

# SYLLABUS

## UNIT I Some Basic Concepts of Chemistry

**General Introduction** Important and scope of chemistry. 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

Atomic number, isotopes and isobars. Concept of shells and subshells, dual nature of matter and light, de-Broglie's relationship, Heisenberg's uncertainty principle, concept of orbital, quantum numbers, shapes of  $s$ ,  $p$  and  $d$  orbitals, rules for filling electrons in orbitals- Aufbau principle, Pauli exclusion principles 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

Modern periodic law and long form of periodic table, periodic trends in properties of elements- atomic radii, ionic radii, ionisation enthalpy, electron gain enthalpy, electronegativity, valence.

## UNIT IV Chemical Bonding and Molecular Structure

Valence electrons, ionic bond, covalent bond, bond parameters, Lewis structure, polar character of covalent bond, valence bond theory, resonance, geometry of 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.

## UNIT V States of Matter: Gases and Liquids

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' law, Gay Lussac's law, Avogadro's law, ideal behaviour of

gases, 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

**First law of thermodynamics** internal energy and enthalpy, heat capacity and specific heat, measurement of  $U$  and  $H$ , 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 and spontaneity. Third law of thermodynamics Brief introduction.

## UNIT VII Equilibrium

Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of chemical equilibrium, equilibrium constant, factors affecting equilibrium-Le Chatelier's principle, 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

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

## UNIT IX Hydrogen

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, uses and structure.

## UNIT X s-Block Elements

(Alkali and Alkaline Earth Metals)

**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. Industrial use of lime and limestone, biological importance of Mg and Ca.

## UNIT XI Some p-Block Elements

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, some important compounds borax, boric acids, boron hydrides. Aluminium, uses, reactions with acids and alkalis.

**General 14 elements** General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first element. Carbon, 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

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

**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

**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.