Isolated, combined and raft foundation; Pile foundations – static and dynamic pile driving formulae (Engineering News and Hiley method) – Pile groups – capacity and settlement – Codal provisions – pile load test – negative friction on piles; Earth pressure theories – Earth pressure on retaining walls – stability analysis of retaining wall.

iii) Transportation Engineering :

Highway Planning : Road Classification, Geometric Design of Highways, Construction of Earth, WBM, Bituminous and concrete roads, Design of flexible and rigid pavements. Drainage of roads, maintenance of roads. Railways, Airways, Docks and

Harbour Planning: Railway alignment, components of permanent way, geometric design Airport planning, components of airport, site selection, planning for terminal building, runways. Harbour planning, components of harbour, inland water transport.

Traffic Engineering : Traffic characteristics, Traffic surveys, Traffic Signals, Road markings and signs.

iv) Water Resources Engineering :

Fluid Mechanics and Hydraulics : Properties of fluids. Fluid statics and relative equilibrium.
Basic concepts of fluid flow – kinematics and dynamics. Concept of system and control volume application to continuity, momentum and energy equations. Dimensional analysis and model studies. Laminar and turbulent flow through pipes. Boundary layers. Steady uniform and gradually varied flow in open channels. Rapidly varied flows. Turbines and pumps and positive displacement pumps.

Hydrology and Ground Water : Hydrometeorology. Hydrologic cycle. Precipitation and its measurements. Abstractions. Runoff estimation. Hydrograph analysis. Unit Hydrograph.
Hydrologic extremes floods and droughts. Rainwater harvesting. Properties of aquifer. Groundwater development. GEC norms. Well hydraulics. Steady and unsteady flows. Ground water quality.

Irrigation Engineering : Irrigation system. National water policy. Components of irrigation network. Design of lined and unlined channels. Waterways, head works, gravity dams and spillways. Design of weirs on permeable foundation. Soil water relations. Crop water requirements. Irrigation scheduling and methods. Duty, delta and base period. Irrigation water quality. Irrigation water management. Participatory approach.

v) Environmental Engineering :
Water and Waste water Engineering : Water requirements; water demand, quality standards; Development of water supply source, conveyance system; basic unit processes and operations for water treatment; water distribution; sewage characteristics; sewage treatment, primary and secondary treatment of sewage, sludge disposal, sewage disposal
.
Air Pollution and Control : Types of pollutants, their sources and impacts, air pollution meteorology, air pollution control, air quality standards and limits.

Noise Pollution and Control : Impacts of noise, permissible limits of noise pollution, measurement of noise and control of noise pollution.

vi) Surveying and Remote Sensing :

Surveying : Chain survey traversing plotting compasses bearings plane Table levelling bench Marks temporary and permanent adjustments reduction contouring and volumes theodolites – Gale's table lay out – setting out works curve Ranging mine Surveying techeometric survey triangulation base Line corrections trigonometric leveling – errors and sources classification of errors equation level nets astronomical Survey practical Astronomy photogrammetry EDM hydrographic survey river. Electronic survey infrared EDM microwave System modern positioning systems – trilateration.

Remote Sensing : Satellite system EMR interaction with each feature, spectral signature – image characters interpretation keys Image enhancement, filters, classification. accuracy Assessment thematic maps.

GIS and Cartography : Cartography map projection map Design map compilation generalisation map Production software and hardware GIS data types data base types raster and vector topology data input data analysis DEM and TIN data. Output applications.

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