

# CHEMISTRY

For 1st Year Science

## Course Structure

Unit	Title	Marks
I	Basic Concepts of Chemistry	11
II	Structure of Atom	
III	Classification of Elements & Periodicity in Properties	4
IV	Chemical Bonding and Molecular Structure	
V	States of Matter : Gases and Liquids	
VI	Thermodynamics	21
VII	Equilibrium	
VIII	Redox Reactions	
IX	Hydrogen	16
X	s-Block Elements	
XI	Organic Chemistry : Basic Principles & Techniques	
XIII	Hydrocarbons	18
XIV	Environmental Chemistry	
	Total	70

### Unit I: Some Basic Concepts of Chemistry

General Introduction: Importance and scope of chemistry

Nature of matter, laws of chemical combination, Dalton's atomic theory: concept of elements, atoms and molecules

Atomic and molecular masses and equivalent mass of elements, acid, base, and salt, oxidants, reductants, and 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's exclusion principle and Hund's rule, electronic configuration of atoms, stability of half filled

### 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, inert gas

radii, ionization enthalpy, electron gain enthalpy, electronegativity, valency and oxidation state. Nomenclature of elements with atomic number greater than 100.

#### **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 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 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. Deviation from ideal behaviour liquefaction of gases, critical temperature, kinetic energy and molecular speeds (elementary idea) Liquid State vapour pressure, viscosity and surface tension (qualitative idea only, no mathematical derivations).

#### **Unit VI : Chemical Thermodynamics**

Concepts of System and surroundings and types of system, 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, Second law of Thermodynamics (brief introduction). Introduction of entropy as a state function, Gibb's energy change for spontaneous and non-spontaneous processes, criteria for equilibrium.

Third law of thermodynamics (brief introduction).

#### **Unit VII : Equilibrium**

Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant ( $K_c$ ,  $K_p$  and  $K_x$  and their relationship) factors affecting equilibrium - Le Chatelier's principle, ionic equilibrium-ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of poly basic acid strength, concept of  $pH$ , Henderson Equation, hydrolysis of salts (elementary idea), buffer solution, solubility, product, common ion effect (with illustrative examples) numerical problems.

#### **Unit VIII : Redox Reaction**

Concept of oxidation and reduction, redox reactions, oxidation number, balancing redox reactions, in terms of loss and gain of electrons and change in oxidation number, 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, reactions and structure and use; 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 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. Calcium Oxide and Calcium Carbonate and their industrial uses, biological importance of Magnesium and Calcium.

### **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 acid, Boron Hydrides, Aluminium : Reactions with acids and alkalis, uses.

**Group 14 Elements :** General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first elements. Carbon-catenation, allotropic forms, physical and chemical properties; uses of some important compounds: oxides. Important compounds of Silicon and a few use: Silicon Tetrachloride, Silicones, Silicates and Zeolites, their uses.

### **Unit XII : Organic Chemistry - Some Basic Principles and Technique**

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 hyperconjugation. 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

Aliphatic Hydrocarbons :

Alkanes - Nomenclature, isomerism, conformation (ethane only), physical properties methods of preparation 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 (Markownikoff'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 monosubstituted 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, strategies for control of environmental pollution.

### **CHEMISTRY (PRACTICAL)**

#### **+2, 1st Year Science**

#### **(Detailed syllabus)**

#### **Experiments :**

##### **1. Basic Laboratory Techniques : (Non-evaluative)**

- Bunsen burner (different parts and their functions)
- Chemical balance - weighing with chemical balance by equal oscillation method.
- Cutting and bending of glass tube, drawing jet and boring a cork.

##### **2. Crystallisation :**

Preparation of  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  crystal from  $\text{CuCO}_3$ .

##### **3. Qualitative Analysis :**

a) Identification of acid radicals :

Radicals :  $\text{CO}_3^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{NO}_2^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$  &  $\text{PO}_4^{3-}$

b) Identification of Basic Radicals :

Radicals :  $\text{Ag}^+$ ,  $\text{Pb}^{2+}$ ,  $\text{Hg}_2^{2+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Hg}^{2+}$ ,  $\text{Bi}^{3+}$ ,  $\text{As}^{3+}$ ,  $\text{Sb}^{3+}$ ,  $\text{Sn}^{2+}$ ,  $\text{Al}^{3+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Cr}^{3+}$ ,  $\text{Co}^{2+}$ ,  $\text{Ni}^{2+}$ ,  $\text{Zn}^{2+}$ ,  $\text{Mn}^{2+}$ ,  $\text{Ba}^{2+}$ ,  $\text{Sr}^{2+}$ ,  $\text{Ca}^{2+}$ ,  $\text{NH}_4^+$ ,  $\text{Mg}^{2+}$ ,  $\text{K}^+$  and  $\text{Na}^+$  (Dry Tests only).

##### **4. Volumetric Analysis :**

Single titration of acids and bases (three experiments to be done; one on direct determination of normality of one of the solutions from that of the other and the other two, involving numerical calculations)

##### **5. Gravimetric Analysis :**

- Equivalent mass of Mg by hydrogen displacement method.
- Solubility of  $\text{K}_2\text{SO}_4$  at room temperature.

#### **Books Recommended :**

+2 Practical Chemistry, Published by Odisha State Bureau of Text Book Preparation and Production, Bhubaneswar