# LEARNING OUTCOMES

## Unit 1 Some Basic Concepts of Chemistry

*After completion of this unit the learner:*

1.1 explains the importance of chemistry in different spheres of life.

1.2 explains the characteristics of three states of matter.

1.3 classifies different substances into elements, compounds and mixtures.

1.4 defines SI base units and list some commonly used prefixes.

1.5 uses scientific notations and performs simple mathematical operations on numbers.

1.6 differentiates precision and accuracy.

1.7 determines the number of significant figures in scientific measurements.

1.8 converts physical quantities from one system of units to another.

1.9 explains laws of chemical combinations.

1.10 explains Daltons Atomic Theory.

1.11 apprises the significance of atomic mass, average atomic mass, molecular mass and formula mass.

1.12 describes the terms mole and molar mass.

1.13 solves numerical problems based on the mass percent of different elements constituting a compound.

1.14 formulates empirical formula and molecular formula of a compound from the given experimental data.

1.15 solves numerical problems based on stoichiometric calculations.

## Unit 2 Structure of Atom

2.1 explains the discovery of electron , proton and neutron and their characteristics

2.2 describes Thomson model of atom

2.3 explains Rutherford's alpha ray scattering experiment

2.4 identifies the characteristics of electromagnetic radiation and electromagnetic spectrum .

2.5 explains Planck's quantum theory, Black body radiation and photoelectric effect.

2.6 identifies and explains different regions of Hydrogen spectrum and solves numerical problems.

2.7 explains Bohr's model of atom and solves numerical problems

2.8 explains de-Broglie's dual behavior of matter and solves numerical problems

2.9 explains Heisenberg's uncertainty principle and solves numerical problems

2.10 summarises the important features of quantum mechanical model of atom

2.11 explains the significance of quantum numbers

2.12 sketches the probability density curves and boundary surface diagrams of s, p and d orbitals

2.13 explains the rules of electron filling in atoms and writes the electronic configuration of atoms

**Unit 3 Classification of Elements and Periodicity in Properties**

3.1 recognises the concept of grouping elements based on their properties, law of triads and law of octaves.

3.2 recognises the periodic law and explains the importance of atomic number, electronic configuration and periodic classification.

3.3 lists the elements with $Z > 100$ according to IUPAC nomenclature.

3.4 recognises s, p, d and f block elements and their characteristics.

3.5 identifies the periodic trends in physical and chemical properties of elements.

3.6 compares the reacticity of elements and explain reasons for the anomalous behaviour

3.7 recognises the periodic trends, the relation between chemical reactivity and the position of element in the periodic table.

**Unit 4 Chemical Bonding and Molecular Structure**

4.1 explains Kossel - Lewis approach to chemical bonding

4.2 explains the octet rule and its limitations

4.3 sketches Lewis structures of simple molecules

4.4 writes the formal charge of atoms in some simple molecular species

4.5 explains the formation of ionic bond and covalent bond

4.6 explains different bond parameters

4.7 sketches the resonance structures of simple molecular species

4.8 identifies the polarity of covalent bonds and predicts the polar nature of some simple molecules

4.9 describes VSEPR theory and predicts the geometry of simple molecules

4.10 explains the valence bond approach for the formation of covalent bonds

4.11 predicts the directional properties of various covalent bonds

4.12 explains the different types of hybridization involving s, p and d orbitals and sketches shapes of simple covalent molecules

4.13 describes the molecular orbital theory of homonuclear diatomic molecules

4.14 explains the concept of hydrogen bonding

**Unit 5 States of Matter**

5.1 explains the existance of different states of matter in terms of the intermolecular forces.

5.2 differentiates the types of van der waals' forces such as London forces, dipole - dipole interactions and dipole - induced dipole interactions.

5.3 explains the laws governing behaviour of ideal gases and solves the numerical problems.

5.4 demonstrates gas laws in various real life situations.

5.5 explains the behaviour of real gases.

5.6 describes the conditions required for liquifaction of gases and critical phenomena.

5.7 explains properties of liquids in terms of intermolecular forces of attraction.

5.8 illustrates the phenomena, surface tension in various life situations

5.9 defines boiling point of a liquid and demonstrates it in various life situations.

5.10 distinguishes various liquids on the basis of their viscous forces.

## Unit 6 Thermodynamics

6.1. explains the terms: system and surroundings;

6.2. discriminates between closed, open and isolated systems;

6.3. explains internal energy, work and heat;

6.4. explains first law of thermodynamics and express it mathematically;

6.5. calculate energy changes as work and heat contributions in chemical systems;

6.6. explains state functions:U, H;

6.7. correlates $\Delta U$ and $\Delta H$;

6.8. measures experimentally $\Delta U$ and$\Delta H$;

6.9. defines standard states for $\Delta H$;

6.10. calculates enthalpy changes for various types of reactions;

6.11. state and apply Hess's Law of constant heat of summation;

6.12. dfferentiate between extensive and intensive propeties;

6.13. defines spontaneous and non spontaneous processes;

6.14. explains entropy as a thermodynamic state function and apply it for spontaneity;

6.15. explains Gibb's energy change ($\Delta G$);

6.16. establish relationship between $\Delta G$ and spontaneity, $\Delta G$ and equilibrium constant;

## Unit 7 Equilibrium

7.1 identifies the dynamic nature of equilibrium in physical and chemical processes.

7.2 states the law of equilibrium and writes the expression for equilibrium constant.

7.3 establishes relationship between $K_p$ and $K_c$.

7.4 lists the applications of equilibrium constant.

7.5 explains various factors that affect equilibrium state of a reaction.

7.6 classifies substance as acids and bases based on Arrhenius concept, Bronsted-Lowry concept and Lewis concept.

7.7 describes the equilibrium involved in the ionisation of water and that of solutions of acids and bases.

7.8 describes the pH scale for representing hydrogen ion concentration.

7.9 explains the dependence of degree of ionization on concentration of electrolyte and that of common ion effect in the degree of ionisation.

7.10 explains the hydrolysis of different types of salts.

7.11 identifies the use of buffer solutions.

7.12 calculates solubility product constant and the solubility of salts.

## Unit 8 Redox Reactions

8.1 identifies oxidation and reduction reactions based on classical concept

8.2 defines the terms, oxidation, reduction, oxidizing agent and reducing agent.

8.3 explains mechanism of redox reaction using electron transfer process

8.4 compares electron releasing tendency of metals and designs electrochemical series.

8.5 recognizes oxidation number and solve problems to find out oxidation number.

8.6 represents Stock notation for compounds

8.7 identifies oxidant and reductant using oxidation number.

8.8 classifies redox reactions into combination reactions, decomposition reactions, displacement reactions, and disproportionation reactions

8.9 recognize balancing of redox reactions using oxidation number method and half reaction method.

8.10 recognize the basis of redox titrations and writes the redox reactions behind permanganometric, dichrometric and iodometric titrations

8.11 chooses concept of redox reaction to describe electrode process.

## Unit 9 Hydrogen

9.1 judges the position of hydrogen in the periodic table.

9.2 recognises the different isotopes of hydrogen.

9.3 explains the different methods of preparation of dihydrogen on small and commercial scale .

9.4 explains the properties of dihydrogen.

9.5 appraises the uses of dihydrogen and need for new technologies related to it.

9.6 differentiates ionic, covalent and metallic hydrides.

9.7 translates the knowledge of structure of water for explaining its physical and chemical properties.

9.8 examines how environmental water quality depends on dissolved ions and differentiates hard and soft water and selects the suitable method of water softening.

9.9 explains the preparation, properties and structure of $H_2O_2$ and lists the uses of $H_2O_2$.

9.10 recognizes what heavy water is and its importance.

9.11 writes a note on the importance of dihydrogen as a fuel.

## Unit 10 The s-Block Elements

10.1 explains the atomic, physical and chemical properties of alkali metals

10.2 lists the uses of alkali metals like Li, Na, K and Cs

10.3 explains the general characteristics of the compounds of the alkali metals

10.4 recognises the anomalous properties of Li and compares the properties Li with those other alkali metals

10.5 explains the preparation, properties and uses of compounds of sodium like sodium carbonate, sodium chloride, sodium hydroxide, sodium hydrogen carbonate

10.6 illustrates the biological importance of sodium and potassium

10.7 explains the atomic, physical and chemical properties of alkaline earth metals

10.8 lists the uses of alkaline earth metals like Be, Mg, Ca, Ba and Ra

10.9 explains the general characteristics of the compounds of the alkaline earth metals

10.10 recognises the anomalous properties of Be and compares the properties of Be with those other alkaline earth metals

10.11 explains the preparation, properties and uses of compounds of calcium like calcium oxide, calcium hydroxide, calcium carbonate, calcium sulphate, and cement

10.12 illustrates the biological importance of Mg and Ca

## Unit 11 The *p*-Block Elements

After teaching this unit, the learner.

11.1 explains the trends in atomic and physical properties of group 13 elements

11.2 explains chemical properties of group 13 elements

11.3 identifies anomalous properties of Boron

11.4 describes structure and properties of some important compounds of Boron

11.5 explains uses of boron, aluminium and their compounds

11.6 explains trends in atomic and physical properties of group 14 elements

11.7 explains chemical properties of group 14 elements

11.8 identifies anomalous behavior of carbon

11.9 describes allotropic forms of carbon

11.10 describes structure and properties of some important compounds of carbon and silicon

11.11 explain the uses of carbon

## Unit 12 Organic Chemistry – Some Basic Principles and Techniques

12.1 recognizes reason for the tetra valency of carbon atom.

12.2 identifies shapes of organic molecules on the basis of sigma bond , doble bond and triple bond.

12.3 writes the structure of organic molecules in various ways.

12.4 classifies the organic compounds on the basis of its structure.

12.5 names the compound according to IUPAC system of nomenclature and also derives the structures from the given name.

12.6 identifies the concepts of organic reaction mechanism.

12.7 explains the influence of electronic displacements on structure and reactivity of organic compounds.

12.8 recognizes the type of organic reactions on the basis of reaction mechanism.

12.9 describes the techniques of purification of organic compounds.

12.10 writes the chemical reactions involved in the qualitative analysis of organic compounds.

12.11 explains the principles involved in qualitative analysis of organic compounds.

12.12 explains the principles involved in quantitative analysis of organic compounds.

## Unit 13 Hydrocarbons

13.1 names hydrocarbons according to IUPAC system of nomenclature.

13.2 recognizes and writes structures of isomers of alkanes, alkenes, alkynes and aromatic hydrocarbons.

13.3 identifies alkenes showing geometrical isomerism.

13.4 describes various methods of preparation of hydrocarbons.

13.5 distinguishes between alkanes, alkenes , alkynes and aromatic hydrocarbonon the basis of physical properties.

13.6 examines the chemical properties of alkanes, alkenes , alkynes and aromatic hydrocarbons.

13.7 sketches and differentiates between various conformations of ethane and their difference in enenergy..

13.8 predicts the formation of the addition products of unsymmetrical alkenes and alkynes on the basis of electrophilic addition mechanism.

13.9 predicts the formation of addition products of unsymmetrical alkenes with HBr free radical addition mechanism.

13.10 appreciates the role of hydrocarbons as source of energy and for other industrial applications.

13.11 describes the structure of benzene, explains aromaticity and mechanism of electrophilic substitution reactions of benzene.

13.12 predicts the directive influence of substituent in mono substituted benzene ring.

13.13 appreciates the adverse effect of carcinogenicity and toxicity.Organises the awareness campaigns by the students.

**Unit 14 Environmental Chemistry**

14.1 identifies the meaning of environmental chemistry.

14.2 defines atmospheric pollution, lists reasons for global warming and Green house effect and acid rain.

14.3 identifies causes for ozone layer depletion and its effects.

14.4 explains reasons for water pollution and identifies international standards for drinking water.

14.5 describes causes of soil pollution.

14.6 suggests and adopts strategies for control of environmental pollution.

14.7 appraises the importance of Green Chemistry in day-to-day life.