

## **CHEMISTRY (Code No. 043) (2022-2023)**

Higher Secondary is the most crucial stage of school education because specialized discipline-based, content-oriented courses are introduced at this juncture. Students reach this stage after 10 years of general education and opt for Chemistry to pursue their career in basic sciences or professional courses like medicine, engineering, technology and study courses in applied areas of science and technology at the tertiary level. Therefore, there is a need to provide learners with sufficient conceptual background in 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 a 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 decade. Many new areas like synthetic materials, biomolecules, natural resources, and industrial chemistry are coming in a big way and deserve to be an integral part of the chemistry syllabus at the senior secondary stage. At the 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 into the updated syllabus. The revised syllabus takes care of all these aspects. Greater emphasis has been laid on the use of new nomenclature, symbols and formulations, the 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) (2022-23)

**Time:3Hours**

**Total Marks70**

S.NO	UNIT	PERIODS	MARKS
1	Some Basic Concepts of Chemistry	18	7
2	Structure of Atom	20	9
3	Classification of Elements and Periodicity in Properties	12	6
4	Chemical Bonding and Molecular Structure	20	7
5	Chemical Thermodynamics	23	9
6	Equilibrium	20	7
7	Redox Reactions	9	4
8	Organic Chemistry: Some basic Principles and Techniques	20	11
9	Hydrocarbons	18	10
	<b>TOTAL</b>	<b>160</b>	<b>70</b>

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

**18 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, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on stoichiometry.

### **Unit II: Structure of Atom**

**20 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**

**12 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**

**20 Periods**

Valence electrons, ionic bond, covalent bond, bond parameters, Lewis's 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**

**23 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**

**20 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**

**09 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 XII: Organic Chemistry -Some Basic Principles and Techniques**

**20 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, 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**

**18 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, the 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, the 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 the functional group in monosubstituted benzene. Carcinogenicity and toxicity.

**PRACTICALS****3 HOURS/ 30 Marks**

<b>Evaluation Scheme for Examination</b>	<b>Marks</b>
Volumetric Analysis	08
Salt Analysis	08
Content Based Experiment	06
Project Work	04
Class record and viva	04
<b>Total</b>	<b>30</b>

**PRACTICAL SYLLABUS****Total Periods: 60**

**Micro-chemical methods are available for several of the practical experiments, wherever possible such techniques should be used.**

**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 based on pH**

1. Any one of the following experiments:
  - Determination of pH of some solutions obtained from fruit juices, solution of known and varied concentrations of acids, bases and salts using pH paper or universal indicator.

- Comparing the pH of solutions of strong and weak acids of same concentration. □ Study the pH change in the titration of a strong base using universal indicator.
2. Study the pH change by common-ion in case of weak acids and weak bases.

#### D. Chemical Equilibrium

One of the following experiments:

1. Study the shift in equilibrium between ferric ions and thiocyanate ions by increasing/decreasing the concentration of either of the ions.
2. 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

1. Using a mechanical balance/electronic balance.
2. Preparation of standard solution of Oxalic acid.
3. Determination of strength of a given solution of Sodium hydroxide by titrating it against standard solution of Oxalic acid.
4. Preparation of standard solution of Sodium carbonate.
5. Determination of strength of a given solution of hydrochloric acid by titrating it against standard Sodium Carbonate solution.

#### F. Qualitative Analysis

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

**Cation:**

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

**Anions:**

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

**(Note: Insoluble salts excluded)**

2. Detection of -Nitrogen, Sulphur, Chlorine in organic compounds.

#### G. PROJECTS

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 study of causes of presence 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 it
- Study the acidity of different samples of tea leaves.
- Determination of the rate of evaporation of different liquids.
- Study the effect of acids and bases on the tensile strength of fibers.

- Study of acidity of fruit and vegetable juices.

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

### **PRACTICAL EXAMINATION FOR VISUALLY IMPAIRED STUDENTS**

**Note:** Same Evaluation scheme and general guidelines for visually impaired students as given for Class XII may be followed.

#### **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. List of Experiments A. Characterization and Purification of Chemical Substances**

1. Crystallization of an impure sample of any one of the following: copper sulphate, benzoic acid

#### **C. Experiments based on pH**

1. Determination of pH of some solutions obtained from fruit juices, solutions of known and varied concentrations of acids, bases and salts using pH paper
2. Comparing the pH of solutions of strong and weak acids of same concentration.

#### **D. Chemical Equilibrium**

1. Study the shift in equilibrium between ferric ions and thiocyanate ions by increasing/decreasing the concentration of either ions.
2. 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**

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.

#### **F. 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)

3. Detection of Nitrogen in the given organic compound.
4. Detection of Halogen in the given organic compound.

**Note:** The above practical 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.
3. Laboratory Manual of Chemistry, Class XI Published by NCERT
4. Other related books and manuals of NCERT including multimedia and online sources

**Note:**

**The content indicated in NCERT textbooks as excluded for the year 2022-23 is not to be tested by schools.**

**Practical Examination for Visually Impaired Students of Classes XI**  
**Evaluation Scheme**

**Time Allowed: Two hours**

**Max. Marks:30**

<b>Topic</b>	<b>Marks</b>
Identification/Familiarity with the apparatus	5
Written test (based on given/prescribed practicals)	10
Practical Record	5
Viva	10
<b>Total</b>	<b>30</b>

**General Guidelines**

- The practical examination will be of two hours duration.
- A separate list of ten experiments is included here.
- The written examination in practicals for these students will be conducted at the time of the practical examination of all other students.
- The written test will be of 30 minutes duration.
- The question paper given to the students should be legibly typed. It should contain a total of 15 practical skill-based very short answer type questions. A student would be required to answer any 10 questions.
- A writer may be allowed to such students as per CBSE examination rules.



- All questions included in the question papers should be related to the listed practical. Every question should require about two minutes to be answered.
- These students are also required to maintain a practical file. A student is expected to record at least five of the listed experiments as per the specific instructions for each subject. These practicals should be duly checked and signed by the internal examiner.
- The format of writing any experiment in the practical file should include aim, apparatus required, simple theory, procedure, related practical skills, precautions etc.
- Questions may be generated jointly by the external/internal examiners and used for assessment.
- The viva questions may include questions based on basic theory/principle/concept, apparatus/materials/ chemicals required, procedure, precautions, sources of error etc.

### **1. Items for Identification/Familiarity of the apparatus for assessment in practical (All experiments)**

Beaker, glass rod, tripod stand, wire gauze, Bunsen burner, Whatman filter paper, gas jar, capillary tube, pestle and mortar, test tubes, tongs, test tube holder, test tube stand, burette, pipette, conical flask, standard flask, clamp stand, funnel, filter paper

Hands-on Assessment

- Identification/familiarity with the apparatus
- Odour detection in qualitative analysis

### **2. List of Practicals**

The experiments have been divided into two sections:

**Section A and Section B.**

**The experiments mentioned in Section B are mandatory.**

#### **SECTION- A**

##### **A Surface Chemistry**

- 1 Preparation of one lyophilic and one lyophobic sol - starch, egg albumin and gum
- 2 Preparation of one lyophobic sol– Ferric hydroxide

##### **B Chromatography**

Separation of pigments from extracts of leaves and flowers by paper chromatography and determination of  $R_f$  values (distance values may be provided).

##### **C Tests for the functional groups present in organic compounds:**

- (1) Alcoholic and Carboxylic groups.
- (2) Aldehydic and Ketonic

**D Characteristic tests of carbohydrates and proteins in the given foodstuffs.**

**E Preparation of Inorganic Compounds- Potash Alum**

**SECTION-B (Mandatory)**

**F 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.
- (2) The above exercise [F 1 (a) and (b)] to be conducted using Ferrous ammonium sulphate (Mohr's salt)

**G 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 practical 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.
3. Laboratory Manual of Chemistry, Class XI Published by NCERT
4. Other related books and manuals of NCERT including multimedia and online sources

**QUESTION PAPER DESIGN CLASSES –XI (2022-23)**

S.No	Domains	Marks	%
1	<b>Remembering and Understanding:</b> Exhibit memory of previously learned material by recalling facts, terms, basic concepts and answers. Demonstrate understanding of facts and ideas by organizing, comparing, translating, interpreting, giving descriptions and stating main ideas.	28	40
2	<b>Applying:</b> Solve problems to new situations by applying acquired knowledge, facts, techniques and rules in a different way.	21	30
3	<b>Analyzing, Evaluating and Creating:</b> Examine and break information into parts by identifying motives or causes. Make inferences and find evidence to support generalizations. Present and defend opinions by making judgments about information, the validity of ideas or quality of work based on a set of criteria. Compile information together in a different way by combining elements in a new pattern or proposing alternative solutions.	21	30

**For more details kindly refer to Sample Question Paper of class XII for the year 2022-23 to be published by CBSE at its website.**