

MATHEMATICS

a. Complex Numbers

Complex numbers in the form $a+ib$ and their representation in a plane. Argand diagram. Algebra of complex numbers, Modulus and argument (or amplitude) of a complex number, square root of a complex number. Cube roots of unity, triangle inequality.

b. Linear Inequalities

Linear inequalities. Algebraic solutions of linear inequalities in one variable and their representation on the number line.

c. Permutations and Combinations

Fundamental principle of counting; Permutation as an arrangement and combination as selection, Meaning of $P(n,r)$ and $C(n,r)$. Simple applications.

d. Binomial Theorem

Binomial theorem for positive integral indices. Pascal's triangle. General and middle terms in binomial expansions, simple applications.

e. Sequences and Series

Arithmetic, Geometric and Harmonic progressions. Insertion of Arithmetic, Geometric and Harmonic means between two given numbers. Relation between A.M., G.M. and H.M. Special series $\sum n$, $\sum n^2$, $\sum n^3$. Arithmetic-Geometric Series, Exponential and Logarithmic Series.

f. Matrices and Determinants

Determinants and matrices of order two and three, Properties of determinants. Evaluation of determinants. Addition and multiplication of matrices, adjoint and inverse of matrix. Solution of simultaneous linear equations using determinants .

g. Quadratic Equations

Quadratic equations in real and complex number system and their solutions. Relation between roots and co-efficients, Nature of roots, formation of quadratic equations with given roots;

h. Relations and Functions

Definition of a relation. Domain, codomain and range of a relation. Function as special kind of relation and their domain, codomain and range. Real valued function of a real variable. Constant, identity, polynomial, rational. Modulus, signum and greatest integer functions. Sum. Difference, product and quotient of functions.

Types of relations: reflexive, symmetric, transitive and equivalence relations. One to one and onto functions.

Composite functions, inverse of a function.

i. Trigonometry

Trigonometrical identities and equations. Inverse trigonometric functions and their properties. Properties of triangles, including centroid, incentre, circumcentre and orthocentre, solution of triangles. Heights and distances.

j. Measures of Central Tendency and Dispersion

Calculation of Mean, Median and Mode of grouped and ungrouped data. Calculation of standard deviation, variance and mean deviation for grouped and ungrouped data.

k. Probability

Probability of an event, addition and multiplication theorems of probability and their applications; Conditional probability; Bayes' theorem, Probability distribution of a random variate; Binomial and Poisson distributions and their properties.

l. Differential Calculus

Polynomials, rational, trigonometric, logarithmic and exponential functions. Graphs of simple functions. Limits, Continuity; differentiation of the sum, difference, product and quotient of two functions. Differentiation of trigonometric, inverse trigonometric, logarithmic, exponential, composite and implicit functions; derivatives of order upto two.

Applications of derivatives: Maxima and Minima of functions one variable, tangents and normals, Rolle's and Lagrange's Mean Value Theorems.

m. Integral Calculus

Integral as an anti derivative. Fundamental integrals involving algebraic, trigonometric, exponential and logarithmic functions. Integration by substitution, by parts and by partial fractions. Integration using trigonometric identities. Integral as a limit of sum. Properties of definite integrals. Evaluation of definite integral; Determining areas of the regions bounded by simple curves.

n. Differential Equations

Ordinary differential equations, their order and degree. Formation of differential equation. Solutions of differential equations by the method of separation of variables. Solution of Homogeneous and linear differential equations, and those of type $d^2y/dx^2 = f(x)$.

o. Two Dimensional Geometry

Review of Cartesian system of rectangular co-ordinates in a plane, distance formula, area of triangle, condition for the collinearity of three points, slope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axes.

p. The straight line and pair of straight lines

Various forms of equations of a line, intersection of lines, angles between two lines, conditions for concurrence of three lines, distance of a point from a line. Equations of internal and external bisectors of angles between two lines, equation of family lines passing through the point of intersection of two lines, homogeneous equation of second degree in x and y, angle between pair of lines through the origin, combined equation of the bisectors of the angles between a pair of lines, condition for the general second degree equation to represent a pair of lines, point of intersections and angles between two lines.

q. Circles and Family of Circles

Standard form of equation of a circle, general form of the equation of a circle, its radius and centre, equation of a circle in the parametric form, equation of a circle when the end points of a diameter are given, points of intersection of a line and circle with the centre at the origin and condition for a line to be tangent, equation of a family of circles through the intersection of two circles, condition for two intersecting circles to be orthogonal.

r. Conic Sections

Sections of cones, equations of conic sections (parabola, ellipse and hyperbola) in standard forms, conditions for $y = mx+c$ to be a tangent and point(s) of tangency.

s. Vector Algebra

Vector and scalars, addition of two vectors, components of a vector in two dimensions and three dimensional space, scalar and vector products, scalar and vector triple product. Application of vectors to plane geometry.

t. Three Dimensional Geometry

Distance between two points. Direction cosines of a line joining two points. Cartesian and vector equation of a line. Coplanar and skew lines. Shortest distance between two lines. Cartesian and vector equation of a plane. Angle between (i) two lines (ii) two planes (iii) a line and a plane Distance of a point from a plane.

PHYSICS

a. UNITS AND DIMENSIONS

Units for measurement, system of units, SI, fundamental and derived units, dimensions and their applications.

b. MECHANICS

Motion in straight line, uniform and non-uniform motion, uniformly accelerated motion and its applications Scalars and Vectors, and their properties; resolution of vectors, scalar and vector products; uniform circular motion and its applications, projectile motion Newton's Laws of motion; conservation of linear momentum and its applications, laws of friction, Concept of work, energy and power; energy-kinetic and potential; conservation of energy; different forms of energy. Elastic collisions in one and two dimensions.

Center of mass of a many particle system; center of mass of a rigid body, rotational motion and torque. Angular momentum and its conservation. Moments of inertia, parallel and perpendicular axes theorem, moment of inertia for a thin rod, ring, disc and sphere.

Gravitation: Acceleration due to gravity and its properties. One and two dimensional motion under gravity. Universal law of gravitation, planetary motion, Kepler's laws, artificial satellite-geostationary satellite, gravitational potential energy near the surface of earth, gravitational potential and escape velocity.

h. SOLIDS AND FLUIDS

Solids: Elastic properties, Hooke's law, Young's modulus, bulk modulus, modulus of rigidity. Liquids: Cohesion and adhesion; surface energy and surface tension; flow of fluids, Bernoulli's theorem and its applications; viscosity, Stoke's Law, terminal velocity.

(i) OSCILLATIONS AND WAVES

Periodic motion, simple harmonic motion and its equation, oscillations of a spring and simple pendulum.

Wave motion, properties of waves, longitudinal and transverse waves, superposition of waves, Progressive and standing waves. Free and forced oscillations, resonance, vibration of strings and air columns, beats, Doppler effect.

(ii) HEAT AND THERMODYNAMICS

Thermal expansion of solids, liquids and gases and their specific heats, relationship between C_p and C_v for gases, first and second laws of thermodynamics, Carnot cycle, efficiency of heat engines. Transference of heat; thermal conductivity; black body radiations, Kirchoff's law, Wein's Law, Stefan's law of radiation and Newton's law of cooling.

(iii) ELECTROSTATICS, CURRENT ELECTRICITY AND MAGNETOSTATICS

Coulomb's law, dielectric constant, electric field, lines of force, field due to dipole, electric flux, Gauss's theorem and its applications; electric potential, potential due to a point charge; conductors and insulators, distribution of charge on conductors; capacitance, parallel plate capacitor, combination of capacitors, energy stored in a capacitor.

Electric current: Cells-primary and secondary, grouping of cells; resistance and specific resistivity and its temperature dependence. Ohm's law, Kirchoff's Law. Series and parallel circuits; Wheatstone's Bridge and potentiometer with their applications.

Heating effects of current, electric power, concept of thermoelectricity-Seebeck effect and thermocouple; chemical effect of current- Faraday's laws of electrolysis.

Magnetic effects: Oersted's experiment, Biot Savart's law, magnetic field due to straight wire, circular loop and solenoid, force on a moving charge in a uniform magnetic field(Lorentz force), forces and torques on a current carrying conductor in a magnetic field, force between current carrying wires, moving coil galvanometer and conversion to ammeter and voltmeter.

Magnetostatics: Bar magnet, magnetic field, lines of force, torque on a bar magnet in a magnetic field, earth's magnetic field; para, dia and ferro magnetism, magnetic induction, magnetic susceptibility.

d. ELECTROMAGNETIC INDUCTION AND ELECTROMAGNETIC WAVES

Induced e.m.f., Faraday's law, Lenz's law, self and mutual inductance; alternating currents, impedance and reactance, power in ac; circuits with L C and R series combination, resonant circuits, transformer and AC generator.

Electromagnetic waves and their characteristics; electromagnetic spectrum from gamma to radio waves.

e. RAY AND WAVE OPTICS

Reflection and refraction of light at plane and curved surfaces, total internal reflection; optical fiber; deviation and dispersion of light by a prism; lens formula, magnification and resolving power; microscope and telescope, Wave nature of light, interference, Young's double experiment; thin films, Newton's rings. Diffraction: diffraction due to a single slit; diffraction grating, polarization and applications.

f. MODERN PHYSICS

Dual nature of Radiation - De Broglie relation, photoelectric effect, Alpha particle scattering experiment, atomic masses, size of the nucleus; radioactivity, alpha, beta and gamma particles/rays. Radioactive decay law, half life and mean life of radio active nuclei; Nuclear binding energy, mass energy relationship, nuclear fission and nuclear fusion.

Energy bands in solids, conductors, insulators and semiconductors, pn junction, diode, diode as a rectifier, transistor action, transistor as an amplifier.

CHEMISTRY

a. BASIC CONCEPTS

Atomic and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on stoichiometry.

b. ATOMIC STRUCTURE, CHEMICAL BONDING AND MOLECULAR STRUCTURE

Bohr's model, de Broglie's and Heisenberg's principles, Quantum mechanical model, Orbital concept and filling up of electrons; Bond formation and bond parameters; Valence bond and molecular orbital theory; VSEPR theory; Hybridization involving s, p and d orbital; Hydrogen bond.

c. EQUILIBRIUM AND THERMODYNAMICS

Law of chemical equilibrium and Equilibrium Constant; Homogeneous and Heterogeneous equilibria; LeChatelier's principle, Ionic equilibrium; Acids, Bases, Salts and Buffers; Solubility product; Thermodynamic state; Enthalpy, Entropy and Gibb's free energy; Heats of reactions; Spontaneous and non-spontaneous processes.

d. ELECTROCHEMISTRY, KINETICS AND SURFACE CHEMISTRY

Specific, molar and equivalent conductance of weak and strong electrolytes; Kohlrausch law; Electrochemical cells and Nernst equation; batteries, fuel cells and corrosion. Rate of a reaction and factors affecting the rate: Rate constant, order and molecularity, collision theory. Physisorption and chemisorptions; colloids and emulsions; homogeneous and heterogeneous catalysis.

e. SOLID STATE AND SOLUTIONS

Molecular, ionic, covalent and metallic solids; amorphous and crystalline solids; crystal lattices and Unit cells; packing efficiency and imperfections; electrical and magnetic properties. Normality, molarity and molality of solutions, vapour pressure of liquid solutions; ideal and non-ideal solutions, colligative properties; abnormality.

f. HYDROGEN

Position of hydrogen in the periodic table; dihydrogen and hydrides- preparation and properties; water, hydrogen peroxide and heavy water; hydrogen as a fuel.

g. S - BLOCK ELEMENTS

Group 1 and 2 Alkali and Alkaline earth elements; general characteristics of compounds of the elements; anomalous behavior of the first element; preparation and properties of compounds like sodium and calcium carbonates, sodium chloride, sodium hydroxide; biological importance of sodium, potassium and calcium.

h. P - BLOCK ELEMENTS

Groups 13 to 17 elements: General aspects like electronic configuration, occurrence, oxidation states, trends in physical and chemical properties of all the families of elements; compounds of boron like borax, boron hydrides and allotropes of carbon; compounds of nitrogen and phosphorus, oxygen and sulphur; oxides and oxyacids of halogens.

i. D, F - BLOCK ELEMENTS

Electronic configuration and general characteristics of transition metals; ionization enthalpy, ionic radii, oxidation states and magnetic properties; interstitial compounds and alloy formation; lanthanides and actinoids and their applications.

j. CO-ORDINATION COMPOUNDS

Werner's theory and IUPAC nomenclature of coordination compounds; coordination number and isomerism; Bonding in coordination compounds and metal carbonyls and stability; application in analytical methods, extraction of metals and biological systems.

k. BASIC ORGANIC CHEMISTRY AND TECHNIQUES

Tetravalence of carbon and shapes of organic compounds; electronic displacement in a covalent bond – inductive and electromeric effects, resonance and hyperconjugation; homolytic and heterolytic cleavage of covalent bond – free radicals, carbocations, carbanions electrophiles and nucleophiles; methods of purification of organic compounds; qualitative and quantitative analysis.

l. HYDROCARBONS, HALOALKANES AND HALOARENES

Alkanes, alkenes, alkynes and aromatic hydrocarbons; IUPAC nomenclature, isomerism; conformation of ethane, geometric isomerism, general methods of preparation and properties, free radical mechanism of halogenations, Markownikoff's addition and peroxide effect; benzene, resonance and aromaticity, substitution reactions; Nature of C-X bond in haloalkanes and haloarenes; mechanism of substitution reactions.

m. ALCOHOLS, PHENOLS AND ETHERS

IUPAC nomenclature, general methods of preparation, physical and chemical properties, identification of primary, secondary and tertiary alcohols, mechanism of dehydration; electrophilic substitution reactions.

n. ALDEHYDES, KETONES, CARBOXYLIC ACIDS AND AMINES

Nomenclature, general methods of preparation, physical and chemical properties of the group members; nucleophilic addition and its mechanism; reactivity of alpha hydrogen in aldehydes; mono and dicarboxylic acids-preparation and reactions; identification of primary, secondary and tertiary amines; preparation and reactions of diazonium salts and their importance in synthesis.

o. POLYMERS AND BIOMOLECULES

Natural and synthetic polymers, methods of polymerization, copolymerization, molecular weight of polymers, Polymers of commercial importance, Carbohydrates: mono, oligo and polysaccharides; Proteins Alpha amino acid, peptide linkage and polypeptides: Enzymes, Vitamins and Nucleic acids (DNA and RNA)

p. ENVIRONMENTAL CHEMISTRY

Air, water and soil pollution, chemical reactions in atmosphere, acid rain; ozone and its depletion; green house effect and global warming; pollution control.

q. CHEMISTRY IN EVERYDAY LIFE

Drugs and their interaction; chemicals as analgesics, tranquilizers, antiseptics, antibiotics, antacids and antihistamines; Chemicals in food- preservatives, artificial sweetening agents; cleansing agents – soaps and detergents.