HPCET Syllabus For Syllabus for B. Tech. and B. Pharmacy

APPENDIX-A

HPCET-2025 Syllabus for B. Tech. and B. Pharmacy

PHYSICS

The syllabus contains two Sections – A and B. Section A pertains to the theory part having 80% weightage, while Section B contains the practical component (experimental skills), having 20% Weightage.

Unit 1: Physics and Measurement

Physics, technology, and society, S I Units, fundamental and derived units, least count, accuracy and precision of measuring instruments, Errors in measurement, Dimensions of Physics quantities, dimensional analysis, and its applications.

Unit 2: Kinematics

The frame of reference, motion in a straight line, Position- time graph, speed and velocity; Uniform and non-uniform motion, average speed and instantaneous velocity, uniformly accelerated motion, velocity-time, position-time graph, relations for uniformly accelerated motion, Scalars and Vectors, Vector. Addition and subtraction, zero vector, scalar and vector products, Unit Vector, Resolution of a Vector. Relative Velocity, Motion in a plane, Projectile Motion, Uniform Circular Motion.

Unit 3: Laws of Motion

Force and inertia, Newton's First law of motion; Momentum, Newton's Second Law of motion, Impulses; Newton's Third Law of motion. Law of conservation of linear momentum and its applications. Equilibrium of concurrent forces. Static and Kinetic friction, laws of friction, rolling friction. Dynamics of uniform circular motion: centripetal force and its applications.

Unit 4: Work, Energy and Power

Work done by a content force and a variable force; Kinetic and potential energies, Work-energy theorem, Power. The potential energy of spring conservation of mechanical energy, conservative and neoconservative forces; Elastic and inelastic collisions in one and two dimensions.

Unit 5: Rotational Motion

Centre of the mass of a two-particle system, Centre of the mass of a rigid body; Basic concepts of rotational motion; A moment of a force; Torque, Angular momentum, Conservation of angular momentumanditsapplications;Themomentofinertia,Theradiusofgyration. Values of moments of inertia for simple geometrical objects, Parallel and perpendicular axes theorems and their applications. Rigid body rotation equations of rotational motion.

Unit 6: Gravitation

The universal law of gravitation. Acceleration due to gravity and its variation with altitude and depth. Kepler's law of planetary motion. Gravitational potential energy; gravitational potential. Escape velocity, Orbital velocity of a satellite. Geo stationary satellites.

Unit 7: Properties of Solids and Liquids

Elastic behaviour, Stress-strain relationship, Hooke's Law. Young's modulus, bulk modulus, modulus of rigidity. Pressure due to a fluid column; Pascal's law and its applications. Viscosity. Stokes' law.

Terminal velocity, streamline and turbulent flow. Reynolds number. Bernoulli's principle and its applications. Surface energy and surface tension, angle of contact, application of surface tension – drops, bubbles and capillary rise. Heat, temperature, thermal expansion; Specific heat capacity, calorimetry; Change of state, latent heat. Heat transfer-conduction, convection and radiation. Newton's law of cooling.

Unit 8: Thermodynamics

Thermal equilibrium, Zeroth law of thermodynamics, The concept of temperature. Heat, work and internal energy. The first law of thermodynamics. The second law of thermodynamics: reversible and irreversible processes. Carnot engine and its efficiency.

Unit 9: Kinetic Theory of Gases

Equation of state of a perfect gas, work done on compressing a gas, Kinetic theory of gases – assumptions, the concept of pressure. Kinetic energy and temperature: RMS speed of gas molecules: Degrees of freedom. Law of equipartition of energy, Applications to specific heat capacities of gases; Mean free path. Avogadro's number.

Unit 10: Oscillations and Waves

Periodic motion – period, frequency, displacement as a function of time. Periodic functions. Simple harmonic motion (S.H.M.) and its equation; Phase: oscillations of a spring -restoring force and force constant: energy in S.H.M. – Kinetic and potential energies; Simple pendulum – derivation of expression for its time period: Free, forced and damped oscillations, resonance.

Wave motion. Longitudinal and transverse waves, speed of a wave. Displacement relation for a progressive wave. Principle of superposition of waves, a reflection of waves. Standing waves in strings and organ pipes, Fundamental mode and harmonics. Beats. Doppler Effect in sound.

Unit 11: Electrostatics

Electric charges: Conservation of charge. Coulomb's law-forces between two point charges, Forces between multiple charges: superposition principle and continuous charge distribution.

Electric field: Electric field due to a point charge, Electric field lines. Electric dipole, Electric field due to a dipole. Torque on a dipole in a uniform electric field.

Electric flux. Gauss's law and its applications to find field due to infinitely long uniformly charged straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell. Electric potential and its calculation for a point charge, electric dipole and system of charges; Equipotential surfaces, Electrical potential energy of a system of two point charges in an electrostatic field.

Conductors and insulators. Dielectrics and electric polarization, Capacitor, The combination of capacitors in series and parallel, Capacitance of a parallel plate capacitor with and without dielectric medium between the plates. Energy stored in a capacitor.

Unit 12: Current Electricity

Electric current. Drift velocity. Ohm's law. Electrical resistance. Resistances of different materials. V-I characteristics of Ohmic and non-ohmic conductors. Electrical energy and power. Electrical resistivity. Colour code for resistors; Series and parallel combinations of resistors; Temperature dependence of resistance.

Electric cell and its Internal resistance, Potential difference and emf of a cell, A combination of cells in series and parallel. Kirchhoff's laws and their applications. Wheatstone bridge. Metre Bridge. Potentiometer – principle and its applications.

Unit 13: Magnetic Effects of Current and Magnetism

Biot–Savart law and its application to current carrying circular loop. Ampere's law and its applications to infinitely long current carrying straight wire and solenoid. Force on a moving charge in uniform magnetic and electric fields. Cyclotron.

Force on a current-carrying conductor in a uniform magnetic field. The force between two parallel current carrying conductors- definition of ampere. Torque experienced by a current loop in a uniform magnetic field: Moving coil galvanometer, its current sensitivity and conversion to ammeter and voltmeter.

Current loop as a magnetic dipole and its magnetic dipole moment. Bar magnet as an equivalent solenoid, Magnetic field lines; Earth's magnetic field and magnetic elements. Para-, dia- and ferromagnetic substances. Magnetic susceptibility and permeability. Hysteresis. Electromagnets and permanent magnets.

Unit 14: Electromagnetic Induction and Alternating Currents

Electromagnetic induction: Faraday's law. Induced emf and current: Lenz's Law, Eddy currents. Self and mutual inductance. Alternating currents, peak and RMS value of alternating current/voltage: Reactance and impedance: LCR series circuit, resonance: Quality factor, power in AC circuits, wattless current. AC generator and transformer.

Unit 15: Electromagnetic Waves

Electromagnetic waves and their characteristics, Transverse nature of electromagnetic waves, Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet. X-rays. Gamma rays), Applications of e. m. waves.

Unit 16: Optics

Reflection and refraction of light at plane and spherical surfaces, mirror formula. Total internal reflection and its applications. Deviation and dispersion of light by a; prism; Lens formula. Magnification. Power of a lens. Combination of thin lenses in contact. Microscope and astronomical telescope (reflecting and refracting) and their magnifying powers.

Unit 17: Dual Nature of Matter and Radiation

Photoelectric effect, Hertz and Lenard's observations; Einstein's photoelectric equation- particle nature of light. Matter waves- wave nature of particles, de Broglie relation. Davisson-Germer experiment (experimental details should be omitted; only conclusion should be explained).

UNIT 18: Atoms and Nuclei

Alpha- particle scattering experiments; Rutherford's model of atom; Bohr model, energy levels, hydrogen spectrum. Composition and size of nucleus, atomic masses, isotopes, isobars; isotones. Radioactivity- alpha, beta and gamma particles/ rays and their properties decay law. Mass-energy relation, mass defect; binding energy per nucleon and its variation with mass number, nuclear fission and fusion.

UNIT 19: Electronic Devices

Energy bands in solids (qualitative ideas only), conductors, insulators and semiconductors; semiconductor diode- I-V characteristics in forward and reverse bias, diode as a rectifier; I-V characteristics of LED, photodiode, solar cell, and Zener diode; Zener diode as a voltage regulator. Junction transistor, transistor action, characteristics of a transistor; transistor as an amplifier (common emitter configuration) and oscillator. Logic gates(OR,AND,NOT,NAND and NOR). Transistor as a switch.

UNIT 20: Communication Systems

Propagation of electromagnetic waves in the atmosphere: Sky and space wave propagation, Need for modulation. Amplitude and Frequency Transmission medium, Basic Elements of a Communication System (Block Diagram only).

UNIT 21: Experimental Skill

1. Vernier calliper, its use to measure external and internal diameter and depth of a given vessel.
2. Screw gauge and its use to determine the diameter/thickness of thin sheet/wire.
3. Simple Pendulum-All the dissipation of energy by plotting a graph between square of amplitude versus time.
4. Metre Scale: Calculate the mass of the given object by principle of moments.
5. Young's modulus of elasticity of the material used in the metallic wire.
6. The surface tension of water by using capillary rise and effect of detergents on it.
7. Calculation of Coefficient of the viscosity of a given viscous liquid by measuring the terminal velocity of a spherical body.
8. Plotting a cooling curve between the temperatures of a hot body versus time.
9. Calculate the speed of sound in air at room temperature using a resonance tube.
10. Specific heat capacity of a given (i) solid and (ii) liquid by method of mixtures.
11. Find the resistivity of the material of a given wire using metre bridge.
12. Calculate the resistance of a given wire using Ohm's law.
13. Potentiometer-
    a) Comparison between emf of two primary cells.
    b) Determination of the internal resistance of the given cell.
14. Calculate the resistance and figure of merit of a galvanometer by half deflection method,
15. The focal length of the optical equipment by using the parallax method:
    a) Convex mirror
    b) Concave mirror, and
    c) Convex lens
16. Plot the graph between angle of deviation vs angle of incidence for a given triangular prism.
17. Calculate the refractive index of a glass slab using a traveling microscope.
18. Characteristic curves of a p-n junction diode in reverse and forward bias.
19. Characteristic curves of Zener diode and finding reverse break-down voltage.
20. Characteristic curves of the transistor and finding current gain and voltage gain.
21. Identification of Diodes, Transistor, LED, IC, Capacitor, Resistor from mixed collection of such items.
22. Using a millimeter to:
    (i) Identify the base of a transistor.
    (ii) Distinguish between n-p-n and p-n-p type transistor
    (iii) See the unidirectional flow of current in case of a LED and a Diode.
    (iv) Check the correctness or otherwise of a given electronic component (Transistor, Diode or IC)

CHEMISTRY

Section-A: Physical Chemistry

Unit 1 Some Basic Concepts of Chemistry:

- Matter and its nature, Dalton's atomic theory, the concept of the atom, molecule, element, and compound.
- Physical quantities and their measurements in Chemistry, precision, and accuracy, significant figures, S.I. Units, dimensional analysis.
- Laws of chemical combination.
- Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae.
- Chemical equations and stoichiometry.

Unit 2 States of Matter:

- Classification of matter into solid, liquid and gaseous states.
- Gaseous State: Measurable properties of gases; Gas laws–Boyle's law, Charles's law, Graham's law of diffusion, Avogadro's law, Dalton's law of partial pressure.
- The concept of the absolute scale of temperature; Ideal gas equation, kinetic theory of gases (only postulates).
- The concept of average, root mean square and most probable velocities.
- Real gases, deviation from Ideal behaviour, compressibility factor, van der Waals equation, liquefaction of gases, critical constants.
- Liquid State: Properties of liquids –vapour pressure, viscosity and surface tension and effect of temperature on them (qualitative treatment only).
- Solid State: Classification of solids-molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea).
- Bragg's Law and its applications.
- Unit cell and lattices, packing in solids (fcc, bcc and hcp lattices), voids, calculations involving unit cell parameters, imperfections in solids.
- Electrical, magnetic and dielectric properties.

Unit 3 Atomic Structure:

- Thomson and Rutherford atomic models and their limitations.
- Nature of electromagnetic radiation, photoelectric effect.
- The spectrum of the hydrogen atom, Bohr model of hydrogen atom – its postulates, derivation of the relations for the energy of the electron and radii of the different orbits, limitations of Bohr's model.
- Dual nature of matter,de-Broglie relationship, Heisenberg uncertainty principle.
- Elementary ideas of quantum mechanics, the quantum mechanical model of an atom, its important features, the concept of atomic orbitals as one-electron wave functions.
- Variation of $\Psi 1$ and $\Psi 2$ with r for1s and 2s orbitals; various quantum numbers (principal, Angular momentum, and magnetic quantum numbers),and their significance.
- Shapes of s,p and d–orbitals, electron spin and spin quantum number.
- Rules for filling electrons in orbitals – Aufbau principle, Pauli exclusion principle and Hund's rule, electronic configuration of elements, the extra stability of half-filled and completely filled orbitals.

Unit 4 Chemical Bonding and Molecular Structure:

- Kossel– Lewis approach to chemical bond formation, the concept of ionic and covalent bonds.
- Ionic Bonding: Formation of ionic bonds, factors affecting the formation of ionic bonds; calculation of lattice enthalpy.
- Covalent Bonding: Concept of electronegativity, Fajan's rule, dipole moment; Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple molecules.
- Quantum mechanical approach to covalent bonding: Valence bond theory, Its important features, the concept of hybridization involving s, p, and d orbitals; Resonance.
- Molecular Orbital Theory: Its important features, LCAOs, types of molecular orbitals (bonding, anti bonding), sigma and pi-bonds, molecular orbital electronic configurations of homonuclear diatomic molecules, the concept of bond order, bond length and bond energy.
- Elementary idea of metallic bonding, Hydrogen bonding, and its applications.

Unit 5 Chemical Thermodynamics:

- Fundamentals of thermodynamics: System and surroundings, extensive and intensive properties, state functions, types of processes.
- First law of thermodynamics: Concept of work, heat internal energy, and enthalpy, heat capacity, molar heat capacity
- Hess's law of constant heat summation.
- Enthalpies of bond dissociation, combustion, formation, atomization, sublimation, phase transition, hydration, ionization, and solution.
- The second law of thermodynamics: Spontaneity of processes; Delta S of the universe and Delta G of the system as criteria for spontaneity, Delta G^o (Standard Gibbs energy change) and equilibrium constant.

Unit 6 Solutions:

- Different methods for expressing the concentration of a solution: molality, molarity, mole fraction, percentage (by volume and mass both), the vapour pressure of solutions and Raoult's Law.
- Ideal and non-ideal solutions, vapour pressure – composition, plots for ideal and non-ideal solutions.
- Colligative properties of dilute solutions, relative lowering of vapour pressure, depression of freezing point, elevation of boiling point and osmotic pressure.
- Determination of molecular mass using colligative properties.
- Abnormal value of molar mass, Hoff factor, and its significance.

Unit 7 Equilibrium:

- Meaning of equilibrium, the concept of dynamic equilibrium.
- Equilibria involving physical processes: Solid-liquid, liquid – gas and solid-gas equilibria, Henry's law, a general characteristic of equilibrium involving physical processes.
- Equilibria involving chemical processes: Law of chemical equilibrium, equilibrium constants (Kp and Kc) and their significance, the significance of Delta G and Delta Go in chemical equilibria, factors affecting equilibrium concentration, pressure, temperature, the effect of the catalyst.
- Le Chatelier's principle.
- **Ionic equilibrium:** Weak and strong electrolytes, ionization of electrolytes, various concepts

of acids and bases (Arrhenius, Bronsted-Lowry and Lewis) and their ionization, acid-base equilibria (including multistage ionization) and ionization constants, ionization of water, pH scale, common ion effect, hydrolysis of salts and pH of their solutions, solubility of sparingly soluble salts and solubility products, buffer solutions.

Unit 8 Redox Reactions and Electrochemistry:

- Electronic concepts of oxidation and reduction, redox reactions, oxidation number, rules for assigning oxidation number, balancing of redox reactions.
- Electrolytic and metallic conduction, conductance in electrolytic solutions, specific and molar conductivities and their variation with concentration.
- Kohlrausch's law and its applications.
- Electrochemical cells: Electrolytic and Galvanic cells, different types of electrodes, electrode potentials including standard electrode potential, half-cell and cell reactions, emf of a Galvanic cell and its measurement.
- Nernst equation and its applications; Relationship between cell potential and Gibbs' energy change.
- Dry cell and lead accumulator, fuel cells.

Unit 9 Chemical Kinetics:

- The rate of a chemical reaction, factors affecting the rate of reactions: concentration, temperature, pressure, and catalyst.
- Elementary and complex reactions, order and molecularity of reactions, rate law, rate constant and its units, differential and integral forms of zero and first-order reactions, their characteristics and half-lives, the effect of temperature on the rate of reactions.
- Arrhenius theory, activation energy and its calculation, collision theory of bimolecular gaseous reactions (no derivation).

Unit 10 Surface Chemistry:

- **Adsorption:** Physisorption and chemisorption and their characteristics, factors affecting the adsorption of gases on solids: Freundlich and Langmuir adsorption isotherms, adsorption from solutions.
- **Catalysis:** Homogeneous and heterogeneous, activity and selectivity of solid catalysts, enzyme catalysis, and its mechanism.
- **Colloidal state:** Distinction among true solutions, colloids, and suspensions, classification of colloids: lyophilic, lyophobic.
- Multimolecular, macromolecular and associated colloids (micelles), preparation and properties of colloids: Tyndall effect, Brownian movement, electrophoresis, dialysis, coagulation, and flocculation.
- Emulsions and their characteristics.

Section-B: Organic Chemistry

Unit 11 Classification of Elements and Periodicity in Properties:

- Modern periodic law and present form of the periodic table.
- s, p, d and f block elements.
- Periodic trends in properties of elements atomic and ionic radii, ionization enthalpy.
- Electron gain enthalpy, valence, oxidation states and chemical reactivity.

Unit 12 General Principles and Process of Isolation of Metals:

- Modes of occurrence of elements in nature, minerals, ores.
- Steps involved in the extraction of metals: concentration, reduction (chemical and electrolytic methods) and refining with special reference to the extraction of Al, Cu, Zn, and Fe.
- Thermodynamic and electrochemical principles involved in the extraction of metals.

Unit 13 Hydrogen:

- The position of hydrogen in periodic table, isotopes, preparation, properties, and uses of hydrogen.
- Physical and chemical properties of water and heavy water.
- Structure, preparation, reactions, and uses of hydrogen peroxide.
- Classification of hydrides :ionic ,covalent and interstitial.
- Hydrogen as a fuel.

Unit 14 S Block Elements (Alkali and Alkaline Earth Metals):

- **Group 1 and Group 2 Elements:** General introduction, electronic configuration and general trends in physical and chemical properties of elements, anomalous properties of the first element of each group, diagonal relationships.
- **Preparation and properties of some important compounds: S**odium carbonate, sodium chloride, sodium hydroxide and sodium hydrogen carbonate.
- Industrial uses of lime, limestone, Plaster of Paris and cement.
- The biological significance of Na, K, Mg and Ca.

Unit 15 P Block Elements:

- **Group 13 to Group 18 Elements:** General introduction, electronic configuration, and general trends in physical and chemical properties of elements across the periods and down the groups; unique behaviour of the first element in each group. Groupwise study of the p block elements.
- **Group 13:** Preparation, properties, and uses of boron and aluminium; Structure, properties and uses of borax, boric acid, diborane, boron trifluoride, aluminium chloride, and alums.
- **Group 14:** Tendency for catenation; Structure, properties, and uses of allotropes and oxides of carbon, silicon tetrachloride, silicates, zeolites, and silicones.
- **Group 15:** Properties and uses of nitrogen and phosphorus; Allotropic forms of phosphorus; Preparation, properties, structure, and uses of ammonia, nitric acid, phosphine and phosphorus halides, (PCl_3, PCl_5); Structures of oxides and oxoacids of nitrogen and phosphorus.
- **Group 16:** Preparation, properties, structures and uses of dioxygen and ozone; Allotropicformsofsulphur;Preparation,properties,structures,andusesofsulphurdioxide,sulphuricacid (including its industrial preparation); Structures of oxoacids of sulphur.
- **Group 17:** Preparation, properties, and uses of chlorine and hydrochloric acid; Trends in the acidic nature of hydrogen halides; Structures of Interhalogen compounds and oxides and oxyacids of halogens.
- **Group 18:** Occurrence and uses of noble gases; Structures of fluorides and oxides of xenon.

Unit 16 D and F Block Elements:

- **Transition Elements:** General introduction, electronic configuration, occurrence and characteristics, general trends in properties of the first-row transition elements: physical properties, ionization enthalpy, oxidation states, atomic radii, colour, catalytic behaviour, magnetic properties, complex formation, interstitial compounds, alloy formation.

- Preparation, properties, and uses of $K_2Cr_2O_7$ and $KMnO_4$.
- **Inner Transition Elements:** Lanthanides, Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction, and Actinoids: Electronic configuration and oxidation states

Unit 17 Coordination Compounds:

- Introduction to coordination compounds, Werner's theory.
- ligands, coordination number, denticity, chelation.
- IUPAC nomenclature of mononuclear coordination compounds, isomerism.
- Bonding-Valence bond approach and basic ideas of Crystal field theory, colour and magnetic properties.
- Importance of coordination compounds (in qualitative analysis, extraction of metals and in biological systems).

Unit 18 Environmental Chemistry:

- **Environmental pollution:** Atmospheric, water, and soil.
- **Atmospheric pollution:** Tropospheric and stratospheric.
- **Gaseous pollutants:** Oxides of carbon, nitrogen, and sulphur, hydrocarbons; their sources, harmful effects, and prevention.
- Greenhouse effect and Global warming, acid rain.
- **Particulate pollutants:** Smoke, dust, smog, fumes, mist; their sources, harmful effects, and prevention.
- **Stratospheric pollution:** Formation and breakdown of ozone, depletion of ozone layer its mechanism and effects.
- **Water Pollution:** Major pollutants such as pathogens, organic wastes, and chemical pollutants; their harmful effects and prevention.
- **Soil pollution:** Major pollutants such as pesticides (insecticides, herbicides and fungicides) their harmful effects and prevention.
- Strategies to control environmental pollution.

Section-C: Organic Chemistry

Unit 19: Purification and Characterisation of Organic Compounds

- **Purification:** Crystallization, sublimation, distillation, differential extraction, and chromatography principles and their applications.
- **Qualitative analysis:** Detection of nitrogen, sulphur, phosphorus, and halogens.
- Quantitative analysis (basic principles only): Estimation of carbon, hydrogen, nitrogen, halogens, sulphur, phosphorus.
- Calculations of empirical formula and molecular formulae; Numerical problems in organic quantitative analysis.

Unit 20: Some Basic Principles of Organic Chemistry

- Tetravalency of carbon; Shapes of simple molecules–hybridization (s and p).
- Classification of organic compounds based on functional groups: -C= C-and those containing halogens, oxygen, nitrogen, and sulphur; Homologous series.
- **Isomerism:** structural and stereoisomerism.
- Nomenclature (Trivial and IUPAC): Covalent bond fission Homolytic and heterolytic: free

radicals, carbocations, and carbanions; stability of carbocations and free radicals, electrophiles and nucleophiles.

- Electronic displacement in a covalent bond: Inductive effect, electromeric effect, resonance, and hyperconjugation.
- Common types of organic reactions: Substitution, addition, elimination, and rearrangement.

Unit 21: Hydrocarbons

- Classification, isomerism, IUPAC nomenclature, general methods of preparation, properties and reactions.
- **Alkanes:** Conformations; Sawhorse and Newman projections (of ethane); Mechanism of halogenation of alkanes.
- **Alkenes:** Geometrical isomerism.
- Mechanism of electrophilic addition: addition of hydrogen, halogens, water, hydrogen halides (Markownikoff's and peroxide effect); Ozonolysis, oxidation, and polymerization.
- **Alkynes:** Acidic character; Addition of hydrogen, halogens, water and hydrogenhalides; Polymerization.
- **Aromatic hydrocarbons:** Nomenclature, benzene structure and aromaticity.
- Mechanism of electrophilic substitution: halogenation, nitration, Friedel-Crafts alkylation and acylation, directive influence of the functional group in monosubstituted benzene.

Unit 22: Organic Compounds Containing Halogens

- General methods of preparation, properties, and reactions.
- Nature of C-X bond.
- Mechanisms of substitution reactions.
- Uses, Environmental effects of chloroform, iodoform, freons, and DDT.

Unit 23: Organic Compounds Containing Oxygen

- General methods of preparation, properties, reactions and uses.
- **Alcohols :** Identification of primary, secondary and tertiary alcohols; mechanism of dehydration.
- **Phenols:** Acidic nature, electrophilic substitution reactions: halogenation, nitration, and sulphonation, Reimer Tiemann reaction.
- **Ethers:** Structure.
- **Aldehyde and Ketones:** Nature of carbonyl group; Nucleophilic addition to >C=O group, relative reactivities of aldehydes and ketones.
- Important reactions such as nucleophilic addition reactions (addition of HCN, NH3 and its derivatives), Grignard reagent; oxidation; reduction (Wolff Kishner and Clemmensen); the acidity of hydrogen, aldol condensation, Cannizzaro reaction, Haloform reaction.
- Chemical tests to distinguish between aldehydesand ketones.
- **Carboxylic Acids:** Acidic strength and factors affecting it.

Unit 24: Organic Compounds Containing Nitrogen

- General methods of preparation, properties, reactions, and uses.
- **Amines:** Nomenclature, classification, structure, basic character and identification of primary, secondary and tertiary amines and their basic character.

- **Diazonium Salts:** Importance in synthetic organic chemistry.

Unit 25: Polymers

- General introduction and classification of polymers, general methods of polymerization addition and condensation, co-polymerization.
- Natural and synthetic rubber and vulcanization.
- Some important polymers with emphasis on their monomers and uses, polyethene, nylon, polyester, and bakelite.

Unit 26: Biomolecules

- General introduction and importance of biomolecules.
- **Carbohydrates:** Classification: aldoses and ketoses; monosaccharides (glucose and fructose), constituent monosaccharides or oligosaccharides (sucrose, lactose, maltose) and polysaccharides (starch, cellulose, glycogen).
- **Proteins:** Elementary Idea of amino acids, peptide bond, polypeptides; Proteins: primary, secondary, tertiary and quaternary structure (qualitative idea only), denaturation of proteins, enzymes.
- **Vitamins:** Classification and functions.
- Nucleic Acids – Chemical constitution of DNA and RNA. Biological functions of nucleic acids.

Unit 27: Chemistry in Everyday Life

- **Chemicals in medicines:** Analgesics, tranquillizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines their meaning and common examples.
- **Chemicals in food:** Preservatives, artificial sweetening agents–common examples.
- **Cleansing agents:** Soaps and detergents, cleansing action.

Unit 28: Principles Related to Practical Chemistry

- Detection of extra elements (Nitrogen, Sulphur, halogens) inorganic compounds.
- **Detection of the following functional groups:** hydroxyl (alcoholic and phenolic), carbonyl (aldehyde and ketone), carboxyl and amino groups in organic compounds.
- **The chemistry involved in the preparation of the following:** Inorganic compounds: Mohr's salt, potash alum, and organic compounds: Acetanilide, p-nitro acetanilide, aniline yellow, iodoform.
- **The chemistry involved in the titrimetric exercises:** Acids bases and the use of indicators, oxalic-acid vs KMnO4, Mohr's salt vs $KMnO_4$.
- **Chemical principles involved in the qualitative salt analysis:** Cations: Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{3+}, Zn^{2+}, Ni^{2+}, Ca^{2+}, Ba^{2+}, Mg^{2+}, NH_4^+, and Anions: CO_3^{2-}, S^{2-}, $SO^{2-}{}_4$ NO^{2-}, NO_3^-, CI^-, Br^-, I^-(Insoluble salt sexcluded).
- **Chemical principles involved in the following experiments:** Enthalpy of solution of CuSO4, Enthalpy of neutralisation of strong acid and strong base, Preparation of lyophilic and lyophobic sols, and Kinetic study of the reaction of iodide ion with hydrogen peroxide at room temperature.

MATHEMATICS

1. **Sets, Relations and Functions:**

   Sets and their representation; Union, intersection and complement of sets and their algebraic properties; Power set; Relation, Types of relations, equivalence relations, functions; one-one, into and onto functions, composition of functions,

2. **Complex Numbers and Quadratic Equations:**

   Complex numbers as ordered pairs of reals, Representation of complex numbers in the form a+b and their representation in aplane, Argand diagram, algebra of complex numbers, modulus and argument (or amplitude) of a complex number, square root of a complex number, triangle inequality, 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.

3. **Matrices and Determinants:**

   Matrices, algebra of matrices, types of matrices, determinants and matrices of order two and three. Properties of determinants, evaluation of determinants, area of triangles using determinants. Adjoint and evaluation of inverse of a square matrix using determinants and elementary transformations, Test of consistency and solution of simultaneous linear equations in two or three variables using determinants and matrices.

4. **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.

5. **Mathematical Induction:**

   Principle of Mathematical Induction and its simple applications.

6. **Binomial Theorem and its Simple Applications:**

   Binomial theorem for a positive integral index, general term and middle term, properties of Binomial coefficients and simple applications.

7. **Sequences and Series:**

   Arithmetic and Geometric progressions, insertion of arithmetic, geometric means between two given numbers. Relation between A.M. and G.M. Sum upto n terms of special series: S n, S n2, Sn3. Arithmetico-Geometric progression.

8. **Limit, Continuity and Differentiability:**

   Real - valued functions, algebra of functions, polynomials, rational, trigonometric, logarithmic and exponential functions, inverse functions. Graphs of simple functions. Limits, continuityand differentiability. 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 up to two. Rolle's and Lagrange's Mean Value Theorems. Applications of derivatives: Rate of change of quantities, monotonic - increasing and decreasing functions, Maxima and minima of functions of one variable, tangents, and normals.

9. **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 limit of a sum. Fundamental Theorem of Calculus. Properties of definite integrals. Evaluation of definite integrals, determining areas of the regions bounded by simple curves in standard form.

10 **Differential Equations:**

Ordinary differential equations, their order and degree. Formation of differential equations. Solution of differential equations by the method of separation of variables, solution of homogeneous and linear differential equations.

11 **Co-ordinate Geometry:**

Cartesian system of rectangular co-ordinates 10 in a plane, distance formula, section formula, locus and its equation, translation of axes, slope of a line, parallel and perpendicular lines, intercepts of a line on the coordinate axes.

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, coordinates of centroid, orthocentre and circumcentre of a triangle, equation of family of lines passing through the point of intersection of two lines.

Circles, conic sections

Standard form of equation of a circle, general form of the equation of a circle, its radius and centre, equation of a circle when the end points of a diameter are given, points of intersection of a line and a circle with the centre at the origin and condition for a line to be tangent to a circle, equation of the tangent. Sections of cones, equations of conic sections (parabola, ellipse and hyperbola) in standard forms, condition for $y = mx + c$ to be a tangent and point (s) of tangency.

12 **Three Dimensional Geometry:**

Coordinates of a point in space, distance between two points, section formula, direction ratios and direction cosines, angle between two intersecting lines. Skew lines, the shortest distance between them and its equation. Equations of a line and a plane in different forms, inter section of a line and a plane, coplanar lines.

13 **Vector Algebra:**

Vectors and scalars, addition of vectors, components of a vector in two dimensions and three-dimensional space, scalar and vector products, scalar and vector triple product.

14 **Statistics and Probability:**

Measures of Dispersion: Calculation of mean, median, mode of grouped and ungrouped data calculation of standard deviation, variance and mean deviation for grouped and ungrouped data. Probability: Probability of an event, addition and multiplication theorems of probability, Baye's theorem, probability distribution of a random variate, Bernoulli trials and Binomial distribution.

15 **Trigonometry:**

Trigonometrical identities and equations. Trigonometrical functions. Inverse trigonometrical functions and their properties. Heights and Distances.

16 **Mathematical Reasoning:**

Statements, logical operations and/or implies, implied by, if and only if. Understanding of tautology, contradiction, converse and contrapositive.

BIOLOGY

CONTENTS OF CLASS XI SYLLABUS

UNIT I: DIVERSITY IN LIVING WORLD:

What is living?; Biodiversity; Need for classification; Three domains of life; Taxonomy & Systematics; Concept of species and taxonomical hierarchy; Binomial nomenclature; Tools for study of Taxonomy – Museums, Zoos, Herbaria, Botanical gardens.

Five kingdom classification; salient features and classification of Monera; Protista and Fungi into major groups; Lichens; Viruses and Viroids.

Salient features and classification of plants into major groups-Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms (three to five salient and distinguishing features and at least two examples of each category); Angiosperms- classification up to class, characteristic features and examples).

Salient features and classification of animals- nonchordate up to phyla level and chordate up to classes level (three to five salient features and at least two examples).

UNIT II: STRUCTURAL ORGANISATION IN ANIMALS AND PLANTS:

Morphology and modifications; Tissues; Anatomy and functions of different parts of flowering plants: Root, stem, leaf, inflorescence- cymose and racemose, flower, fruit and seed (To be dealt along with the relevant practical of the Practical Syllabus).

Animal tissues; Morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of an insect (cockroach). (Brief account only)

UNIT III: CELL STRUCTURE AND FUNCTION:

Cell theory and cell as the basic unit of life; Structure of prokaryotic and eukaryotic cell; Plant cell and animal cell; Cell envelope, cell membrane, cell wall; Cell organelles-structure and function; Endomembrane system-endoplasmic reticulum, Golgi bodies, lysosomes, vacuoles; mitochondria, ribosomes, plastids, micro bodies; Cytoskeleton, cilia, flagella, centrioles (ultra structure and function); Nucleus-nuclear membrane, chromatin, nucleolus.

Chemical constituents of living cells: Biomolecules- structure and function of proteins, carbodydrates, lipids, nucleic acids; Enzymes-types, properties, enzyme action.

B Cell division: Cell cycle, mitosis meiosis and their significance.

UNIT IV: PLANT PHYSIOLOGY:

Transport in plants: Movement of water, gases and nutrients; Cell to cell transport-Diffusion, facilitated diffusion, active transport; Plant–water relations–Imbibition, waterpotential, osmosis, plasmolysis; Long distance transport of water – Absorption, apoplast, symplast, transpiration pull, root pressure and guttation; Transpiration-Opening and closing of stomata; Uptake and translocation Of mineral nutrients-Transport of food, phloem transport, Mass flow hypothesis; Diffusion of gases (brief mention).

Mineral nutrition: Essential minerals, macro and micronutrients and their role; Deficiency symptoms; Mineral toxicity; Elementary idea of Hydroponics as a method to study mineral nutrition;

Nitrogen metabolism-Nitrogen cycle, bio logical nitrogen fixation.

Photosynthesis: Photosynthesis as a means of Autotrophic nutrition; Site of photosynthesis take place; pigments involved in Photosynthesis (Elementary idea); Photochemical and biosynthetic phases of photosynthesis; Cyclic and non cyclic and photophosphorylation; Chemiosmotic hypothesis; Photorespiration C3 and C4 pathways; Factors affecting photosynthesis.

Respiration: Exchange gases; Cellular respiration- glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); Energy relations- Number of ATP molecules generated; Amphibolic pathways; Respiratory quotient.

Plant growth and development: Seed germination; Phases of Plant growth and plant growth rate; Conditions of growth; Differentiation, dedifferentiation and re differentiation; Sequence of developmentalprocessinaplantcell;Growthregulators-auxin,gibberellin,cytokinin,ethylene, ABA; Seed dormancy; Vernalisation; Photoperiodism.

UNIT V: HUMAN PHYSIOLOGY:

Digestion and absorption; Alimentary canal and digestive glands; Role of digestive enzymes and gastrointestinal hormones; Peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats; Caloric value of proteins, carbohydrates and fats; Egestion; Nutritional and digestive disorders – PEM, indigestion, constipation, vomiting, jaundice, diarrhea.

Breathing and Respiration: Respiratory organs in animals (recall only); Respiratory system in humans; Mechanism of breathing and its regulation in humans-Exchange of gases, transport of gases and regulation of respiration Respiratory volumes; Disorders related to respiration-Asthma, Emphysema, Occupational respiratory disorders.

Body fluids and circulation: 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.

Excretory products and their elimination: Modes of excretion- Ammonotelism, ureotelism, uricotelism; Human excretory system-structure and fuction; Urine formation, Osmoregulation; Regulationofkidneyfunction-Renin-angiotensin,AtrialNatriureticFactor,ADHandDiabetes insipidus; Role of other organs in excretion; Disorders; Uraemia, Renal failure, Renal calculi, Nephritis; Dialysis and artificial kidney.

Locomotion and Movement: Types of movement- ciliary, fiagellar, muscular; Skeletal musclecontractile proteins and muscle contraction; Skeletal system and its functions (To be dealt with the relevant practical of Practical syllabus); Joints; Disorders of muscular and skeletal system- Myasthenia gravis, Tetany, Muscular dystrophy, Arthritis, Osteoporosis, Gout.

Neural control and coordination: Neuron and nerves; Nervous system in humans- central nervous system,peripheralnervoussystemandvisceralnervoussystem;Generationandconductionof nerve impulse; Reflex action; Sense organs; Elementary structure and function of eye and ear.

Chemical coordination and regulation: Endocrine glands and hormones; Human endocrine system-Hypothalamus, Pituitary, Pineal, Thyroid, Parathyroid, Adrenal, Pancreas, Gonads; Mechanism of hormone action (Elementary Idea); Role of hormones as messengers and regulators, Hypo-and hyperactivity and related disorders (Common disorders e.g. Dwarfism, Acromegaly, Cretinism, goiter, exopthalmic goiter, diabetes, Addison's disease).

(*Important: Diseases and disorders mentioned above to be dealt in brief.*)

CONENTS OF CLASS XII SYLLABUS

UNIT I: REPRODUCTION:

Reproduction in organisms: Reproduction, a characteristic feature of all organisms for continuation of species; Modes of reproduction – Asexual and sexual; Asexual reproduction; Modes-Binary fission, sporulation, budding, gemmule, fragmentation; vegetative propagation in plants.

Sexual reproduction in flowering plants: Flower structure; Development of male and female

gametophytes; Pollination-types, agencies and examples; Outbreeding devices; Pollen-Pistil interaction; Double fertilization; Post fertilization events- Development of endosperm and embryo, Development of seed and formation of fruit; Special modes-apomixis, parthenocarpy, polyembryony; Significance of seed and fruit formation.

Human Reproduction: Male and female reproductive systems; Microscopic anatomy of testis and ovary; Gametogenesis-spermatogenesis & oogenesis; Menstrual cycle; Fertilization, embryo development upto blastocyst formation, implantation; Pregnancy and placenta formation (Elementary idea); Parturition (Elementary idea); Lactation (Elementary idea).

Reproductive health: Need for reproductive health and prevention of sexually transmitted diseases (STD); Birth control-Need and Methods, Contraception and Medical Termination of Pregnancy (MTP); Amniocentesis; Infertility and assisted reproductive technologies – IVF, ZIFT, GIFT (Elementary idea for general awareness).

UNIT II: GENETICS AND EVOLUTION:

Heredity and variation: Mendelian Inheritance; Deviations from Mendelism- Incomplete dominance, Co-dominance, Multiple alleles and Inheritance of blood groups, Pleiotropy; Elementary idea of polygenic inheritance; Chromosome theory of inheritance; Chromosomes and genes; Sex determination-In humans, birds, honey bee; Linkage and crossing over; Sex linked inheritance- Haemophilia, Colour blindness; Mendelian disorders in humans- Thalassemia; Chromosomal disorders in humans; Down's syndrome, Turner's and Klinefelter's syndromes.

Molecular basis of Inheritance: Search for genetic material and DNA as genetic material; Structure of DNA and RNA; DNA packaging; DNA replication; Central dogma; Transcription, genetic code, translation; Gene expression and regulation- Lac Operon; Genome and human genome project; DNA finger printing.

Evolution: Origin of life; Biological evolution and evidences for biological evolution from Paleontology,comparativeanatomy,embryologyandmolecularevidence);Darwin'scontribution,

Modern Synthetic theory of Evolution; Mechanism of evolution-Variation (Mutation and Recombination) and Natural Selection with examples, types of natural selection; Gene flow and genetic drift; Hardy-Weinberg's principle; Adaptive Radiation; Human evolution.

UNIT III: BIOLOGY AND HUMAN WELFARE:

Health and Disease; Pathogens; parasites causing human diseases (Malaria, Filariasis, Ascariasis. Typhoid, Pneumonia, common cold, amoebiasis, ring worm); Basic concepts o immunology vaccines; Cancer, HIV and AIDS; Adolescence, drug and alcohol abuse. Improvement in food production; Plant breeding, tissue culture, single cell protein, Biofortification; Apiculture and Animal husbandry.

Microbes in human welfare: In household food processing, industrial production, sewag treatment, energy generation and as biocontrol agents and biofertilizers.

UNIT IV: BIOTECHNOLOGY AND ITS APPLICATIONS:

Principles and process of Biotechnology: Genetic engineering (Recombinant DNA technology).

Application of Biotechnology in health and agriculture: Human insulin and vaccine production, gene therapy; Genetically modified organisms-Bt crops; Transgenic Animals; Biosafety issues-Biopiracy and patents.

UNIT V: ECOLOGY AND ENVIRONMENT:

Organisms and environment: Habitat and niche; Population and ecological adaptations; Population interactions-mutualism, competition, predation, parasitism; Population attributes-growth, birth rate and death rate, age distribution. Ecosystem: Patterns, components; productivity an decomposition;

Energy flow; Pyramids of number, biomass, energy; Nutrient cycling (carbon and phosphorous); Ecological succession; Ecological Services-Carbon fixation, pollination, oxygen release. Biodiversity and its conservation :Concept of Biodiversity ;Patterns of Biodiversity; Importance of Biodiversity; Loss of Biodiversity; Biodiversity conservation; Hotspots, endangered organisms, extinction, Red Data Book, biosphere reserves, National parks and sanctuaries.

Environmental issues: Air pollution and its control; Water pollution and its control; Agrochemicals and their effects; Solid waste management; Radioactive waste management; Greenhouse effect and global warning; Ozone depletion; Deforestation; Any three case studies a success stories address in environmental issues.