DETAILED SYLLABUS

(SI system of units to be used)

PHYSICS

Measurement and Units : Dimensions of a physical quantity, uses of dimensional analysis, Errors in measurement.

Dynamics of a Particle: Newton's laws, motion in one, two and three dimensions, relative motion, inertial frames, circular motion, spring force, gravitational force, law of gravitation, variation of gravity with altitude, escape velocity, satellite motion, work, kinetic and potential energies, conservation of energy, momentum and angular momentum, elastic collisions in one and two dimensions.

Dynamics of a System of Particles : Centre of mass, motion under external forces, rigid bodies, rotation of a rigid body about a fixed axis, torque, angular acceleration, angular momentum, moment of inertia, radius of gyration, kinetic energy of rotation, combined translational and rotational motions, parallel and perpendicular axes theorems, moment of inertia of a ring, disc, cylinder and sphere.

Simple Harmonic Motion: Basic equation, displacement, velocity and acceleration, graphical and mathematical representation, kinetic and potential energies, Lissajous figures, simple pendulum, compound pendulum as a rigid oscillating body. Mass-spring system, damped harmonic oscillations, forced oscillations and resonance.

Intermolecular Forces : Attractive and repulsive forces, three states of matter, ionic, covalent, Van der Waals and metallic bondings, surface tension, angle of contact, capillarity, pressure difference across a spherical film, determination of surface tension by capillary rise and Jaeger's methods, elasticity, Hooke's law, Young's modulus, shear and bulk moduli.

Kinetic Theory of Gases : Basic postulates, derivation of an expression for pressure exerted by an ideal gas, interpretation of temperature, equipartition of energy, specific heats of monoatomic and diatomic gases.

First Law of Thermodynamics : Dependence of work and heat on path, internal energy, isothermal, isobaric, isochoric and adiabatic processes, specific heats of an ideal gas, Mayer's relation.

Radiation: Black-body, Kirchhoff's law, Stefan's law, Newton's law of cooling, black-body spectrum, Wien's law.

Wave Motion: Progressive waves, superposition principle, beats, stationary waves, vibration of strings, air columns, resonance, Doppler's principle and its applications to sound and light waves.

Nature of Light : Light as wave motion, plane and spherical waves, Huygen's principle, reflection and refraction at a plane surface, electromagnetic nature of light waves, quantum nature of light, coherent sources; Fresnel's biprism, measurement of wavelength, Fresnel's half -period zones, rectilinear propagation of light, diffraction at a circular obstacle, aperture and a slit for plane waves.

Electrostatics : Conservation and quantization of charge, Coulomb's law, electric field, superposition principle, electric flux, Gauss's law and its applications in simple cases, electric potential and potential difference, electric field and potential due to a dipole, capacitance, capacitors in series and parallel, energy stored in a capacitor.

Electric Circuits: Kirchhoff's laws, Wheat-stone bridge and its applications, potentiometer and its applications.

Magnetic Field: Biot-Savart and Ampere's laws, magnetic field along the axis of a current carrying circular coil, inside a torroid, due to a straight wire, magnetic moment of a current loop, force on a moving charge and on a current carrying wire in a magnetic field, moving coil galvanometer, voltmeter, ammeter, electromagnetic induction, Faraday's and Lenz's laws, self and mutual inductances, transformer, energy stored in an inductor.

Alternating Current Circuits : Rotating coil in a magnetic field, ac, rms and peak values, phase relations between voltage and current in a resistor, inductor, capacitor and their series combinations, impedance and reactance (definitions only), instantaneous and average power in ac circuits, power factor, wattless current and choke coil. **Modern Physics:** Photons, photoelectric effect, Bohr's theory of hydrogen-like atoms, X-rays-production and properties, de Broglie hypothesis, Davisson and Germer experiment, Thomson's experiment, explanation of Bohr's orbits, uncertainty principle. radioactivity, nature of alpha, beta and gamma rays, laws of disintegration, half and mean lives, atomic nucleus, binding energy, nuclear energy by fission and fusion.

Electronics : Thermionic emission, work function, diode rectification and triode amplification, bands in solids (descriptive ideas only), conductors, semiconductors and insulators, intrinsic and extrinsic semiconductors, pn junction and its rectification properties.

CHEMISTRY

Development of Classical Model of an Atom: Bohr model of an atom, calculation of radius of the Bohr's orbit, quantisation of electronic energy levels, Spectral evidence for quantisation, introductory concept of four quantum numbers, Pauli's exclusion principle, Hund's rule, AufBau principle, concept of the spatial distributions of s and p orbitals. Isotopes.

The Periodic Law : Long form of the Periodic Table. Electronic configuration and the Periodic Table. Periodicity in properties, elementary ideas about ionisation potential, electron affinity, electronegativity and atomic radii. Position of hydrogen.

The Theory of Chemical Bonding : The ionic bond, characteristic properties of ionic compounds. The covalent bond. Introductory concept of overlapping of orbitals, σ and π bonds, Co-ordinate bond. Oxidation number. Characteristic properties of covalent compounds, hybridisation as illustrated by common molecules like NH_3, H_2O, CH_4, C_2H_4 and C_2H_2.

Chemical Equilibrium and Ionic Equillibria : Generalised expression of law of mass action and its applications. Arhenius theory, evidence in favour of dissociation theory, ionic product of water, hydrolysis, relation between hydrolysis constant, ionic product of water and dissociation constant, solubility product and its applications to analytical chemistry.

Chemical Kinetics : Order and Molecularity of reaction. Photochemical reactions. Expression for first and second order reactions.

Acids and Bases : Hydrogen and hydroxyl ions in aqueous solution, Lewis concept of acids, dissociation of acids, pH value, Buffer solution, Theory of indicators for acid- alkali titrations, choice of indicators for acid-alkali titrations.Oxidation-reduction, ion electron concept. Solid and liquid state of matter, Crystalline and amorphus solids, Four types of crystalline solids, crystal lattice and unit cell. Types of solutions, properties of solutions, osmosis and osmotic pressure, preparation and properties of colloidal solutions.

Metals: Nature of metallic state. The metallic bond. Occurrence of metals in nature. General principle of metallurgy as illustrated by methods used for the extraction of iron, copper, aluminium and silver from various types of ores.

Preparation and properties of heavy water, ozone and hydrogen peroxide.

s-Block Elements : General characteristics, Trends in variation of properties in periodic table of alkali and alkaline earth metals.

d-Block Elements : General characteristics, Elementary idea about paramagnetism and diamagnetism, different oxidation states of transition elements as illustrated by chromium, manganese and iron.

Classification of organic compounds, nomenclature, Homologous series. Functional groups; Isomerism (position, chain, functional, metamerism). Petroleum as the commercial source of hydrocarbon and organic chemicals, petroleum refining practice, octane number.

General methods of preparation, properties and uses of alkanes (upto five carbon atoms). Isomerism of butanes and pentanes. Substitution reaction (free radical mechanism). Alkenes : General method of preparation, properties and uses, Ethylene: Electrophillic addition (Mechanism). Markownikoff's rule, Peroxide effect.

Alkynes : General methods of preparation, properties and uses, Acetylene: Substitution reaction; Polymerisation.

General method of preparation, properties and uses of mono, di- and tri-halogen derivatives (excluding unsaturated) upto two carbon atoms, haloform reaction, synthetic uses of alkyl halides, polarity of carbon-halogen bond: Elementary concept of nucleophilic substitution. Freons preparation and uses. Grignard reagents and their synthetic applications.

General methods of preparation, properties and uses of alcohols with reference to methyl and ethyl alcohols; Absolute alcohol and power alcohol. Fermentation. General methods of preparation, properties and uses of ether with reference to diethyl ether.
General methods of preparation, properties and uses of aldehydes and ketones with reference to formaldehyde, acetaldehyde and acetone, Polymerization and condensation reaction (No mechanism).
General methods of preparation, properties and uses of monocarboxylic acids with reference to formic and acetic acids.
Derivatives of fatty acids; acetyl chloride, acetamide, acetic anhydride and ethyl acetate, Soaps and detergents.
General methods of preparation, properties and uses of aliphatic amines with reference to methyl and ethyl amines. Urea.
Preparation, properties and uses of Benzene (structure excluded), nitrobenzene, aniline and phenol, benzaldehyde, benzoic acid.
Polymers, Examples of natural and synthetic polymers and their importance. Preparation and uses of nylon, terylene and Buna-S.

MATHEMATICS

Algebra: Complex number as an ordered pair of real numbers; real and imaginary parts, absolute value, graphical representation of complex numbers, triangle inequality, complex conjugate co-ordinates, roots of a complex number.
Theory of quadratic equations and expressions; relation between roots and coefficients.
Arithmetic, geometric and harmonic progressions. Permutations and combinations. Elementary applications of mathematical induction. Binomial theorem. Determinants of order two and three and their elementary properties.
Matrices: definition, addition, subtraction and multiplication, transpose and adjoint of a matrix, inverse of a matrix.
Trigonometry: De Moivre's theorem and its applications; hyperbolic and inverse hyperbolic functions, separation of real and imaginary parts of a complex quantity.
Co-ordinate Geometry: Rectangular cartesian co- ordinates, distance between two points, area of a triangle. Straight lines, angle between two lines, parallel and perpendicular lines. Circle, equation of tangent and normal to a circle. Pole, polar, radical axis. Parametric representation. Parabola, tangent and normal, its properties.
Coordinate axes and planes in three-dimensional space, coordinates of point in space, distance between two points, section formula, direction cosines & direction ratios of a line joining two points, projection of the join of two points on a line, angle between two lines, whose direction ratios are given.
Calculus : Functions; into, onto and one-one function, polynomial, rational, trigonometric, logarithmic and exponential functions.
Notion of limit and continuity of a function, derivative of a function at a point; derivatives of sum, difference, product and quotient of functions, derivatives of composite functions, implicit functions and inverse trigonometrical, logarithmic and exponential functions. Logarithmic differentiations. Geometrical interpretation of derivative; successive differentiation, tangents and normals. Sign of the derivative and monotonicity. Maximum and minimum values of a function.
Integration as the inverse process of differentiation; integration by parts and by substitutions; definite integral and its application for the determination of areas (simple cases), properties of definite integrals.
Vectors: Addition of vectors, multiplication by a scalar; scalar product, cross product and scalar triple product with geometrical applications.
Probability: Probability; sum and product laws; conditional probability.

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