

# **CORE SYLLABUS**

**Physics, Chemistry, Biology**  
**(Higher Secondary Stage)**

**Medical Council of India**

Prepared by:-

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# PHYSICS

## INFORMATION

The syllabus for Physics at the Higher Secondary Stage has been developed with a view that this stage of school education is crucial and challenging as it is transition from general science to discipline-based curriculum. The recommendations of National Curriculum Framework-2005 have been followed, keeping the disciplinary approach with rigour and depth, appropriate to the comprehension level of learners. Due care has been taken that the syllabus is not heavy and at the same time it is comparable to the international standards. The syllabus provides logical sequencing of the subject matter with proper placement of concepts with their linkages for better understanding. It is expected that the syllabus will help to develop an interest in the learners to study Physics as a discipline and inculcate in learners the abilities, useful concepts of Physics in real-life situations for making learning of Physics relevant, meaningful and interesting. The learner is expected to realize and appreciate the interface of Physics with other disciplines.

### **RATIONALE**

The higher secondary stage is crucial and challenging stage of school education as it a transition from general science to discipline-based curriculum. Physics is being offered as an elective subject at the higher secondary stage of school education. At this stage, the students take up Physics, as a discipline, with a purpose of pursuing their future careers in basic sciences or professional courses like medicine, engineering, technology and studying courses in applied areas of science and technology at tertiary level. There is a need to provide the learners with sufficient conceptual background of Physics which would eventually make them competent to meet the challenges of academic and professional courses after the higher secondary stage.

The present effort of reforming and updating the Physics curriculum is an exercise based on the feedback received from the school system about existing syllabus and curricular material, large expansion of Physics knowledge, and also the educational and curricular concerns and issues provided in the National Curriculum Framework- 2005.

The recommendations of National Curriculum Framework-2005 have been followed, keeping the disciplinary approach with rigour and depth, appropriate to the comprehension level of learners. Due care has been taken that the syllabus is not heavy and at the same time, it is comparable to the international standards. Also, it is essential to develop linkages with other disciplines for better learning of Physics concepts and establishing relationship with daily-life situations and life-skills.

### **SALIENT FEATURES**

- Emphasis on basic conceptual understanding of content.
- Promoting process-skills, problem-solving abilities and applications of Physics concepts/content, useful in real-life situations for making Physics learning more relevant, meaningful and interesting.
- Emphasis on use of SI Units, Symbols, nomenclature of physical quantities and formulations as per international standards.

- Emphasis on Physics-related technological/industrial aspects to cope up with changing demand of society committed to the use of Physics, technology and informatics.
- Providing logical sequencing of the 'Units' of the subject matter and proper placement of concepts with linkages for better learning and matching the concepts/content with comprehension level of the learners.
- Reducing the curriculum load by eliminating overlapping of concepts/ content within the discipline of Physics or with other disciplines, reducing the descriptive portion and providing suitable formulation/depth of treatment appropriate to the comprehension level of learners, making room for contemporary core-topics and emerging curricular areas in Physics.
- The syllabus is arranged in Units spread over two years duration. The Units are so sequenced as to provide different dimensions of Physics as a discipline. The time allocation of learning Physics content per Units in terms of instructional periods have been mentioned for each Unit to help the Textbook Development Team members to develop the instructional material so as to cover it within the time frame. Each Unit has been arranged with a topic, content related practical work (one core experiment, two activities to be evaluated) and suggested investigatory projects (one project to be evaluated). There is an imperative need for evaluating the learners through Continuous and Comprehensive Evaluation of various concepts covered in a Unit.

With this background, the Physics curriculum at the higher secondary stage attempts to:

- Strengthen the concepts developed at the secondary stage to provide firm ground work and foundation for further learning Physics at the tertiary level more effectively and learning the relationship with daily-life situations;
- Develop conceptual competence in the learners and make them realize and appreciate the interface of Physics with other disciplines;
- Expose the learners to different processes used in Physics-related industrial and technological applications;
- Develop process-skills and experimental, observational, manipulative, decision-making and investigatory skills in the learners;
- Promote problem-solving abilities and creative thinking to develop interest in the learners in the study of Physics as a discipline;

- Understand the relationship between nature and matter on scientific basis, develop positive scientific attitude, and appreciate the contribution of Physics towards the improvement of quality of life and human welfare;
- Physics teaching-learning at the higher secondary stage enables the learners to comprehend the contemporary knowledge and develop aesthetic sensibilities and process skills. The experimental skills and process-skills developed together with conceptual Physics knowledge prepare the learners for more meaningful learning experiences and contribute to the significant improvement of quality of life. The learners would also appreciate the role and impact of Physics and technology, and their linkages with overall national development.

## CONTENTS CLASS XI SYLLABUS

### UNIT I: Physical World and Measurement

#### Details:-

- *Physics*: Scope and excitement; nature of physical laws; Physics, technology and society.
- *Need for measurement*: Units of measurement; systems of units; SI units, fundamental and derived units. Length, mass and time measurements; accuracy and precision of measuring instruments; errors in measurement; significant figures.

- Dimensions of physical quantities, dimensional analysis and its applications.

## **UNIT II: Kinematics**

### **Details:-**

- 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 and position-time graphs, for uniformly accelerated motion (graphical treatment).
- Elementary concepts of differentiation and integration for describing motion. *Scalar and vector quantities:* Position and displacement vectors, general vectors, general vectors and notation, equality of vectors, multiplication of vectors by a real number; addition and subtraction of vectors. Relative velocity.
- Unit vectors. Resolution of a vector in a plane-rectangular components.
- Scalar and Vector products of Vectors. Motion in a plane. Cases of uniform velocity and uniform acceleration- projectile motion. Uniform circular motion.

## **UNIT III: Laws of Motion**

### **Details:-**

- Intuitive concept of force. Inertia, Newton's first law of motion; momentum and Newton's second law of motion; impulse; 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, lubrication.
- *Dynamics of uniform circular motion.* Centripetal force, examples of circular motion (vehicle on level circular road, vehicle on banked road).

## **UNIT IV: Work, Energy and Power**

### **Details:-**

- Work done by a constant force and variable force; kinetic energy, work-energy theorem, power.
- Notion of potential energy, potential energy of a spring, conservative forces; conservation of mechanical energy (kinetic and potential energies); non-conservative forces; motion in a vertical circle, elastic and inelastic collisions in one and two dimensions.

## **UNIT V: Motion of System of Particles and Rigid Body**

**Details:-**

- Centre of mass of a two-particle system, momentum conservation and centre of mass motion. Centre of mass of a rigid body; centre of mass of uniform rod.
- Moment of a force, -torque, angular momentum, conservation of angular momentum with some examples.
- Equilibrium of rigid bodies, rigid body rotation and equation of rotational motion, comparison of linear and rotational motions; moment of inertia, radius of gyration. Values of M.I. for simple geometrical objects (no derivation). Statement of parallel and perpendicular axes theorems and their applications.

**UNIT VI: Gravitation**

**Details:-**

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

**UNIT VII: Properties of Bulk Matter**

**Details:-**

- Elastic behavior, Stress-strain relationship. Hooke's law, Young's modulus, bulk modulus, shear, modulus of rigidity, poisson's ratio; elastic energy.
- Pressure due to fluid column; Pascal's law and its applications (hydraulic lift and hydraulic brakes). Effect of gravity of fluid pressure.
- Viscosity, Stokes' law, terminal velocity, Reynold's number, streamline and turbulent flow. Critical velocity, Bernoulli's theorem and its applications.
- Surface energy and surface tension, angle of contact, excess of pressure, application of surface tension ideas to drops, bubbles and capillary rise.
- Heat, temperature, thermal expansion; thermal expansion of solids, liquids, and gases. Anomalous expansion. Specific heat capacity:  $C_p$ ,  $C_v$ - calorimetry; change of state – latent heat.
- Heat transfer- conduction and thermal conductivity, convection and radiation. Qualitative ideas of Black Body Radiation, Wein's displacement law, and Green House effect.

- Newton's law of cooling and Stefan's law.

### **UNIT VIII: Thermodynamics**

#### **Details:-**

- Thermal equilibrium and definition of temperature (zeroth law of Thermodynamics). Heat, work and internal energy. First law of thermodynamics. Isothermal and adiabatic processes.
- *Second law of the thermodynamics:* Reversible and irreversible processes. Heat engines and refrigerators.

### **UNIT IX: Behaviour of Perfect Gas and Kinetic Theory**

#### **Details:-**

- Equation of state of a perfect gas, work done on compressing a gas.
- *Kinetic theory of gases:* Assumptions, concept of pressure. Kinetic energy and temperature; *rms* speed of gas molecules; degrees of freedom, law of equipartition of energy (statement only) and application to specific heat capacities of gases; concept of mean free path, Avogadro's number.

### **UNIT X: Oscillations and Waves**

#### **Details:-**

- Periodic motion-period, frequency, displacement as a function of time. Periodic functions. Simple harmonic motion(SHM) and its equation; phase; oscillations of a spring-restoring force and force constant; energy in SHM –Kinetic and potential energies; simple pendulum-derivation of expression for its time period; free, forced and damped oscillations (qualitative ideas only), resonance.
- Wave motion. Longitudinal and transverse waves, speed of wave motion. Displacement relation for a progressive wave. Principle of superposition of waves, reflection of waves, standing waves in strings and organ pipes, fundamental mode and harmonics. Beats. Doppler effect.

## CONTENTS OF CLASS XII SYLLABUS

### **UNIT I: Electrostatics**

#### **Details:-**

- Electric charges and their conservation. Coulomb's law-force 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, statement of Gauss's theorem and its applications to find field due to infinitely long straight wire, uniformly charged infinite plane sheet and uniformly charged thin spherical shell (field inside and outside)
- Electric potential, potential difference, electric potential due to a point charge, a dipole and system of charges: equipotential surfaces, electrical potential energy of a system of two point charges and of electric dipoles in an electrostatic field.
- Conductors and insulators, free charges and bound charges inside a conductor. Dielectrics and electric polarization, capacitors and capacitance, combination of capacitors in series and in parallel, capacitance of a parallel plate capacitor with and without dielectric medium between the plates, energy stored in a capacitor, Van de Graaff generator.

## **UNIT II: Current Electricity**

### **Details:-**

- Electric current, flow of electric charges in a metallic conductor, drift velocity and mobility, and their relation with electric current; Ohm's law, electrical resistance,  $V-I$  characteristics (linear and non-linear), electrical energy and power, electrical resistivity and conductivity.
- Carbon resistors, colour code for carbon resistors; series and parallel combinations of resistors; temperature dependence of resistance.
- Internal resistance of a cell, potential difference and emf of a cell, combination of cells in series and in parallel.
- Kirchhoff's laws and simple applications. Wheatstone bridge, metre bridge.
- Potentiometer-principle and applications to measure potential difference, and for comparing emf of two cells; measurement of internal resistance of a cell.

## **UNIT III: Magnetic Effects of Current and Magnetism**

### **Details:-**

- Concept of magnetic field, Oersted's experiment. Biot-Savart law and its application to current carrying circular loop.
- Ampere's law and its applications to infinitely long straight wire, straight and toroidal solenoids. Force on a moving charge in uniform magnetic and electric fields. Cyclotron.
- Force on a current-carrying conductor in a uniform magnetic field. Force between two parallel current-carrying conductors-definition of ampere. Torque

experienced by a current loop in a 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. Magnetic dipole moment of a revolving electron. Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to its axis. Torque on a magnetic dipole (bar magnet) in a uniform magnetic field; bar magnet as an equivalent solenoid, magnetic field lines; Earth's magnetic field and magnetic elements.
- Para-, dia-and ferro-magnetic substances, with examples.
- Electromagnetic and factors affecting their strengths. Permanent magnets.

#### **UNIT IV: Electromagnetic Induction and Alternating Currents**

##### **Details:-**

- 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; LC oscillations (qualitative treatment only), LCR series circuit, resonance; power in AC circuits, wattles current.
- AC generator and transformer.

#### **UNIT V: Electromagnetic Waves**

##### **Details:-**

- Need for displacement current.
- Electromagnetic waves and their characteristics (qualitative ideas only). Transverse nature of electromagnetic waves.
- Electromagnetic spectrum (radio waves, microwaves, infrared, visible, ultraviolet, x-rays, gamma rays) including elementary facts about their uses.

#### **UNIT VI: Optics**

##### **Details:-**

- Reflection of light, spherical mirrors, mirror formula. Refraction of light, total internal reflection and its applications optical fibres, refraction at spherical surfaces, lenses, thin lens formula, lens-maker's formula. Magnification, power of a lens, combination of thin lenses in contact combination of a lens and a mirror. Refraction and dispersion of light through a prism.

- Scattering of light- blue colour of the sky and reddish appearance of the sun at sunrise and sunset.
- *Optical instruments:* Human eye, image formation and accommodation, correction of eye defects (myopia and hypermetropia) using lenses.
- Microscopes and astronomical telescopes (reflecting and refracting) and their magnifying powers.
- *Wave optics:* Wavefront and Huygens' principle, reflection and refraction of plane wave at a plane surface using wavefronts.
- Proof of laws of reflection and refraction using Huygens' principle.
- Interference, Young's double hole experiment and expression for fringe width, coherent sources and sustained interference of light.
- Diffraction due to a single slit, width of central maximum.
- Resolving power of microscopes and astronomical telescopes. Polarisation, plane polarized light; Brewster's law, uses of plane polarized light and Polaroids.

#### **UNIT VII: Dual Nature of Matter and Radiation**

##### **Details:-**

- 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 VIII: Atoms and Nuclei**

##### **Details:-**

- 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 IX: Electronic Devices**

**Details:-**

- 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 X: Communication System**

**Details:-**

- Elements of a communication system (block diagram only); bandwidth of signals (speech, TV and digital data); bandwidth of transmission medium. Propagation of electromagnetic waves in the atmosphere, sky and space wave propagation. Need for modulation. Production and detection of an amplitude –modulated wave.

# CHEMISTRY

## INFORMATION

### **RATIONALE**

Higher Secondary Stage is the most crucial stage of school education because at this stage specialized discipline based, content oriented courses are introduced. Students reach this stage after 10 years of general education and option for Chemistry with a purpose of mostly for pursuing their career in basic sciences or professional courses like medicines, engineering, technology and studying courses in applied areas of science and technology at tertiary level. Therefore, at this stage, there is a need to provide learners with sufficient conceptual background of Chemistry, which will make them competent to meet the challenges of academic and professional courses after the higher secondary stage.

National Curriculum Framework-2005 recommends a disciplinary approach with appropriate rigour and depth with the care that syllabus is not heavy and at the same time it is comparable to the international level. It emphasizes a coherent focus on important ideas within discipline that are properly sequenced to optimize learning. It recommends that theoretical component of Higher Secondary Science should emphasize on problem solving methods and the awareness of historical development of key concepts of science by judiciously integrated into content. The present exercise of syllabus development in Chemistry at Higher Secondary Stage is based on this framework.

**Salient features of the present syllabus are thus:**

- Some background of Chemistry from secondary stage is assumed; however, no specific knowledge of topics in Chemistry is pre-supposed.
- The course is self-contained and broadly covers fundamental concepts of Chemistry.
- Attempt has been made to see discipline of Chemistry does not remain only the science of facts but becomes related to modern applications in the world around us.
- The syllabus provides logical sequencing of the 'Units' of the subject matter with proper placement of concepts with their linkages for better understanding.
- Emphasis has been on promoting process-skills, problem solving abilities and applications of concepts of Chemistry useful in real life situation for making learning of Chemistry more relevant, meaningful and interesting.
- An effort has been made on the basis of feedback, to remove repetition besides reducing the content by suitably integrating the different content areas.
- Practical syllabus has two components. There are core experiments to be undertaken by the students in the classroom and will be part of examination while each student will carry out one investigatory project and submit the report for the examination.
- With this background, the Chemistry curriculum at the higher secondary stage attempts to
- Promote understanding of basic principles in Chemistry while retaining the excitement in Chemistry;
- Develop an interest in students to study Chemistry as discipline;
- Strengthen the concepts developed at the secondary stage and to provide firm foundation for further learning of Chemistry at tertiary level more effectively.
- Develop positive scientific attitude, and appreciate contribution of Chemistry towards the improvement of quality of human life.
- Develop problem solving skills and nurture curiosity, aesthetic and creativity.
- Inculcate values of honesty, integrity, cooperation, concern for life and reservation of the environment;
- Make the learner realize the interface of Chemistry with other disciplines of science such as Physics, Biology, Geology, etc;
- Equip students to face challenges related to health, nutrition, environment, population, whether industries and agriculture.

## CONTENTS OF CLASS XI SYLLABUS

### UNIT I: Some Basic Concepts of Chemistry

#### Details:-

- *General Introduction:* Important and scope of chemistry.
- Historical approach to particular nature of matter, laws of chemical combination, *Dalton's atomic theory:* concept of elements, atoms and molecules.
- Atomic and molecular masses. Mole concept and molar mass; percentage composition and empirical and molecular formula; chemical reactions, stoichiometry and calculations based on stoichiometry.

## **UNIT II: Structure of Atom**

### **Details:-**

- Discovery of electron, proton and neutron; atomic number, isotopes and isobars. Thompson's model and its limitations, Rutherford's model and its limitations, Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, de Broglie's relationship, Heisenberg uncertainty principle, concept of orbital, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals- Aufbau principle, Pauli exclusion principle and Hund's rule, electronic configuration of atoms, stability of half filled and completely filled orbitals.

## **UNIT III: Classification of Elements and Periodicity in Properties**

### **Details:-**

- Significance of classification, brief history of the development of periodic table, modern periodic law and the present form of periodic table, periodic trends in properties of elements- atomic radii, ionic radii, inert gas radii, ionization enthalpy, electron gain enthalpy, electronegativity, valence. Nomenclature of elements with atomic number greater than 100.

## **UNIT: Chemical Bonding and Molecular Structure**

### **Details:-**

- Valence electrons, ionic bond, covalent bond, bond parameters, Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization involving *s*, *p* and *d* orbitals and shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules (qualitative idea only). Hydrogen bond.

## **UNITV: States of Matter: Gases and Liquids**

### **Details:-**

- Three states of matter, intermolecular interactions, types of bonding, melting and boiling points, role of gas laws of elucidating the concept of the molecule, Boyle's law, Charles's law, Gay Lussac's law, Avogadro's law, ideal gas behaviour, empirical derivation of gas equation. Avogadro number, ideal gas equation. Kinetic energy and molecular speeds (elementary idea), deviation from ideal behaviour, liquefaction of gases, critical temperature.

- Liquid State- Vapour pressure, viscosity and surface tension (qualitative idea only, no mathematical derivations).

### **UNIT VI : Thermodynamics**

#### **Details:-**

- Concepts of system, types of systems, surroundings, work, heat, energy, extensive and intensive properties, state functions.
- First law of thermodynamics-internal energy and enthalpy, heat capacity and specific heat, measurement of  $\Delta U$  and  $\Delta H$ , Hess's law of constant heat summation, enthalpy of : bond dissociation, combustion, formation, atomization, sublimation, phase transition, ionization, solution and dilution.
- Introduction of entropy as state function, Second law of thermodynamics, Gibbs energy change for spontaneous and non-spontaneous process, criteria for equilibrium.
- Third law of thermodynamics- Brief introduction.

### **UNIT VII: Equilibrium**

#### **Details:-**

- Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium-Le Chatelier's principle; ionic equilibrium-ionic equilibrium- ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of polybasic acids, acid strength, concept of pH., Hydrolysis of salts (elementary idea)., buffer solutions, Henderson equation, solubility product, common ion effect (with illustrative examples).

### **UNIT VIII: Redox Reactions**

#### **Details:-**

- Concept of oxidation and oxidation and reduction, redox reactions oxidation number, balancing redox reactions in terms of loss and gain of electron and change in oxidation numbers, applications of redox reactions.

### **UNIT IX: Hydrogen**

#### **Details:-**

- Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen; hydrides-ionic, covalent and interstitial; physical

and chemical properties of water, heavy water; hydrogen peroxide-preparation, reactions, use and structure; hydrogen as a fuel.

### **UNIT X: s-Block Element (Alkali and Alkaline earth metals)**

#### **Details:-**

- *Group 1 and group 2 elements:*
- General introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens; uses.
- Preparation and Properties of Some important Compounds:
- Sodium carbonate, sodium chloride, sodium hydroxide and sodium hydrogencarbonate, biological importance of sodium and potassium.
- CaO, CaCO<sub>3</sub>, and industrial use of lime and limestone, biological importance of Mg and Ca.

### **UNIT XI: Some p-Block Elements**

#### **Details:-**

- General Introduction to p-Block Elements.
- *Group 13 elements:* General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group; Boron-physical and chemical properties, some important compounds: borax, boric acids, boron hydrides. Aluminium: uses, reactions with acids and alkalies.
- *General 14 elements:* General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first element. Carbon-catenation, allotropic forms, physical and chemical properties: uses of some important compounds: oxides.
- Important compounds of silicon and a few uses: silicon tetrachloride, silicones, silicates and zeolites, their uses.

### **UNIT XII: Organic Chemistry- Some Basic Principles and Techniques**

#### **Details:-**

- General introduction, methods of purification qualitative and quantitative analysis, classification and IUPAC nomenclature of organic compounds.

- Electronic displacements in a covalent bond: inductive effect, electromeric effect, resonance and hyper conjugation.
- Homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions; electrophiles and nucleophiles, types of organic reactions.

### UNIT XIII: Hydrocarbons

#### Details:-

- Classification of Hydrocarbons.
- Aliphatic Hydrocarbons:
  - *Alkanes*- Nomenclature, isomerism, conformations (ethane only), physical properties, chemical reactions including free radical mechanism of halogenation, combustion and pyrolysis.
  - *Alkenes*-Nomenclature, structure of double bond (ethene), geometrical isomerism, physical properties, methods of preparation: chemical reactions: addition of hydrogen, halogen, water, hydrogen halides (Markovnikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.
  - *Alkynes*-Nomenclature, structure of triple bond (ethyne), physical properties, methods of preparation, chemical reactions: acidic character of alkynes, addition reaction of- hydrogen, halogens, hydrogen halides and water.
  - *Aromatic hydrocarbons*- Introduction, IUPAC nomenclature; Benzene; resonance, aromaticity; chemical properties: mechanism of electrophilic substitution- Nitration sulphonation, halogenation, Friedel Craft's alkylation and acylation; directive influence of functional group in mono-substituted benzene; carcinogenicity and toxicity.

### UNIT XIV: Environmental Chemistry

#### Details:-

- *Environmental pollution*: Air, water and soil pollution, chemical reactions in atmosphere, smogs, major atmospheric pollutants; acid rain ozone and its reactions, effects of depletion of ozone layer, greenhouse effect and global warming-pollution due to industrial wastes; green chemistry as an alternative tool for reducing pollution, strategy for control of environmental pollution.

## CONTENTS OF CLASS XII SYLLABUS

### **UNIT I: Solid State**

#### **Details:-**

- Classification of solids based on different binding forces; molecular, ionic covalent and metallic solids, amorphous and crystalline solids (elementary idea), unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in solids, packing efficiency, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties, Band theory of metals, conductors, semiconductors and insulators and  $n$  and  $p$  type semiconductors.

### **UNIT II: Solutions**

#### **Details:-**

- Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties- relative lowering of vapour pressure, Raoult's law, elevation B.P. depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties abnormal molecular mass. Van Hoff factor.

### **UNIT III: Electrochemistry**

#### **Details:-**

- Redox reactions, conductance in electrolytic solutions, specific and molar conductivity variations of conductivity with concentration, Kohlrausch's Law, electrolysis and Laws of electrolysis (elementary idea), dry cell- electrolytic cells and Galvanic cells; lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells. Relation between Gibbs energy change and EMF of a cell, fuel cells; corrosion.

### **UNIT IV: Chemical Kinetics**

#### **Details:-**

- Rate of a reaction (average and instantaneous), factors affecting rates of reaction; concentration, temperature, catalyst; order and molecularity of a reaction; rate law and specific rate constant, integrated rate equations and half life (only for zero and first order reactions); concept of collision theory ( elementary idea, no mathematical treatment). Activation energy, Arrhenius equation.

### **UNIT V: Surface Chemistry**

#### **Details:-**

- *Adsorption*-physisorption and chemisorption; factors affecting adsorption of gases on solids, catalysis homogenous and heterogeneous, activity and selectivity: enzyme catalysis; colloidal state: distinction between true solutions, colloids and suspensions; lyophilic, lyophobic multimolecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation; emulsions- types of emulsions.

### **UNIT VI: General Principles and Processes of Isolation of Elements**

#### **Details:-**

- *Principles and methods of extraction*- concentration, oxidation, reduction electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and iron.

## UNIT VII: *p*- Block Elements

### Details:-

- *Group 15 elements*: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; nitrogen-preparation, properties and uses; compounds of nitrogen: preparation and properties of ammonia and nitric acid, oxides of nitrogen (structure only); Phosphorous-allotropic forms; compounds of phosphorous: preparation and properties of phosphine, halides ( $\text{PCl}_3$ ,  $\text{PCl}_5$ ) and oxoacids (elementary idea only).
- *Group 16 elements*: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; dioxygen: preparation, properties and uses; classification of oxides; ozone. Sulphur – allotropic forms; compounds of sulphur: preparation, preparation, properties and uses of sulphur dioxide; sulphuric acid: industrial process of manufacture, properties of manufacture, properties and uses, oxoacids of sulphur (structures only).
- *Group 17 elements*: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens: preparation, preparation, properties and uses of chlorine and hydrochloric acid, interhalogen compounds oxoacids of halogens (structures only).
- *Group 18 elements*: General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.

## UNIT VIII: *d* and *f* Block Elements

### Details:-

- General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals-metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation. Preparation and properties of  $\text{K}_2\text{Cr}_2\text{O}_7$  and  $\text{KMnO}_4$ .
- *Lanthanoids*- electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and its consequences.
- *Actinoids*: Electronic configuration, oxidation states and comparison with lanthanoids.

## UNIT IX: Coordination Compounds

**Details:-**

- *Coordination compounds:* Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds, bonding, Werner's theory VBT,CFT; isomerism (structural and stereo) importance of coordination compounds (in qualitative analysis, extraction of metals and biological systems).

**UNIT X: Haloalkanes and Haloarenes**

**Details:-**

- *Haloalkanes:* Nomenclature, nature of C –X bond, physical and chemical properties, mechanism of substitution reactions. Optical rotation.
- *Haloarenes:* Nature of C-X bond, substitution reactions (directive influence of halogen for monosubstituted compounds only).
- Uses and environment effects of – dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

**UNIT XI: Alcohols, Phenols and Ethers**

**Details:-**

- *Alcohols:* Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only); identification of primary, secondary and tertiary alcohols; mechanism of dehydration, uses, with special reference to methanol and ethanol.
- *Phenols:* Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols.
- *Ethers:* Nomenclature, methods of preparation, physical and chemical properties uses.

**UNIT XII: Aldehydes, Ketones and Carboxylic Acids**

**Details:-**

- *Aldehydes and Ketones:* Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties; and mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes; used.
- *Carboxylic Acids:* Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

**UNIT XIII: Organic Compounds Containing Nitrogen**

**Details:-**

- *Amines*: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary secondary and tertiary amines.
- *Cyanides and Isocyanides*- will be mentioned at relevant places I context.
- *Diazonium salts*: Preparation, chemical reactions and importance in synthetic organic chemistry.

**UNIT XIV: Biomolecules**

**Details:-**

- *Carbohydrates*- Classification (aldoses and ketoses), monosaccharide (glucose and fructose), D.L. configuration, oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen): importance.
- *Proteins*- Elementary idea of a – amino acids, peptide bond, polypeptides, proteins, primary structure, secondary structure, tertiary structure and quaternary structure (qualitative idea only), denaturation of proteins; enzymes.
- *Hormones*- **Elementary idea (excluding structure).**
- *Vitamins*- Classification and function.
- *Nucleic Acids*: DNA and RNA

**UNIT XV: Polymers**

**Details:-**

- *Classification*- Natural and synthetic, methods of polymerization (addition and condensation), copolymerization. Some important polymers: natural and synthetic like polyesters, bakelite; rubber, Biodegradable and non-biodegradable polymers.

**UNIT XVI: Chemistry in Everyday Life**

**Details:-**

- Chemicals in medicines- analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines.
- Chemicals in food- preservatives, artificial sweetening agents, **elementary idea of antioxidants.**
- Cleansing agents- soaps and detergents, cleansing action.

# **BIOLOGY**

### Information

In the present attempt of the NCERT to revise the Biology syllabus of the Classes XI and XII, several documents like 'Learning without Burden', the National Curriculum Framework-2005, the report of the 'National Focus Group on Teaching of Science' as well as reports of several external and internal reviews carried out, helped to decide the main focus of the revision. Hence, the revised syllabus aims primarily at reducing the information load while ensuring at the same time that ample opportunities and scope for learning and appreciating basic concepts of Biology continues to be available within the framework.

The Biology Syllabus reinforces the ideas introduced in the lower classes while the children learn new concepts besides getting an exposure to contemporary areas of Biology. The syllabus aims also at emphasizing the underlying principles that are common to both animals and plants, as well as highlighting the interrelationships of Biology with other areas of knowledge. The format of the syllabus allows a simple, clear, sequential flow of concepts without any jarring jumps. The empirical experience gained and practical exercises carried out during the course would prepare the student to handle Biology easily at higher levels in case she / he opts to continue further studies in this area. The revised syllabus stresses the connection of the study of Biology to real life problems-use of biological discoveries / innovations in everyday life-in environment, industry, medicine, health and agriculture.

Since it was important that the quality of Biology education at the higher secondary level was not compromised in any way, the reduction in load from the syllabus required a very careful selection of topics to be taught. The Committee chose to leave topics out if: the question about why the child needs to study the topics at the particular stage could not be answered; if the topic had no direct relevance to the child i.e. was not contextual; if the content was repetitive across stages with no change in expected understanding, and if any topic was in isolation with no evident horizontal or vertical linkages. The need for a

network of ideas and cross-linking between the areas being identified was deemed very important. While deciding on the units / topics and the depth of each topic for the higher secondary level, a holistic view of the syllabus across all stages from the primary to the higher secondary and beyond was taken. Reducing the use of too many technical terms and avoiding very large numbers of examples will also help to make the content a little lighter. The importance of careful selection of illustrations and their use to make the concepts more explicit was stressed; in Biology the quality of illustrations can make or mar any attempt at good textbooks / teaching.

The principal objective at this stage would be to explore the variations amongst the living and developing respect for the diversities, and to appreciate that the most complex biological phenomena are also built on essentially simple processes. Learning Biology should uncover these elementary aspects and illustrate their linkage to more complex phenomena. It was also felt that the contributions of scientists (women scientists in particular) that led to critical and important discoveries in Biology should be highlighted, not merely through a chronological listing, but through brief biographical discussions, in a effort to bring out the processes that led to the discovery of principles and ideas in Biology. These would stimulate critical and creative thinking. Besides, the proposed course at the higher secondary stage provides substantial orientation to the students to professional / career opportunities available in medicine, agriculture, research teaching and industry.

The syllabus also takes up issues pertaining to environment, health and other ethical issues that arise with any interference of human beings in the natural processes, which have great relevance from the societal.

## CONTENTS OF CLASS XI SYLLABUS

### UNIT I: Diversity in Living World

#### Details:

- What is living? ; Biodiversity; Need for classification; Three domain 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, Gymnosperm and Angiosperm (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-non-chordate 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

#### Details:

- Morphology and modifications; Tissues; Anatomy and functions of different parts of flowering plants: Root, stem, leaf, inflorescence- cymose and recemose, 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**

#### **Details:**

- 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, carbohydrates, lipid, nucleic acids; Enzymes-types, properties, enzyme action.
- B Cell division: Cell cycle, mitosis, meiosis and their significance.

### **UNIT IV: Plant Physiology**

#### **Details:-**

- Transport in plants: Movement of water, gases and nutrients; Cell to cell transport-Diffusion, facilitated diffusion, active transport; Plant – water relations – Imbibitions, water potential, 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, biological nitrogen fixation.

## CONTENTS OF CLASS XII SYLLABUS

### UNIT I: Reproduction

#### Details:-

- 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; Outbreedings 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; Fertilisation, 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**

### **Details:-**

- 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 (Paleontological, comparative anatomy, embryology and molecular evidence); Darwin's contribution, 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**

### **Details:-**

- Health and Disease; Pathogens; parasites causing human diseases (Malaria, Filariasis, Ascariasis. Typhoid, Pneumonia, common cold, amoebiasis, ring worm); Basic concepts of 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, sewage treatment, energy generation and as biocontrol agents and biofertilizers.

## **UNIT IV: Biotechnology and Its Applications**

**Details:-**

- 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**

**Details:-**

- 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 and 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 warming; Ozone depletion; Deforestation; Any three case studies as success stories addressing environmental issues.