

Structure of entrance exam will include:

- **Compulsory general aptitude**
- **Basic knowledge in physics, mathematics, chemistry and biology at 10 + 2 level**
- **Advanced level knowledge in respective field of graduation**

Syllabus

General Aptitude

(COMMON TO ALL)

- **Verbal Ability:** English grammar, sentence completion, verbal analogies, word groups, instructions, critical reasoning and verbal deduction.
- **Numerical Ability:** Numerical computation, numerical estimation, numerical reasoning and data interpretation.

Mathematics

Algebra

- *Matrices*
Concept, notation, order, equality, types of matrices, zero and identity matrix, transpose of a matrix, symmetric and skew symmetric matrices. Operation on matrices: Addition and multiplication and multiplication with a scalar. Simple properties of addition, multiplication and scalar multiplication.
- *Determinants*
Determinant of a square matrix (up to 3 x 3 matrices), properties of determinants, minors, co-factors and applications of determinants in finding the area of a triangle. Adjoint and inverse of a square matrix. Consistency, inconsistency and number of solutions of system of linear equations by examples, solving system of linear equations in two or three variables (having unique solution) using inverse of a matrix.
- **Calculus**
Continuity and Differentiability
Continuity and differentiability, derivative of composite functions, chain rule, derivatives of inverse trigonometric functions, derivative of implicit functions. Concept of exponential and logarithmic functions.
Derivatives of logarithmic and exponential functions. Logarithmic differentiation, derivative of functions expressed in parametric forms. Second order derivatives. Rolle's and Lagrange's Mean Value Theorems (without proof) and their geometric interpretation.
Integrals

Integration as inverse process of differentiation. Integration of a variety of functions by substitution, by partial fractions and by parts.

Definite integrals as a limit of a sum, Fundamental Theorem of Calculus (without proof). Basic properties of definite integrals and evaluation of definite integrals.

Differential Equations

Definition, order and degree, general and particular solutions of a differential equation. Formation of differential equation whose general solution is given. Solution of differential equations by method of separation of variables solutions of homogeneous differential equations of first order and first degree. Solutions of linear differential equation.

- **Vectors**

Vectors and scalars, magnitude and direction of a vector. Direction cosines and direction ratios of a vector. Types of vectors (equal, unit, zero, parallel and collinear vectors), position vector of a point, negative of a vector, components of a vector, addition of vectors, multiplication of a vector by a scalar, position vector of a point dividing a line segment in a given ratio. Definition, Geometrical Interpretation, properties and application of scalar (dot) product of vectors, vector (cross) product of vectors, scalar triple product of vectors.

- **Linear Programming**

Introduction, related terminology such as constraints, objective function, optimization, different types of linear programming (L.P.) problems, mathematical formulation of L.P. problems, graphical method of solution for problems in two variables, feasible and infeasible regions (bounded and unbounded), feasible and infeasible solutions, optimal feasible solutions (up to three non-trivial constraints).

- **Probability**

Conditional probability, multiplication theorem on probability. independent events, total probability, Baye's theorem, Random variable and its probability distribution, mean and variance of random variable. Repeated independent (Bernoulli) trials and Binomial distribution.

Physics

- Systems of units; SI units, Length, mass and time measurements; accuracy and precision of measuring instruments; error analysis and significant figures
- Uniform and non-uniform motion, motion in a plane, projectile motion. Uniform circular motion

- Force, inertia, Newton's laws of motion; momentum, impulse, conservation of linear momentum, equilibrium of concurrent forces. friction, uniform circular motion: Centripetal force, Moment of a force, torque, angular momentum, laws of conservation of angular momentum. Moment of inertia, radius of gyration.
- Kinetic and potential energy, work-energy theorem, power, potential energy of a spring, conservative forces and energy; elastic and inelastic collisions
- Elastic behaviour, Stress-strain relationship, Hooke's law, Young's modulus, bulk modulus, shear modulus of rigidity, Poisson's ratio; elastic energy
- Pascal's law, Effect of gravity on fluid pressure, Viscosity, Stokes' law, terminal velocity, streamline and turbulent flow, critical velocity, Bernoulli's theorem and its applications, Surface energy and surface tension, angle of contact
- Thermal expansion of solids, liquids and gases; Calorimetry, latent heat; Heat conduction in one dimension; Elementary concepts of convection and radiation; Newton's law of cooling; Ideal gas laws; Specific heats (C_v and C_p for monoatomic and diatomic gases); Isothermal and adiabatic processes, bulk modulus of gases; Equivalence of heat and work; First law of thermodynamics and its applications (only for ideal gases); Blackbody radiation: absorptive and emissive powers; Kirchhoff's law; Wien's displacement law, Stefan's law
- Periodic motion, Simple harmonic motion, oscillations of a spring-restoring force and force constant; Kinetic and potential energies; Free, forced and damped oscillations, Wave motion. Transverse and longitudinal waves, superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics, Beats, Doppler effect
- Coulomb's law-force, Electric field, electric dipole, torque on a dipole, electric flux, Gauss's theorem and its applications. Conductors and insulators, Dielectrics and electric polarisation, capacitance. Electric current, drift velocity, mobility, Ohm's law, energy and power, Kirchhoff's laws, Magnetic field, Biot - Savart law, Ampere's law,. Cyclotron, Magnetic dipole moment and its field intensity, Torque on a magnetic dipole, Earth's magnetic field and magnetic elements, Para-, dia- and ferro - magnetic substances, Electromagnets. Energy bands structures, p-n junction diodes, Rectifier; Logic gates, bandwidth of signals and transmission
- Electromagnetic waves and their characteristics, , Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, X-rays, gamma rays) and their uses.
- Atomic models
- Radioactivity: isotopes, isobars; isotones. alpha, beta and gamma particles/rays and their properties; radioactive decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number; nuclear fission, nuclear fusion, α , β and γ radiations; energy calculation in these processes. Photoelectric effect; X-rays, Moseley's law; de Broglie wavelength of matter waves

Chemistry

- Atomic and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry
- Atomic structure, electronic configuration of atoms and related principles
- Periodic table, periodic trends in properties of elements , ionization enthalpy, electron gain enthalpy, electronegativity, valency
- Molecular structure and chemical bonding, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization
- Gases, Liquids and Solids: Boyle's law, Charles law, Gay Lussac's law, Avogadro's law, ideal behaviour, empirical derivation of gas equation, Avogadro's number, ideal gas equation and deviation, vapour pressure, viscosity and surface tension, classification of solids based on different binding forces.
- Thermodynamics: Concepts of System and types of systems, surroundings, work, heat, energy, extensive and intensive properties, state functions, laws of thermodynamics
- Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium
- Redox reactions
- Isotopes of elements and nuclear chemistry
- Basic principles and techniques of organic chemistry: IUPAC nomenclature, Electronic displacements in a covalent bond: inductive effect, electromeric effect, resonance and hyper conjugation. Homolytic and heterolytic fission of a covalent bond, electrophiles and nucleophiles, types of organic reactions, Classification and characteristics of Hydrocarbons , chemical reactions including free radical mechanism of halogenation, combustion and pyrolysis, Aliphatic Hydrocarbons
- Aromatic Hydrocarbons: Nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation, directive influence of functional group in monosubstituted benzene. Carcinogenicity and toxicity.
- Environmental Chemistry: chemical reactions in atmosphere, smog, major atmospheric pollutants, acid rain, ozone and its reactions, effects of depletion of ozone layer, greenhouse effect and global warming, green chemistry

Biology

- Three domains of life; taxonomy and systematics; concept of species and taxonomical hierarchy; binomial nomenclature
- Structural organisation in plants and animals: Structure of prokaryotic and eukaryotic cells; Plant cell and animal cell; cell envelope; cell membrane, cell wall; cell organelles - structure and function; cytoskeleton, cilia, flagella, centrioles (ultrastructure and function); nucleus.

- Biomolecules : Chemical constituents of living cells: biomolecules, structure and function of proteins, carbohydrates, lipids, nucleic acids; Enzymes- types, properties, enzyme action, enzyme kinetics
- Cell Cycle and Cell Division: Cell cycle, mitosis, meiosis and their significance
- Cell to cell transport, diffusion, facilitated diffusion, active transport; osmosis, plasmolysis; absorption, apoplast, symplast, ion channels
- Cellular respiration: glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic)
- Basics of Biochemistry, Biophysics, Molecular Biology: Buffers; trace elements in biological systems; enzymes and proteins; vitamins; biological oxidations, carbohydrates and lipids and their metabolisms; digestion and absorption; detoxifying mechanisms; plant and animal hormones and their action, nucleic acids, nature of gene and its function, genetic code, synthesis of nucleic acids and proteins. Enzyme mechanisms and kinetics, nucleic acid metabolism, photosynthesis. Structure of biomolecules; protein conformation and folding; intra and intermolecular forces; thermodynamics and kinetics of biological systems
- Microbiology, Cell Biology and Immunology: Classes of microorganisms and their characterization, nutrient requirement for growth; laboratory techniques in microbiology, pathogenic microorganisms and disease; applied microbiology; viruses, Microbial genetics. Innate and adaptive immunity, antigen and antibodies. Cell architecture; methods of cell fractionation; cell division; types of chromosome structure; biochemical genetics- inborn errors of metabolisms
- Mendelian genetics and heredity; Molecular genetics, biology and populations and communities; evolution; animal behaviour, plant and animal diseases.
- Composition of blood, blood groups, coagulation of blood; composition of lymph and its function; human circulatory system - Structure of human heart and blood vessels; cardiac cycle, cardiac output, ECG; double circulation; regulation of cardiac activity; disorders of circulatory system - hypertension, coronary artery disease, angina pectoris, heart failure.
- Organ systems: basic concepts and organization, related pathophysiology
- Communicable and non communicable disease