TG ECET-2026

SYLLABUS FOR CIVIL ENGINEERING

MATHEMATICS (50 Marks)

UNIT-I: MATRICES AND DETERMINANTS

Definition of Matrix, Types of matrices-Algebra of matrices-Transpose of a matrix-Symmetric, skew symmetric matrices-Minor, cofactor of an element-Determinant of a square matrix up to third order – Properties - Laplace's expansion-singular and non-singular matrices- Adjoint and multiplicative inverse of a square matrix-System of linear equations in 3 variables-Solutions by Cramer's rule, Matrix inversion method-Gauss-Jordan method.

Partial Fractions: Resolving a given rational function into partial fractions.

Logarithms: Definition of logarithm and its properties, meaning of 'e', exponential function and logarithmic function.

UNIT–II: TRIGONOMETRY

Properties of Trigonometric functions– Ratios of Compound angles, multiple angles, sub multiple angles – Transformations of Products into sum or difference and vice versa. Properties of triangles: sine rule, cosine rule, tangent rule and projection rule. Solution of a triangle when (i) three sides (SSS), (ii) two sides and an included angle (SAS), (iii) one side and two angles are given (SAA). Inverse Trigonometric functions, Hyperbolic functions.

Complex Numbers: Definition of a complex number, Modulus, amplitude and conjugate of complex number, arithmetic operations on complex numbers - Modulus-Amplitude form (Polar form) - Euler form (exponential form).

UNIT–III: ANALYTICAL GEOMETRY

Straight Lines–different forms of Straight Lines, distance of a point from a line, angle between two lines, intersection of two non-parallel lines and distance between two parallel lines.

Circles - Equation of circle given center and radius, given ends of diameter-General equation-finding center and radius, center and a point on the circumference, 3 non-collinear points, center and tangent, equation of tangent and normal at a point on the circle.

Conic section – Properties of parabola, ellipse and hyperbola – Standard forms with vertex at origin and axis along co-ordinate axes only, simple problems.

UNIT–IV: DIFFERENTIATION AND ITS APPLICATIONS

Functions and limits – Standard limits – Differentiation of sum, product, quotient of functions, function of function, trigonometric, inverse trigonometric, exponential, logarithmic, hyperbolic functions, implicit, explicit and parametric functions–Derivative of a function with respect to another function-Second order derivatives – Geometrical applications of the derivative(angle between curves, tangent and normal)–Increasing and decreasing functions–Maxima and Minima(single variable functions) using second order derivative only, Physical application –

Rate measure - Partial differentiation–Partial derivatives up to second order–Euler's theorem.

UNIT–V: INTEGRATION AND ITS APPLICATIONS

Indefinite integral – Standard forms – Integration by substitution, Integration of trigonometric, algebraic, exponential, logarithmic and hyperbolic functions—Integration of reducible and irreducible quadratic factors, Integration by decomposition of the integrand, Integration by parts – Definite integrals and properties, Definite integral as the limit of a sum – Application of integration to find areas under plane curves and volumes of solids of revolution– Mean and RMS values, Trapezoidal rule and Simpson's 1/3 rule for approximation of integrals.

UNIT–VI: DIFFERENTIAL EQUATIONS

Definition of a differential equation-order and degree of a differential equation- formation of differential equations-solution of differential equation of the type first order first degree, variable-separable, homogeneous equations, exact, linear differential equation of the form $dy/dx+Py=Q$, Bernoulli's equation, 2^{nd} order linear differential equations with constant coefficients both homogeneous and non-homogeneous and finding the particular integrals for the functions e^{ax}, sin ax, cos ax, $ax^2 + bx + c$ (a, b, c are real numbers) and general solutions.

UNIT–VII: LAPLACE TRANSFORMS

Laplace Transforms (LT) of elementary functions-Linearity property, first shifting property, change of scale property, multiplication by t^n and division by t - LT of derivatives and integrals, Unit step function, LT of unit step function, second shifting property, evaluation of improper integrals, Inverse Laplace transform (ILT)-shifting theorems, change of scale property, multiplication by s^n and division by s, ILT by using partial fractions and convolution theorem. Applications of LT to solve linear ordinary differential equations up to second order with initial conditions.

UNIT–VIII: FOURIER SERIES

Fourier series, Euler's formulae over the interval $(C, C+2\pi)$ for determining the Fourier coefficients. Fourier series of simple functions in $(0, 2\pi)$ and $(-\pi, \pi)$, Fourier series for even and odd functions in the interval $(-\pi, \pi)$ – Half range Fourier series – sine and cosine series over the interval $(0, \pi)$.

PHYSICS (25 Marks)

UNIT-I: UNITS, DIMENSIONS AND MEASUREMENTS

Physical quantity – Fundamental and derived quantities, unit – definitions – system of units – Advantages of S.I. units.

Dimensions and dimensional formula – definitions, units and dimensional formulae for physical quantities, Dimensionless quantities, Principle of homogeneity, Applications of dimensional analysis – Checking the correctness of physical equations – conversion of unit from one system to another system – problems on density, force and energy.

UNIT-II: VECTORS

Scalar and Vector quantities – definition and examples, representation of a vector, Classification of vectors - Proper vector, Equal vectors, Unit vector, Negative vector, null vector and Position vector, Resolution of a vector.

Lami's theorem, Parallelogram law of vectors – statement- expression for magnitude and direction of resultant vector – derivation, Representation of a vector in unit vectors **i**, **j** and **k** – numerical problems.

Scalar product of vectors - application to work done by force and power – properties of scalar product – Numerical problems.

Vector product of vectors – Right hand thumb rule and right hand screw rule - application to torque - properties of vector product - Application to area of parallelogram and triangle - numerical problems.

UNIT-III: MECHANICS

Concept of Friction - Normal reaction, Angle of friction, Motion of a body over a rough horizontal surface - expressions for Acceleration, Displacement, Time taken to come to rest - derivations, inclined plane - Motion of a body over a smooth inclined plane and rough inclined plane–forces acting on the body - angle of repose, Application of friction – brake system in bicycle – numerical problems.
Projectile motion – definition – examples, Horizontal projection - Oblique projection, Expression for path of a projectile in oblique projection – derivation, Maximum height, Time of ascent, Time of descent, Time of flight, Horizontal range and maximum horizontal range in oblique projection – derivations, numerical problems.
Circular motion – definition of angular displacement, angular velocity, angular acceleration, frequency and time period, Relation between linear and angular velocity – derivation – related numerical problems, Central force – examples, Expressions for centripetal and centrifugal forces (no derivation), Applications of centripetal and centrifugal forces - Banking of roads and its expression, bending of cyclist and principle of centrifuge - related numerical problems.

UNIT-IV: PROPERTIES OF MATTER

Elasticity – Elastic body – definition - examples, Stress and Strain – definitions and expressions, types of stress and strain, elastic limit - Hooke's law – statement – modulus of elasticity, significance of stress and strain curve -Young's modulus – Derivation, numerical problems.

Surface tension - Capillarity –angle of contact – definition- examples for capillarity- Formula for

Surface tension based on capillarity (no derivation), effect of temperature and impurity on surface tension, applications and illustrations of surface tension, numerical problems.

Viscosity - Newton's formula for viscous force – derivation - Coefficient of viscosity - Poiseuille's equation (formula only), Effect of temperature on viscosity of liquids and gases, applications of viscosity, numerical problems.

Concept of fluid motion – streamline and turbulent flow, Reynold's number, equation of continuity, Bernoulli's theorem (only formula) and applications - related problems.

UNIT-V: CONSERVATION LAWS AND ENERGY SOURCES

Work, Power and Energy – explanation, Potential Energy and Kinetic energy –examples – expressions for Potential energy and Kinetic energy – derivations, Work-Energy theorem – derivation, Law of conservation of energy – examples, Law of conservation of energy in the case of freely falling body – proof – Illustration of conservation of energy in the case of simple pendulum, related problems.

UNIT-VI: HEAT

Heat – thermal expansion of solids – Coefficients of expansions, Boyle's law – statement, concept of absolute zero - Absolute scale of temperature, Charles' laws, Ideal gas equation – derivation - value of universal gas constant 'R', Gas equation in terms of density, Isothermal and Adiabatic processes - Differences between isothermal and adiabatic processes, Internal energy and External work done, Expression for work done – derivation, first law of thermodynamics – application of first law to isothermal and adiabatic processes, second law of thermodynamics, specific heats of a gas, related numerical problems.

UNIT-VII: SIMPLE HARMONIC MOTION

Periodic motion - Simple Harmonic Motion (SHM) – definition – examples, Conditions for SHM, Time period, frequency, amplitude and phase of a particle in SHM, Expressions for Displacement, Velocity, Acceleration, Time period and frequency of a particle executing SHM – derivations.

Ideal simple pendulum – time period of simple pendulum – derivation, laws of simple pendulum, Second's pendulum - related numerical problems.

UNIT-VIII: SOUND

Stationary waves, beats - applications of beats, echo – definition - applications - relation between time of echo and distance of obstacle.

Doppler effect in sound (no derivation, formulae only) – list the applications – ultrasound and radar in medicine and engineering - derivation - Reverberation and time of reverberation - Sabine's formula - Free and forced vibrations - Resonance - Conditions of good auditorium, noise pollution – causes, effects and methods to minimize noise pollution, related numerical problems.

UNIT-IX: MAGNETISM AND ELECTRICITY

Basics of magnetism, Coulomb's inverse square law in magnetism, moment of couple on a bar magnet placed in a uniform magnetic field – derivation, expression for magnetic induction field strength at a point on the axial line of a bar magnet – derivation.

Kirchhoff's laws in electricity, Wheatstone bridge – balancing condition, application of Wheatstone bridge – Meter bridge,
Concept of electromagnetic induction – self induction and mutual induction, Faraday's Laws, Lenz's law, principle and working of transformer - types of transformers, types of magnetic materials – dia, para and ferromagnetic materials, related numerical problems.

UNIT-X: OPTICS

Light theories - dual nature, reflection, refraction, and interference.
Photo electric effect - Einstein's photo electric equation – Work function and threshold frequency - laws of photo electric effect - applications of photo electric effect – photo cell.

UNIT-XI: MODERN PHYSICS

LASER – definition, Spontaneous emission and Stimulated emission – principle and working of LASER, characteristics of LASER- types of LASER, applications of LASER.
Total internal reflection, critical angle, conditions for total internal reflection, Principle and working of Optical fiber – types - Applications of optical fiber –Nano technology, nano particles and nano materials - applications and devices, Superconductivity - basic concept - applications of Superconductors.

UNIT-XII: SEMICONDUCTOR PHYSICS

Energy bands in solids - valence band- conduction band – forbidden gap – Energy band diagram of conductors, insulators and semiconductors – concept of Fermi level - Intrinsic semiconductors - examples - Concept of holes in semiconductors - Doping - Extrinsic semiconductors - P-type and N-type semiconductors, PN Junction diode – Forward Biasing and Reverse Biasing - Volt-Ampere (V-I) characteristics - Applications of PN diode - Diode as rectifier (half wave rectifier), Light Emitting Diode – principle and working, solar cell – principle and working.

CHEMISTRY (25 Marks)

UNIT-I: FUNDAMENTALS OF CHEMISTRY

Atomic Structure: Introduction – Atomic number – Mass number - Isotopes and Isobars - Bohr's Atomic Theory - Orbitals - Shapes of s, p and d orbitals – Aufbau principle - Hund's rule - Pauli's exclusion principle - Electronic configuration of elements

Chemical Bonding: Introduction – Electronic theory of valency - Types of chemical bonds - Ionic, Covalent, Co-ordinate covalent, Metallic and Hydrogen bonds with examples - Properties of Ionic and Covalent compounds - Types of Hydrogen bonds – Effect of hydrogen bonding on physical properties.

Oxidation - Reduction: Electronic concept of Oxidation, Reduction, Oxidation Number - Calculations.

UNIT-II: SOLUTIONS AND COLLOIDS

Introduction - Solution – Solubility - Classification of solutions based on physical state - Atomic weight, Molecular weight, Equivalent weight - Mole concept – Molarity and Normality - Numerical problems on mole, molarity and normality – Colloids - Types of colloids - Lyophilic and Lyophobic colloids - Protective Colloids - Gold number - Properties of Colloids - Industrial applications of colloids.

UNIT-III: ACIDS AND BASES

Introduction - Theories of acids and bases and limitations - Arrhenius theory - Bronsted -Lowry theory - Lewis's acid base theory - Ionic product of water - pH and related numerical problems - Buffer solutions - buffer action - Applications of buffer solutions - Ostwald's theory of indicators.

UNIT-IV: ENVIRONMENTAL SCIENCE

Introduction - Environment - Scope and importance of environmental studies - Important terms - Concept of ecosystem - Producers, consumers and decomposers - Food chain - Food web - Carbon and nitrogen cycles - Biodiversity, definition and threats to Biodiversity - Forest resources - Deforestation – Green Chemistry – E-waste – Management of e-waste.

UNIT-V: WATER TECHNOLOGY

Introduction - Soft and hard water - Causes of hardness – Types of hardness - Disadvantages of hard water using in industries - Degree of hardness - Softening methods - Permutit process and Ion exchange process - Drinking water - Municipal treatment of water for drinking purpose – Osmosis and Reverse Osmosis - Advantages of Reverse osmosis – Desalination by Electro dialysis – Defluoridation – Nalgonda Technique.

UNIT-VI: ELECTROCHEMISTRY

Conductors, insulators, electrolytes – Types of electrolytes - Arrhenius theory of electrolytic dissociation - Electrolysis – Electrolysis of fused NaCl and aqueous NaCl –Applications of electrolysis - Faraday's laws of electrolysis - Numerical problems.

UNIT-VII: METALLURGY

Characteristics of metals - Distinguish between metals and non metals - Mineral, Ore, Gangue, Flux, Slag - Concentration of ore - Construction and operation of Reverberatory furnace and Blast furnace - Methods of extraction of crude metal - Roasting, Calcination, Smelting – Alloys - Purpose of making alloys - Composition and uses of Brass, German Silver, Nichrome, Stainless Steel and Duralumin.

UNIT – VIII: CORROSION

Corrosion - Factors influencing the rate of corrosion – Dry and wet theories of corrosion – Composition cell, Stress cell and Concentration cell - Rusting of iron and its mechanism - Prevention of corrosion – Protective coatings - Cathodic protection - Paint – Constituents of paint – Functions of constituents of paint.

UNIT – IX: POLYMERS

Polymers - Polymerization - Types of polymerizations – Addition polymerization and Condensation polymerization - Plastics - Types of plastics - Advantages of plastics over traditional materials - Disadvantages of using plastics - Preparation and uses of the following plastics: 1. Polythene 2. PVC 3. Teflon 4. Polystyrene 5. Urea formaldehyde 6. Bakelite - Compounding and moulding of plastics – Natural rubber – Vulcanization of natural rubber - Elastomers – Preparation and uses of Butyl rubber, Buna-S rubber and Neoprene rubber - Fibre - Preparation and uses of Nylon 6,6 and Polyester (Polyethylene terephthalate) - Biodegradable polymers and their general applications.

UNIT – X: FUELS AND LUBRICANTS

Definition and classification of fuels - Characteristics of good fuels - Calorific value - HCV and LCV - Calculation of oxygen required for combustion of methane and ethane – Preparation method, composition, calorific value, and uses of some gaseous fuels; a) CNG b) LPG c) Water gas, d) Producer gas, e) Coal gas, and f) Bio gas – Explosives – Classification of explosives – Applications of explosives – Lubricants – Classification and functions of lubricants.

UNIT XI: ELECTROCHEMICAL CELL - BATTERIES

Galvanic cell - Standard electrode potential - Reference electrodes - Types of reference electrodes - Electro chemical series - EMF of cell – batteries - Types of batteries - Fuel cells.

UNIT – XII: ENVIRONMENTAL STUDIES

Introduction - Classification of air pollutants based on origin and states of matter - Air pollution – Causes, effects and controlling methods of air pollution - Water pollution – Causes, effects and controlling methods of water pollution – Soil pollution – Causes of soil pollution – General effects of soil pollution - Controlling methods of soil pollution – Carbon Trading.

CIVIL ENGINEERING (100 Marks)

UNIT–I: ENGINEERING MECHANICS

Forces and moments- Vectors and scalars (Without i,j,k representations), resultant forces at a point, resolution and moment of forces, types of supports, beams, types of loading. Centroid – rectangle, triangle, parallelogram, circle, semicircle, trapezium. Location of centroid of T, L, I, channel, Z sections. built-up sections. Moment of Inertia and radius of gyration – T, L, I and built up sections,; Polar moment of inertia of solid and hollow circular sections using perpendicular axis theorem only. Simple stresses and strains - ductile materials- - Hooke‘s law - lateral strain-Poisson‘s ratio-Elastic constants and the relation between them- Composite sections-Mechanical properties of materials.

UNIT-II: STRENGTH OF MATERIALS

Shear force and Bending Moment Diagrams for cantilever, Simply supported and overhanging beams subjected to Point loads and UDL. Theory of simple bending-assumptions-bending equation-bending Stresses-Section Modulus Neutral Axis - Flexural Rigidity, Radius of curvature, Moment of Resistance – Calculation of bending stresses in Symmetrical and Unsymmetrical sections-practical applications. Shear stress distribution across various sections like rectangular, circular and I and T- Sections-Torsion-solid and hollow circular shafts subjected to pure torsion – shear stress – distribution in shafts – power transmitted by circular shafts.

Slope and Deflection of cantilevers and simply supported beams by Double Integration method and Deflection of simply supported beams by Macaulay‘s method – Mohr‘s theorems for slopes and deflections-Symmetrical loading. Columns and struts-types-slenderness ratio- Euler’s and Rankine’s formulae for axial loading.

UNIT-III: REINFORCED CONCRETE STRUCTURES

Grades of concrete, characteristic strength, Modulus of Elasticity-I.S.456-2000- Philosophy of Limit state design. Limit state of Strength and Serviceability, partial safety factor-design strength of materials and design loads- assumptions – stress strain diagram of singly reinforced R.C.C beams.

Analysis and Limit state design of rectangular Beams-Singly, Doubly reinforced and T-beams. Shear in RCC beams - Development length. Slabs-analysis and limit state design of one-way and two-way slabs as per IS.456-2000, Torsion reinforcement. Design of continuous slabs and beams - Deflection check for slabs and beams. Detailing of reinforcement in singly reinforced and doubly reinforced simply supported beams of rectangular sections and lintels, one way and two way slabs.

Columns: Codal provisions of I.S 456-2000 - short and long columns-different shapes-design of short columns by limit state method-long columns- concept, effective length for different end conditions. Footings-Isolated column footings-one way shear and two way shear.

UNIT-IV: SURVEYING

Chain surveying - purpose and principle - offsets - errors and corrections- different operations in chain surveying- obstacles - methods of calculation of area. Compass Surveying - purpose and principle - bearings- traversing using prismatic compass- local attraction - errors. Levelling - definitions - component parts of Dumpy level - contouring - Methods of levelling - errors - characteristics and methods. Theodolite - principles and component parts- fundamental lines and relationship among them – temporary adjustments of theodolite - measurement of horizontal and vertical angles - errors-traverse computations - Bowditch and Transit rule. Tachometry - principles - stadia tachometry - tangential tachometry(simple problems), Principle and uses of E.D.M, Electronic Theodolite, Total Station, Global positioning System - Importance, G.I.S – Use and applications in Civil Engineering, Curves - simple curves, elements of simple, compound and reverse curves, setting out of simple curves by chain & tape, single & double theodolite method (problems).

UNIT-V: HYDRAULICS

Fluid properties - specific weight – mass density-specific gravity - surface tension - capillarity-viscosity. Atmospheric pressure, gauge pressure and absolute pressure. Centre of pressure and total pressure on plane surfaces, measurement of fluid pressure using piezometer and manometers. Types of flows-uniform, non-uniform, steady, unsteady, laminar and turbulent flows. Energies of liquid in motion - continuity equation. Bernoulli‘s theorem - Pitot tube - Venturimeter. Flow thorough small and large orifices, coefficients of orifices - Cc, Cv and Cd. Flow through internal, external, convergent and divergent mouthpieces. Types of Notches – rectangular, triangular and trapezoidal notch, Types of Weirs- sharp crested and broad crested-mathematical formulae for discharge- Francis and Bazin’s empirical formulae.

Flow through pipes-major and minor losses - Chezy‘s and Darcy‘s formulae for loss of head due to friction-HGL & TEL. Discharge through parallel pipes, Reynolds number, Flow through open channels-rectangular and trapezoidal - Chezy‘s formula for discharge -Manning‘s equation for Chezy‘s constants-Most economical sections. Reciprocating and Centrifugal pumps (without problems). Classification of Turbines - Kaplan, Francis and Pelton wheel (without problems) – component parts and functions of surge tanks.

UNIT VI: IRRIGATION ENGINEERING

Necessity of Irrigations - Perennial and inundation Irrigation, Flow and Lift Irrigation, Principal seasons - kharif and rabi crops - Duty, delta and base period. Methods of Irrigation - check flooding, basin flooding, Border strip, furrow, sprinkler and drip Irrigations. Hydrology - Rainfall, types of Rain gauges, types of catchments-rainfall and runoff (without problems). Measurement of velocity of flow in streams. Classification of Head works - component parts of diversion head works. Weirs and Barrages. Percolation and uplift pressures. Types of Reservoirs - dead storage and live storage.

Storage Head works-different types of dams- gravity dams-low and high dams. Failures of gravity dams - drainage galleries. Types of spillways. Earth dams - types, failures and precautions. Phreatic lines. Distribution works-classifications and alignment of canals-typical

cross section of canal-berms - balanced depth of cutting- canal lining. Cross drainage works – types and functions. Soil erosion, Types and causes-measures to control erosion.

UNIT VII: TRANSPORTATION ENGINEERIN

Importance of transportation engineering – Highway development in India, I.R.C. – Classification of roads as per I.R.C., alignment of Highway & Highway surveys, recommended I.R.C. values of camber for different roads. Gradients – Ruling gradient, limiting and exceptional gradient, Recommended I.R.C values of gradients. Super elevation & sight distance.
Traffic Engg. - Traffic studies and its importance, Road intersections- Traffic signs- Informatory signs- Mandatory signs, Cautionary signs – pavement – types & its design. Highway constructions and Maintenance. Tests on road materials - Purpose of road drainage - surface and sub-surface drainage, Typical cross section of highway in cutting and embankment. Water bound macadam roads, Cement concrete roads. Permanent way of Railways, Importance of Railways- Gauge, Types of gauges, Structure of permanent way – different types of rails, requirements of a good rail, Sleepers - functions, Types of sleepers, characteristics of a good sleeper – spacing of sleepers-sleeper density (without problems). Rail joints, coning of wheels, ballast - Points and crossings, turnout.

UNIT VIII : WATER SUPPLY AND SANITARY ENGINEERING

Quality of water, Need for protected water supply, Total quantity of water for a town, per capita demand and factors affecting demand, Forecasting population by arithmetical, geometrical and incremental increase methods, Sources and conveyance of water: surface sources, underground sources, Types of Intakes. Quality and Methods of purification of water.
Distribution System: Methods of supply, Storage-Distribution systems, Types of layout- dead end, grid, radial and ring system their merits and demerits and their suitability. General layout of water supply arrangements in buildings.
System of sewage disposal-types of sewerage systems, design of sewers. Different shapes of cross-section for sewers, Strength of sewage, sampling of sewage, characteristics of sewage - principles of treatment, Preliminary and secondary treatment (theoretical concepts). BOD-COD - pH. Sewers – sewer appurtenances - shapes, merits and demerits. Septic tank – soak pit (without problems).

UNIT IX: **BUILDING MATERIALS AND CONSTRUCTION PRACTICE**

Stones-classification of rocks. Bricks – manufacturing, tests on bricks. Tiles- types of tiles. Cement- classification, manufacturing - tests - As per IS specifications. Mortars – classification - proportioning. Concrete- proportioning – water-cement ratio – workability – admixtures-curing methods-R.M.C. Timber and surface protective materials. Characteristics-types and uses.
Classification of buildings, foundations-N.B.C classification-bearing capacity of soil- types of foundations. Masonry-Bonds in brick masonry. Plastering-purpose. Pointing purpose and types.