

## 4. CHEMISTRY

### Class XI (Theory)

One Paper

Time: 3 Hours

70 Marks

Unit No.	Title	Marks
Unit I	Some Basic concepts of chemistry	03
Unit II	Structure of Atom	06
Unit III	Classification of Elements and Periodicity in Properties	04
Unit IV	Chemical Bonding and molecular Structure	05
Unit V	States of Matter: Gases and Liquids	04
Unit VI	Thermodynamics	06
Unit VII	Equilibrium	06
Unit VIII	Redox Reactions	03
Unit IX	Hydrogen	03
Unit X	S-Block Elements	05
Unit XI	Some P-Block Elements	07
Unit XII	Organic Chemistry: some basic Principles and Techniques	07
Unit XIII	Hydrocarbons	08
Unit XIV	Environmental Chemistry	03
<b>Total</b>		<b>70</b>

#### Unit I: Some Basic Concepts of Chemistry

General Introduction: Importance and scope of chemistry. Historical approach to particulate 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, empirical and molecular formula chemical reactions, stoichiometry and calculations based on stoichiometry.

#### Unit II: Structure of Atom

Discovery of electron, proton and neutron; atomic number, isotopes and isobars. Thomson'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 orbitals, 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

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. Ionization enthalpy, electron gain enthalpy, electro negativity, valence.

## **Unit IV: Chemical Bonding and Molecular Structure**

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 homo nuclear diatomic molecules (qualitative idea only), hydrogen bond.

## **Unit V: States of Matter: Gases and Liquids**

Three states of matter. Intermolecular interactions, type of bonding, melting and boiling points. Role of gas laws in elucidating the concept of the molecule, Boyle's law. Charles law, Gay Lussac's law, Avogadro's law. Ideal behaviour, empirical derivation of gas equation, Avogadro's number. Ideal gas equation. Derivation 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**

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 transformation, ionization, and solution. Introduction of entropy as a state function, free energy change for spontaneous and nonspontaneous processes, criteria for equilibrium.

## **Unit VII: Equilibrium**

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 - ionization of acids and bases, strong and weak electrolytes, degree of ionization, concept of pH. Hydrolysis of salts (elementary idea). Buffer solutions, solubility product, common ion effect (with illustrative examples).

## **Unit VIII: Redox Reactions**

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, applications of redox reactions.

## **Unit IX : Hydrogen**

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, properties and structure; hydrogen as a fuel.

## **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 hydrogen carbonate, 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

### 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.

**Group 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.

## Unit XII: Organic Chemistry - Some Basic Principles and Techniques

General introduction, methods of 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

### Classification of 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, smog, 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.

### Practicals

Evaluation Scheme for Examination	Marks
Volumetric Analysis	10
Salt Analysis	06
Content Based Experiment	04
Class Record and Viva	05
Investigatory project	05
<b>Total</b>	<b>30</b>

## PRACTICALS SYLLABUS

### A. Basic Laboratory Techniques

1. Cutting glass tube and glass rod
2. Bending a glass tube
3. Drawing out a glass jet
4. Boring a cork

### B. Characterization and purification of chemical substances

1. Determination of melting point of an organic compound
2. Determination of boiling point of an organic compound
3. Crystallization of impure sample of any one of the following: Alum, copper sulphate, Benzoic acid.

### C. Experiments related to pH change

- (a) Any one of the following experiments:
- Determination of pH of some solutions obtained from fruit juices, varied concentrations of acids, bases and salts using pH paper or universal indicator.
  - Comparing the pH of solutions of strong and weak acid of same concentration.
  - Study the pH change in the titration of a strong base using universal indicator.
- (b) Study of pH change by common-ion effect in case of weak acids and weak bases.

### D. Chemical equilibrium

One of the following experiments:

- (a) Study the shift in equilibrium between ferric ions and thiocyanate ions by increasing/decreasing the concentration of either ions.
- (b) Study the shift in equilibrium between  $[\text{Co}(\text{H}_2\text{O})_6]^{2+}$  and chloride ions by changing the concentration of either of the ions.

### E. Quantitative estimation

- Using a chemical balance.
- Preparation of standard solution of oxalic acid.
- Determination of strength of a given solution of sodium hydroxide by titrating it against standard solution of oxalic acid.
- Preparation of standard solution of sodium carbonate.
- Determination of strength of a given solution of hydrochloric acid by titrating it against standard sodium carbonate solution.

### F. Qualitative analysis

Determination of one anion and one cation in a given salt

**Cations-**  $\text{Pb}^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{As}^{3+}$ ,  $\text{Al}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{NH}_4^+$

**Anions-**  $\text{CO}_3^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_2^-$ ,  $\text{NO}_3^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{PO}_4^{3-}$ ,  $\text{C}_2\text{O}_4^{2-}$ ,  $\text{CH}_3\text{COO}^-$

**(Note: Insoluble salts excluded)**

### **G. Detection of nitrogen, sulphur, Chlorine**

bromine and iodine in an organic compound.

## **PROJECT**

Scientific investigations involving laboratory testing and collecting information from other sources.

### **A Few suggested Projects**

- Checking the bacterial contamination in drinking water by testing sulphide ion.
- Study of the methods of purification of water.
- Testing the hardness, presence of iron, fluoride, chloride etc. depending upon the regional variation in drinking water and the study of causes of presences of these ions above permissible limit (if any).
- Investigation of the foaming capacity of different washing soaps and the effect of addition of sodium carbonate on them.
- Study of the acidity of different samples of the tea leaves.
- Determination of the rate of evaporation of different liquids.
- Study of the effect of acids and bases on the tensile strength of fibers.
- Analysis of fruit and vegetable juices for their acidity.

**Note:** Any other investigatory project, which involves about 10 period of work, can be chosen with the approval of the teacher.