

## Council of Higher Secondary Education, Odisha

### Syllabus: CHEMISTRY, XI-XII (2023-24)

#### Rationale

Higher Secondary is the most crucial stage of school education because at this juncture specialized discipline based, content -oriented courses are introduced. Students reach this stage after 10 years of general education and opt for Chemistry with a purpose of pursuing their career in basic sciences or professional courses like medicine, engineering, technology and study courses in applied areas of science and technology at tertiary level. Therefore, there is a need to provide learners with sufficient conceptual background of Chemistry, which will make them competent to meet the challenges of academic and professional courses after the senior secondary stage.

The new and updated curriculum is based on disciplinary approach with rigour and depth taking care that the syllabus is not heavy and at the same time it is comparable to the international level. The knowledge related to the subject of Chemistry has undergone tremendous changes during the past one decade. Many new areas like synthetic materials, bio -molecules, natural resources, industrial chemistry are coming in a big way and deserve to be an integral part of chemistry syllabus at senior secondary stage. At international level, new formulations and nomenclature of elements and compounds, symbols and units of physical quantities floated by scientific bodies like IUPAC and CGPM are of immense importance and need to be incorporated in the updated syllabus. The revised syllabus takes care of all these aspects. Greater emphasis has been laid on use of new nomenclature, symbols and formulations, teaching of fundamental concepts, application of concepts in chemistry to industry/ technology, logical sequencing of units, removal of obsolete content and repetition, etc.

#### Objectives

The curriculum of Chemistry at Senior Secondary Stage aims to:

- Promote understanding of basic facts and concepts in chemistry while retaining the excitement of chemistry.
- make students capable of studying chemistry in academic and professional courses (such as medicine, engineering, technology) at tertiary level.
- expose the students to various emerging new areas of chemistry and apprise them with their relevance in future studies and their application in various spheres of chemical sciences and technology.
- equip students to face various challenges related to health, nutrition, environment, population, weather, industries and agriculture.
- develop problem solving skills in students.
- expose the students to different processes used in industries and their technological applications.
- apprise students with interface of chemistry with other disciplines of science such as physics, biology, geology, engineering etc.
- acquaint students with different aspects of chemistry used in daily life.
- develop an interest in students to study chemistry as a discipline.
- integrate life skills and values in the context of chemistry.

**COURSE STRUCTURE**  
**CLASS-XI (THEORY) (2023-24)**

Time: 3 Hours

Total Marks :70

Sl. No.	UNIT	No. of Periods	Marks
1	Some Basic Concepts of Chemistry	12	7
2	Structure of Atom	14	9
3	Classification of Elements and Periodicity in Properties	8	6
4	Chemical Bonding and Molecular Structure	14	7
5	Chemical Thermodynamics	16	9
6	Equilibrium	14	7
7	Redox Reactions	6	4
8	Organic Chemistry: Some basic Principles and Techniques	14	11
9	Hydrocarbons	12	10
	<b>TOTAL</b>		<b>70</b>

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

**12 Periods**

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, Equivalent masses, concentration of solutions, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on stoichiometry.

**Unit II: Structure of Atom**

**14 Periods**

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 and completely filled orbitals.

**Unit III: Classification of Elements and Periodicity in Properties**

**08 Periods**

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. Nomenclature of elements with atomic number greater than 100.

**Unit IV: Chemical Bonding and Molecular Structure****14 Periods**

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 homonuclear diatomic molecules(qualitative idea only), Hydrogen bond.

**Unit VI: Chemical Thermodynamics****16 Periods**

Concepts of System and 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 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****14 Periods**

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 poly basic acids, acid strength, concept of pH, hydrolysis of salts (elementary idea), buffer solution, Henderson Equation, solubility product, common ion effect (with illustrative examples).

**Unit VIII: Redox Reactions****06 Periods**

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: Organic Chemistry -Some Basic Principles and Techniques****14 Periods**

General introduction, methods of purification, qualitative and quantitative analysis, classification and IUPAC nomenclature of organic compounds. Electronic displacements in a covalent bond: inductive effect, electrometric effect, resonance and hyper conjugation. Hemolytic and heterolysis fission of a covalent bond: free radicals, carbocation, carbanions, electrophiles and nucleophiles, types of organic reactions.

**Unit X: Hydrocarbons****12 Periods****Classification of Hydrocarbons****Aliphatic Hydrocarbons:**

**Alkanes-** Nomenclature, isomerism, conformation (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 monosubstituted benzene.

Carcinogenicity and toxicity.

**Prescribed Books:**

1. +2 Chemistry Vol- I : Published by Odisha State Bureau of Text Book Preparation and production, Bhubaneswar.
2. Chemistry Part - I, Class-XI, Published by NCERT.
3. Chemistry Part - II, Class-XI, Published by NCERT.

**Experiments:**

1. Basic Laboratory Techniques: (Non-evaluative)
  - a) Bunsen burner (different parts and their functions)
  - b) Chemical balance - weighing with chemical balance by equal oscillation method.
  - c) Cutting and bending glass tube, drawing jet and boring a cork.

2. Crystallization:

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

- a) Equivalent mass of Mg by hydrogen displacement method.
- b) 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

**QUESTION PATTERN AND DISTRIBUTION OF MARKS**  
**Class- XI (PRACTICAL)**

**Full Mark : 30**

**Time : 3 Hrs.**

1. Salt analysis (Acid radical)	<b>10 marks</b>
Dry Test	<b>04 marks</b>
Wet Test	<b>06 marks</b>
2. Crystallization / Single titration / Equivalent mass / Solubility	<b>10 marks</b>
3. Viva-Voce	<b>06 marks</b>
4. Record	<b>04 marks</b>

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**Practical Examination for Visually Impaired Students**  
**Class XI**

**A. List of apparatus for identification for assessment in practical (All experiments)**

Beaker, tripod stand, wire gauze, glass rod, funnel, filter paper, Bunsen burner, test tube, test tube stand, dropper, test tube holder, ignition tube, china dish, tongs, standard flask, pipette, burette, conical flask, clamp stand, dropper, wash bottle

- Odour detection in qualitative analysis
- Procedure/Setup of the apparatus

**B. Quantitative estimation**

1. Preparation of standard solution of oxalic acid.
2. Determination of molarity of a given solution of sodium hydroxide by titrating it against standard solution of oxalic acid.

**C. Qualitative Analysis**

1. Determination of one anion and one cation in a given salt
2. Cations -  $\text{NH}_4^+$   
Anions -  $(\text{CO}_3)^{2-}$ ,  $\text{S}^{2-}$ ,  $(\text{SO}_3)^{2-}$ ,  $\text{Cl}^-$ ,  $\text{CH}_3\text{COO}^-$   
(Note: insoluble salts excluded)

**Note: The above practicals may be carried out in an experiential manner rather than recording observations.**

**Prescribed Books:**

1. Chemistry Part - I, Class-XI, Published by NCERT
2. Chemistry Part - II, Class-XI, Published by NCERT

## QUESTION PATTERN AND DISTRIBUTION OF MARKS

Identification/Familiarity with the apparatus	5 marks
Written test (based on given/prescribed practicals)	10 marks
Practical Record	5 marks
Viva	10 marks
Total	30 marks

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### CLASS XII (2023-24) (THEORY)

Time: 3 Hours

70 Marks

#### Unit wise distribution of Periods and marks

Sl.No.	Title	No. of Periods	Marks
1	Solutions	10	7
2	Electrochemistry	12	9
3	Chemical Kinetics	10	7
4	d -and f -Block Elements	12	7
5	Coordination Compounds	12	7
6	Haloalkanes and Haloarenes	10	6
7	Alcohols, Phenols and Ethers	10	6
8	Aldehydes, Ketones and Carboxylic Acids	10	8
9	Amines	10	6
10	Biomolecules	12	7
	<b>Total</b>		<b>70</b>

#### Unit I: Solutions

10 Periods

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, Raoul's law, colligative properties - relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass, Van't Hoff factor.

#### Unit II: Electrochemistry

12 Periods

Redox reactions, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis (elementary idea), dry cell-electrolytic cells and Galvanic cells, lead accumulator, fuel cells, corrosion.

**Unit III: Chemical Kinetics****10 Periods**

Rate of a 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 IV: d and f Block Elements****12 Periods**

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, color, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and properties of  $K_2Cr_2O_7$  and  $KMnO_4$ .

**Lanthanides** - Electronic configuration, oxidation states, chemical reactivity and lanthanide contraction and its consequences.

**Actinides** - Electronic configuration, oxidation states and comparison with lanthanides.

**Unit V: Coordination Compounds****12 Periods**

Coordination compounds - Introduction, ligands, coordination number, color, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, VBT, and CFT; structure and stereoisomerism, importance of coordination compounds (in qualitative analysis, extraction of metals and biological system).

**Unit VI: Halo alkanes and Halo alkenes****10 Periods**

**Halo alkanes:** Nomenclature, nature of C-X bond, physical and chemical properties, optical rotation mechanism of substitution reactions.

**Halo alkenes:** Nature of C-X bond, substitution reactions (Directive influence of halogen in mono substituted compounds only).

Uses and environmental effects of - dichloromethane, tri chloromethane, tetra chloromethane, iodoform, freons, DDT.

**Unit VII: Alcohols, Phenols and Ethers****10 Periods**

**Alcohols:** Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration, uses with special reference to 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 VIII: Aldehydes, Ketones and Carboxylic Acids****10 Periods**

**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 IX: Amines****10 Periods**

**Amines:** Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

**Diazonium salts:** Preparation, chemical reactions and importance in synthetic organic chemistry.

**Unit X: Biomolecules****12 Periods**

**Carbohydrates** - Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); Importance of carbohydrates.

**Proteins** -Elementary idea of - amino acids, peptide bond, polypeptides, proteins, structure of proteins

- primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins; enzymes. Hormones - Elementary idea excluding structure.

**Vitamins** - Classification and functions.

**Nucleic Acids:** DNA and RNA.

**Prescribed Books:**

1. +2 Chemistry Vol- II : Published by Odisha State Bureau of Text Book Preparation and production, Bhubaneswar
2. Chemistry Part - I, Class-XII, Published by NCERT
3. Chemistry Part - II, Class-XII, Published by NCERT

**CHEMISTRY (PRACTICAL)**  
**XII (Science)**  
**(Detailed Syllabus)**

**1. Crystallization:**

- a) Preparation of Mohr's Salt [ $\text{FeSO}_4, (\text{NH}_4)_2\text{SO}_4, 6\text{H}_2\text{O}$ ] crystal.
- b) Preparation of potash alum [ $\text{K}_2\text{SO}_4, \text{Al}_2(\text{SO}_4)_3, 24\text{H}_2\text{O}$ ] crystal.

**2. Quantitative Analysis :**

- a) **Double titration** : Two experiments to be done - i) one acid two alkalis double titration and ii) Two acids one alkali double titration.
- b) **Bench Acid Titration:** Strong acid of approximately 2.0 N be supplied.
- c) **Redox Titration:** Titration between potassium permanganate and oxalic acid.

**3. Qualitative Inorganic Analysis :**

**Wet tests for basic radicals:** Wet tests for the following basic radicals be done.

Group-I basic radicals:  $\text{Ag}^+, \text{Pb}^{2+}, \text{Hg}_2^{2+}$

Group-II basic radicals :  $\text{Hg}^{2+}, \text{Cu}^{2+}, \text{Bi}^{3+}, \text{As}^{3+}, \text{Sb}^{3+}, \text{Sn}^{2+} \& \text{Sn}^{4+}$ ,

Group-III A basic radicals:  $\text{Fe}^{3+}, \text{Al}^{3+} \& \text{Cr}^{3+}$ .

Group-III B basic radicals:  $\text{Co}^{2+}, \text{Ni}^{2+}, \text{Zn}^{2+} \& \text{Mn}^{2+}$

Group-IV basic radicals:  $\text{Ba}^{2+}, \text{Ca}^{2+} \& \text{Sr}^{2+}$

Group-V basic radicals:  $\text{NH}_4^+, \text{Mg}^{2+}, \text{K}^+, \text{Na}^+$ .

**Identification of unknown basic radicals.**

[For identification of unknown basic radicals both dry and wet tests are to be performed]



#### 4. Qualitative Organic Analysis :

Tests for unsaturation, distinction between aromatic and aliphatic compounds by copper foil test, tests for carboxylic, phenolic, aldehydes, ketonic and alcoholic groups.

#### Book Recommended

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

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### QUESTION PATTERN AND MARK DISTRIBUTION CHEMISTRY (PRACTICAL) XII (Science)

Full Mark: 30

Time: 3 Hrs.

1. Salt Analysis (Identification of basic radical only) 12 mark
  - a) Dry Test = 05 marks
  - b) Wet Test = 07 marks
2. Crystallization / Double Titration /Bench Acid Titration Redox Titration / Organic compound =10 marks
3. Viva-voce=05 marks
4. Record =03 marks

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#### Practical Examination for Visually Impaired Students of Classes XII

Full Mark: 30

Time: 3 Hrs.

#### A. Quantitative Analysis

- (1) (a) Preparation of the standard solution of Oxalic acid of a given volume
- (b) Determination of molarity of  $\text{KMnO}_4$  solution by titrating it against a standard solution of Oxalic acid.

#### B. Qualitative Analysis:

- (1) Determination of one cation and one anion in a given salt.

Cation -  $\text{NH}_4^+$

Anions -  $\text{CO}_3^{2-}$ ,  $\text{S}^{2-}$ ,  $\text{SO}_3^{2-}$ ,  $\text{Cl}^-$ ,  $\text{CH}_3\text{COO}^-$

(Note: Insoluble salts excluded)

**Note:** The above practicals may be carried out in an experiential manner rather than recording observations.

#### Prescribed Books:

1. Chemistry Part -I, Class-XII, Published by NCERT
2. Chemistry Part -II, Class-XII, Published by NCERT

**QUESTION PATTERN AND MARK DISTRIBUTION**  
**CHEMISTRY (PRACTICAL)**  
**XII (Science)**

Identification/Familiarity with the apparatus	5 marks
Written test (based on given/prescribed practicals)	10 marks
Practical Record	5 marks
Viva	10 marks
Total	30 marks

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