TG ECET-2025

Syllabus of Chemical Engineering

MATHEMATICS (50 Marks)

UNIT-I: MATRICES

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 -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 decomposition of the integrand,

Integration of trigonometric, algebraic, exponential, logarithmic and hyperbolic functions– Integration by substitution –Integration of reducible and irreducible quadratic factors – 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).

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 upto second order with initial conditions.

UNIT–VIII: FOURIER SERIES

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

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 systemin 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 –

Nanotechnology, 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 nonmetals - 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 AND BATTERIES

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

UNIT – XII: ENVIRONMENTAL STUDIES

Introduction- Classification of air pollutants based on origin and physical state 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.

CHEMICAL ENGINEERING (100 Marks)

UNIT I: MATERIAL TECHNOLOGY

Mechanical properties of engineering materials and Testing of materials– Structure of metals and alloys- Thermal equilibrium diagram-Production of Iron& Steel - Plain

carbon steels, alloy steels–Nonferrous metals & their alloys - Aluminum, copper, nickel, lead, tin, zinc-Miscellaneous materials – Glass, carbon, graphite, rubber, elastomers – glass fibers – Corrosion-causes, types& prevention methods.

UNIT II: MATERIAL AND ENERGY BALANCES

Basic calculations of molarity, molality and normality, analysis of solids, liquids and gases on dry and wet basis- Kinetic theory of gases & Gas laws,Ideal solutions and Non-Ideal solutions,Material balances with and without chemical reactions - Material balance problems related to evaporation, distillation, drying and mixing, Bypass and Recycle streams– limiting component, excess reactant, percentage of conversion, yield and degree of completion - Heat of reaction, heat of formation and heat of combustion.

UNIT III: ORGANIC CHEMICAL TECHNOLOGY

Coal chemicals, coking of coal, coal tar distillation, -carbonization-petroleum refining - atmospheric distillation and vacuum distillation, fluid catalytic cracking, catalytic reforming, petrochemicals from methane and ethylene- Pulp and paper industry, Kraft process - Oils, fats and soaps-sugar and fermentation industries– synthetic fibers - rubber industries.

UNIT IV: INORGANIC CHEMICAL TECHNOLOGY

Water and its treatment, water softening methods, impurities-treatment-dissolved solids-ion exchange process and reverse osmosis (RO) process- Manufacture of chemicals like soda ash, ammonia, urea, nitric acid, sulphuric acid, phosphoric acid, super phosphate and industrial gases (O_2, N_2, H_2, CO_2 and acetylene)- Paints, pigments and varnishes, graphite and silicon carbide and cement. calcium carbide, NPK Fertilizers.

UNIT V: FLUID MECHANICS

Flow of incompressible fluids, Newtonian and non-Newtonian fluids, Pressure concept and manometers, viscosity, laminar & turbulent flows, Bernoulli‘s theorem, and modified Bernoulli‘s equation friction losses, friction factor – pressure drop, flow meters, different types of pumps for transportation of fluids, Centrifugal pump, Displacement pump, Reciprocating pump, Flow past immersed bodies-packed bed and fluidized bed, Types of fluidizations**.**

UNIT VI: HEAT TRANSFER

Conduction–mechanisms of heat flow–Fourier‘s law, thermal conductivity, steady state conduction- compound resistances in series, heat flow through a cylinder. Natural and forced Convection–heat flow in fluids-rate of heat transfer, counter current and parallel flows-Overall heat transfer coefficient–LMTD–Fouling factors– Nusselt Number - Prandtl Number. Heat transfer to fluids with and without phase change. Drop wise and Film wise condensation, Heat transfer to boiling liquids, Radiation, laws of radiation, radiation between surfaces – Stefan’s law-view factor- Heat Exchange Equipment – types of heat exchange equipment, Evaporation – types of evaporators, evaporator economy, Boiling point Elevation, single and multiple effect evaporators– related

problems**.**

UNIT VII: MECHANICAL UNIT OPERATIONS

Properties of particulate solids Size reduction- methods & laws- crushers and grinders. Different types of equipment for mixing of liquids, viscous masses, dry powders, Differential and cumulative screen analysis, screen effectiveness, average particle size, storage of solids, conveyers, mechanical separations - Screening, froth floatation, electrostatic precipitator, scrubber, cyclone separators, filtration, filtration equipment, sedimentation.

UNIT VIII: THERMODYNAMICS AND REACTION ENGINEERING

Basics of thermodynamics, state and path functions, First law of Thermodynamics, PVT relationships for gases-ideal gas- isobaric-isochoric, isothermal and adiabatic processes – cubic equations of state –Second law of Thermodynamics, Carnot cycle-entropy - refrigeration and liquefaction, chemical reaction equilibria-determination of equilibrium constant and conversion, Temperature effect on reactions- Gibbs free energy - chemical kinetics - classification of reactions - reaction order and molecularity - working of batch, tubular and stirred tank reactors, industrial reactors - space time - space velocity.

UNIT IX: MASS TRANSFER OPERATIONS

Principles of diffusion, Fick's law of diffusion – molecular diffusion - Diffusion in gases - interphase mass transfer, film theory -wet bulb & dry bulb temperature – Distillation- simple, steam and continuous distillation - Rayleigh's equation, reflux ratio– McCabe Thiele method tray columns- absorption principles - tower packing, channeling, loading & flooding- Adsorption – adsorbents - humidification, extraction and leaching, drying - drying rate curves, time of drying, equipment for drying – crystallization – equipment.

UNIT X: INSTRUMENTATION & PROCESS CONTROL

Static and dynamic characteristics of an instrument-step input, linear input, sinusoidal input, measurement of temperature, pressure, vacuum, liquid levels, viscosity, density and composition – thermocouples - types of pressure gauges & vacuum gauges for distillation column, evaporator, reactor and extractor. Process Control – simple automatic process control- components of a control system - different types of control systems- different control actions-terms associated with a control system-different types of controllers- various control actions, transfer function expressions for P, PI, PD & PID controllers.