

## Chemistry (55)

### Introduction

According to NCF 2005, the new and updated curriculum is introduced at +2 stage. There is a need to provide the sufficient conceptual background of chemistry which will help the students to appear for different common entrance test at the state level and the national level. This new syllabus will make them competent to meet the challenges of academic and professional courses like medicine, engineering, technology, etc, after the +2 stage. The syllabus is comparable to the international level.

The syllabus contains areas like physical, organic, inorganic, industrial, analytical and polymer chemistry. The upgraded syllabus has taken care of new formulations and nomenclature of elements, compounds and IUPAC units of physical quantities. New nomenclature, symbols and formulations, fundamental concepts, modern techniques are given importance.

#### Objectives :

The broad objectives of teaching Chemistry at Higher Secondary stage are to help the learners :

- 1) To promote understanding of basic facts and concepts in chemistry while retaining the excitement of chemistry.
- 2) To make students capable of studying chemistry in academic and professional courses (such as medicine, engineering, technology) at tertiary level.

- 3) To expose the students to various emerging new areas of chemistry and apprise them with their relevance in their future studies and their applications in various spheres of chemical sciences and technology.
- 4) To equip students to face various changes related to health, nutrition, environment, population, weather, industries and agriculture.
- 5) To develop problem solving skills in students.
- 6) To expose the students to different processes used in industries and their technological applications.
- 7) To apprise students with interface of chemistry with other disciplines of science such as physics, biology, geology, engineering, etc.

### Std. XI (Theory)

#### Unit 1: 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 : Avogadro's law and Avogadro number, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on stoichiometry.



## Unit 2 :States of matter : Gases and liquids

Three states of matter. Intermolecular interactions, type of bonding. Role of gas laws in elucidating the concept of the molecule, Boyle's law, Charles law, Gay Lussac's law. Ideal behaviour, empirical derivation of gas equation. 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 3 : Structure of atom

Discovery of electron, proton and neutron; atomic number, isotopes and isobars. 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's 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 and completely filled orbitals.

## Unit 4 : Periodic table

Significance of classification, brief history of the development of periodic table, modern periodic law and present form of periodic table, periodic trends in properties of elements atomic radii, ionic radii. Inert gas radii nomenclature of elements with atomic number greater than 100. Enthalpy: Explanation and definition of term. Ionization enthalpy, electron gain enthalpy,

electronegativity, valence.

## Unit 5: Redox reactions

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.

## Unit 6: Chemical 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, ionization of polybasic acids, acid strength, concept of pH. Hydrolysis of salts (elementary idea). Buffer solutions, solubility product, common ion effect (with illustrative examples.) Handerson equation.

## Unit 7 : Surface chemistry

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; emulsion – types of emulsions. Elementary idea of nanomaterials.

## Unit 8 : Nature of chemical bond

Valence electrons, ionic bond, Born Haber cycle : covalent 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.

### **Unit 9 : 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. Uses of hydrogen peroxide.

### **Unit 10: 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 hydroxide and sodium hydrogen carbonate, biological importance of sodium and potassium. Calcium oxide and calcium carbonate and industrial uses of lime and limestone, biological importance of Magnesium and Calcium.

### **Unit 11 : p-Block elements**

#### **Group 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 behavior of first element. Carbon – catenation, allotropic forms, physical and chemical properties; uses of some important compounds; oxides. Important compounds of silicon and their uses: silicon tetrachloride, silicones, silicates and zeolites and structure of silicates.

### **Unit 12: Basic principles and techniques in organic chemistry**

General introduction, methods of qualitative and quantitative analysis, Classification and IUPAC nomenclature of organic compounds. Melting point and boiling point. 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 13 : Alkanes**

Classification of hydrocarbons – Nomenclature, isomerism, conformations (ethane only), physical properties, chemical reactions including free radical mechanism



of halogenation, combustion and pyrolysis.

#### Unit 14 : Alkenes

Nomenclature, structure of double bond (ethane), geometrical isomerism, physical properties, methods of preparation. Chemical reactions; addition of hydrogen, halogen, water, hydrogen halides (Markovnikoff's addition and peroxide effect) ozonolysis, oxidation, mechanism of electrophilic addition.

#### Unit 15: Alkynes

Nomenclature, structure of triple bond (ethylene), physical properties. Methods of preparation, chemical reactions: acidic character of alkynes, addition reaction of – hydrogen, halogens, hydrogen halides, water.

#### Unit 16 : Aromatic compounds

Introduction, IUPAC nomenclature; benzene; resonance aromaticity; chemical properties; mechanism of electrophilic substitution. – nitration, sulphonation, halogenation, Friedel Craft alkylation and acylation; Carcinogenicity and toxicity.

#### UNIT-17: 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, green house effect and global warming. Pollution due to industrial wastes, green chemistry as an alternative tool for reducing pollution, strategy for control of environmental pollution.

### Practical Syllabus - Std. XI

#### A. Basic laboratory techniques

1. Cutting glass tube and glass rod

2. Bending glass tube
3. Drawing out a glass jet
4. Study of burner
5. Operating pinch cork

#### B. Characterization and purification of chemical substances

1. Determination of melting point of an organic compound. (p-toludine, naphthalene, oxalic acid,  $\beta$ -naphthol, resorcinol, benzoic acid.)
2. Determination of boiling point of an organic compound. (acetone, methyl acetate, acetic acid, xylene (o,m,p), water)
3. Crystallization of impure sample of any one of the following compounds. Alum, copper sulphate, benzoic acid.

#### C. Surface chemistry

- (a) Preparation of one lyophilic and one lyophobic sol: Lyophilic sol-starch and gum.  
Lyophobic sol–aluminium hydroxide, ferric hydroxide, arseneous sulphide.
- (b) Study of the role of emulsifying agents in stabilizing the emulsion of oil.

#### D. Chemical equilibrium

Any one of the following experiments:

- (a) Study the shift in equilibrium between ferric ions and thiocyanate ions by changing the concentration of either ion.
- (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. 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 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 bases.

#### F. 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.

#### G. Qualitative analysis

Determination of one cation and one anion in a given salt:

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

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

(Note: Insoluble salts excluded)

- #### H. 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

- 1 Checking the bacterial contamination in drinking water by testing sulphide ion.
- 2 Study of the methods of purification of water.
- 3 Testing the hardness, presence of iron,

fluoride, chloride etc. depending upon the regional variation in drinking water and the study of causes of presence of these ions above permissible limit (if any).

- 4 Investigation of the foaming capacity of different washing soaps and the effect of addition of sodium carbonate on them.
- 5 Study of the acidity of different samples of the tea leaves.
- 6 Determination of the rate of evaporation of different liquids.
- 7 Study of the effect of acids and bases on the tensile strength of fibers.
- 8 Analysis of fruit and vegetable juices for their acidity.

#### Note:

Any other investigatory project can be chosen with the approval of the teacher.

### Std. XII (Theory)

#### Unit 1: Solid State

Classification of solids based on different 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, voids, number of atoms per unit cell in a cubic unit cell, point defects, electrical and magnetic properties, **Band theory of metals, conductors and semiconductors and insulators and n and p type semiconductors.**

#### Unit 2 : Solutions and colligative properties

Types of solutions, expression of concentration of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties –relative lowering



of vapor pressure, **Raoult's law** elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass. **Van't Hoff factor and calculations involving it.**

### **Unit 3 :Chemical thermodynamics and energetic**

Concepts of system, types of systems, surroundings. Work, heat, energy, extensive and intensive properties, state functions. First law of thermodynamics – internal energy and enthalpy, Hess' law of constant heat summation, enthalpy of bond dissociation, combustion, formation, atomization, sublimation. Phase transition, ionization and solution **and dilution** Introduction of entropy as a state function, free energy change for spontaneous and non spontaneous processes, and equilibrium constant. **Second and third law of thermodynamics**

### **Unit 4: Electrochemistry**

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 and galvanic cells; lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, fuel cells; corrosion. **Relation between Gibb's energy change and emf of a cell.**

### **Unit 5: Chemical kinetics**

Rate of reaction (average and instantaneous), factors affecting rate 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 6 :General principles and processes of isolation of elements**

Principles and methods of extraction – concentration, oxidation, reduction electrolytic method and refining; occurrence and principle of extraction of aluminium, copper, zinc and iron

### **Unit 7: p-Block elements**

#### **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**, simple oxides; Ozone.

Sulphur – allotropic forms; compounds of sulphur; preparation, properties and uses of sulphur dioxide; sulphuric acid; industrial process 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, properties and uses of chlorine and hydrochloric acid, interhalogen compounds, oxoacids of halogens (structure only).

#### **Group 18 elements:**

General introduction, electronic configuration. Occurrence, trends in physical and chemical properties, uses.

### **Unit 8 : d and f Block Elements**

#### **d-Block Elements -**

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  $K_2Cr_2O_7$  and  $KMnO_4$ .

#### **f-Block elements-**

**Lanthanoids** – Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction **and its consequences**. **Actinoids** – Electronic configuration, oxidation states.

#### **Comparison with lanthanoids.**

### **Unit 9: Coordination compounds**

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 10 : Halogen derivatives of alkanes (and arenes)**

#### **Haloalkanes :**

Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions.

#### **Stability of carbocations, R-S and d-l configuration**

#### **Haloarenes :**

Nature of C-X bond, substitution reactions (directive influence of halogen for monosubstituted compounds only) **stability of carbocations, R-S and d-l configurations**. Uses and environmental effects of – dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

### **Unit 11 : Alcohols, phenols and ethers**

#### **Alcohols :**

Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only); identification of primary, secondary and tertiary alcohols; mechanism of dehydration, uses of 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 12 : Aldehydes, ketones and**



**carboxylic acids****Aldehydes and ketones :**

Nomenclature, nature of carbonyl group, methods of preparation. Physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes; uses.

**Carboxylic acids :**

Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

**Unit 13: Organic compounds containing nitrogen**

Nitro compounds-General methods of preparation and chemical reactions

**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 in context.

**Diazonium salts:**

Preparation, chemical reactions and importance in synthetic organic chemistry.

**Unit 14: Biomolecules****Carbohydrates:**

Classification (aldoses and ketoses), monosaccharides **d-l configuration** (glucose and fructose), oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen), importance.

**Proteins:**

Elementary idea of  $\alpha$ -amino acids, peptide, linkage, polypeptides, proteins; structure of amines-primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of

proteins; enzymes.

Lipids and hormones (elementary idea) excluding structure, their classification and functions.

**Vitamins:** Classification and functions.

**Nucleic acids:** DNA and RNA

**Unit 15: Polymers**

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

**Unit 16: Chemistry in everyday life :**

- Chemicals in medicines :** analgesics, tranquilizers, antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines
- Chemicals in food :** Preservatives, artificial sweetening agents.
- Cleansing agents :** Soaps and detergents, cleansing action.

**Practical Syllabus - Std. XII****A. Chemical Kinetics**

(Any one of the following) :

- Effect of concentration and temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.
- Study of reaction rate of any one of the following:
  - Reaction of iodide ion with hydrogen peroxide at room temperature using different concentration of iodide ions.
  - Reaction between potassium iodate,  $\text{KIO}_3$  and sodium sulphite ( $\text{Na}_2\text{SO}_3$ )





using starch solution as indicator (clock reaction).

(c) Acid hydrolysis of ethyl acetate.

### B. Thermochemistry

Any one of the following experiments:

- i] Enthalpy of dissolution of copper sulphate or potassium nitrate.
- ii] Enthalpy of neutralization of strong acid (HCl) and strong base (NaOH).
- iii] Determination of enthalpy change during interaction (hydrogen bond formation) between acetone and chloroform.
- iv] Heat of displacement of Cu from  $\text{CuSO}_4$  by Zn.

### C. Electrochemistry

Variation of cell potential in  $\text{Zn}|\text{Zn}^{2+}||\text{Cu}^{2+}|\text{Cu}$  with change in concentration of electrolytes ( $\text{CuSO}_4$  or  $\text{ZnSO}_4$ ) at room temperature (demonstration).

### D. Chromatography (demonstration)

- (i) Separation of pigments from extracts of leaves and flowers by paper chromatography and determination of  $R_f$  values.
- (ii) Separation of constituents present in an inorganic mixture containing two cations only (constituents having large difference in  $R_f$  values to be provided).

### E. Preparation of Inorganic Compounds

- (i) Preparation of double salt of ferrous ammonium sulphate or potash alum.
- (ii) Preparation of potassium ferric oxalate.

### F. Preparation of Organic Compounds

- (i) p-Nitroacetanilide
- (ii) Aniline yellow or 2-Naphthol aniline dye.
- (iii) Iodoform
- (iv) Phthalic or succinic anhydride.
- (v) Di-benzal acetone

### G. Tests for the functional groups present in organic compounds

Unsaturation, alcoholic, phenolic, aldehydic, ketonic, carboxylic and amino (primary) groups.

### H. Characteristic tests of arbohydrates, fats and proteins in pure samples and their detection in given food stuffs.

### I. Determination of concentration/molarity of $\text{KMnO}_4$ solution by titrating it against a standard solution of:

- (i) Oxalic acid
- (ii) Ferrous ammonium sulphate (Students will be required to prepare standard solutions by weighing themselves).

### J. Qualitative analysis

- 1) Determination of two cations from a given mixture of salts.
- 2) Determination of two anions from a given mixture of salts.

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

**Anions** –  $\text{CO}_3^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_2^-$ ,  $\text{NO}_3^-$ ,  $\text{Cl}^-$ ,  $\text{Br}^-$ ,  $\text{I}^-$ ,  $\text{PO}_4^{3-}$ ,  $\text{C}_2\text{O}_4^{2-}$ ,  $\text{CH}_3\text{COO}^-$   
(Note : Insoluble salts excluded.)

### PROJECT

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

#### A few suggested Projects:

- 1 Study of presence of oxalate ions in guava fruit at different stages of ripening.
- 2 Study of quantity of casein present in different samples of milk.
- 3 Preparation of soyabean milk and its comparison with the natural milk with



- respect to curd formation, effect of temperature, etc.
- 4 Study of the effect of potassium bisulphate as food preservative under various conditions (temperature, concentration, time etc).
  - 5 Study of digestion of starch by salivary amylase and, effect of pH and temperature on it.
  - 6 Comparative study of the rate of fermentation of following materials: wheat flour, gram flour, potato juice, carrot juice, etc.
  - 7 Extraction of essential oils present in Saunf (aniseed), Ajwain (carum), Illaichi (cardamom).
  - 8 Study of common food adulterants in fat, butter, sugar, turmeric powder, chilli powder and pepper.
- Note :** Any investigatory project, can be chosen with the approval of the teacher.

