

CHEMISTRY (043)

SYLLABUS FOR SESSION 2021-22 CLASS XI Term-I

S	UNIT	Periods	Marks
1	Some Basic Concepts of Chemistry	10	11
2	Structure of Atom	12	
3	Classification of Elements and Periodicity in Properties	6	4
4	Chemical Bonding and Molecular Structure	14	6
5	Redox Reactions	4	5
6	Hydrogen	4	
7	Organic Chemistry: Some basic Principles and Techniques	10	9
	TOTAL	60	35

Some Basic Concepts of Chemistry: General Introduction: Importance and scope of Chemistry. Atomic and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on stoichiometry.

Structure of Atom: 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

Classification of Elements and Periodicity in Properties: 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.

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

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.

Hydrogen: Position of hydrogen in periodic table, occurrence, isotopes, hydrides-ionic covalent and interstitial; physical and chemical properties of water, heavy water, hydrogen as a fuel

Organic Chemistry: Some basic Principles and Techniques: General introduction, 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.

PRACTICALS

Term I: A 15-mark Practical would be conducted under the supervision of subject teacher. This would contribute to the overall practical marks for the subject.

OR

In case the situation of lockdown continues until Nov-Dec 2021, a *Practical Based Assessment (pen-paper)* of 15 marks would be conducted at the end of Term I.

Term-I Evaluation Scheme

S. No	Practical	Marks
1.	Volumetric Analysis	8
2.	Content Based experiment	2
3.	Class record and viva (Internal Examiner)	5
TOTAL		15

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 of Chemical Substances (2 Marks)

1. Determination of melting point of an organic compound.
2. Determination of boiling point of an organic compound.

C. Quantitative Estimation (8 marks)

- i. Using a mechanical balance/electronic balance.
- ii. Preparation of standard solution of Oxalic acid.
- iii. Determination of strength of a given solution of Sodium hydroxide by titrating it against standard solution of Oxalic acid.
- iv. Preparation of standard solution of Sodium carbonate.
- v. Determination of strength of a given solution of hydrochloric acid by titrating it against standard Sodium Carbonate solution.

SYLLABUS FOR SESSION 2021-22 CLASS XI Term-II

S.No	UNIT	Periods	Marks
1	States of Matter: Gases and Liquids	9	15
2	Chemical Thermodynamics	14	
3	Equilibrium	12	
4	s -Block Elements	5	11
5	Some p -Block Elements	9	
6	Hydrocarbons	10	9
	TOTAL	59	35

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 and deviation from ideal behaviour.

Chemical Thermodynamics: 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, measurement of ΔU and ΔH , 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.

Third law of thermodynamics (brief introduction).

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 poly basic acids, acid strength, concept of pH, buffer solution, solubility product, common ion effect (with illustrative examples).

s -Block Elements: 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.

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.

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.

Hydrocarbons: Classification of Hydrocarbons Aliphatic Hydrocarbons:

Alkanes - Nomenclature, isomerism, conformation (ethane only), physical properties, chemical reactions.

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.

PRACTICALS

Term II: At the end of Term II, a **15-mark Practical** would be conducted under the supervision of subject teacher. This would contribute to the overall practical marks for the subject.

OR

In case the situation of lockdown continues beyond December 2021, a *Practical Based Assessment (pen-paper) of 10 marks and Viva 5 marks* would be conducted at the end of Term II by the subject teacher. This would contribute to the overall practical marks for the subject.

TERM-II Evaluation Scheme

S. No	Practical	Marks
1.	Salt Analysis	8
2.	Content Based Experiment	2
3	Project Work and Viva(Internal)	5
TOTAL		15

A. Qualitative Analysis(Marks 8)

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

Cations- Pb^{2+} , Cu^{2+} , As^{3+} , Al^{3+} , Fe^{3+} , Mn^{2+} , Ni^{2+} , Zn^{2+} , Co^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , NH_4^+

Anions – $(\text{CO}_3)^{2-}$, S^{2-} , NO_2^- , SO_3^{2-} , SO_4^{2-} , NO_3^- , Cl^- , Br^- , I^- , PO_4^{3-} , $\text{C}_2\text{O}_4^{2-}$, CH_3COO^- (Note: Insoluble salts excluded)

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

B. Crystallization of impure sample of any one of the following: Alum, Copper Sulphate, Benzoic Acid. (Marks 2)

PROJECTS scientific investigations involving laboratory testing and collecting information from other sources.

Guidelines on Syllabus for Visually Handicapped students.

Schools are expected to rationalise and divide the syllabus of practicums for visually handicapped students into two halves on the basis of collective guidelines given for the same in the complete syllabus and as per the convenience of their students. This flexibility is given in view of the special

condition of visually handicapped students .They will, however, be assessed on 15 marks in practical examination in both the terms as rest of their peers.

SYLLABUS FOR SESSION 2021-22 CLASS XII Term-I

S.No	UNIT	Periods	MARKS
1	Solid State	8	10
2	Solutions	8	
3	p-Block Elements	7	10
4	Haloalkanes and Haloarenes	9	15
5	Alcohols, Phenols and Ethers	9	
6	Biomolecules	8	
	TOTAL	49	35

Solid State: Classification of solids based on different binding 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, packing efficiency, voids, number of atoms per unit cell in a cubic unit cell, point defects.

Solutions: Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, Raoult'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.

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.

Group 16 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties, dioxygen: preparation, properties and uses, classification of Oxides, Ozone, Sulphur -allotropic forms; compounds of Sulphur: preparation properties and uses of Sulphur-dioxide, Sulphuric Acid: 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 (structures only).

Group 18 Elements: General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.

Haloalkanes and Haloarenes: Haloalkanes: Nomenclature, nature of C–X bond, physical and chemical properties, optical rotation mechanism of substitution reactions.

Haloarenes: Nature of C–X bond, substitution reactions (Directive influence of halogen in monosubstituted compounds only).

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.

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.

Biomolecules: Carbohydrates - Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L configuration

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.

Nucleic Acids: DNA and RNA

PRACTICALS

Term I: A 15-mark Practical would be conducted under the supervision of subject teacher/ internal examiner. This would contribute to the overall practical marks for the subject.

OR

In case the situation of lockdown continues until Nov-Dec 2021, a *Practical Based Assessment (pen-paper) of 15 marks* would be conducted at the end of Term I at the school level and marks would be submitted by the schools to the Board. This would contribute to the overall practical marks for the subject.

Term-I Evaluation Scheme

S. No	Practical	Marks
1.	Volumetric Analysis	4
2.	Salt Analysis	4
3.	Content Based experiment	2
4.	Class record and viva (Internal Examiner)	5
	TOTAL	15

(1) Volumetric analysis (4 marks)

Determination of concentration/ molarity of KMnO_4 solution by titrating it against a standard solution of:

- Oxalic acid,
- Ferrous Ammonium Sulphate

(Students will be required to prepare standard solutions by weighing themselves).

(2) Salt analysis (Qualitative analysis) (4 marks)

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

Cations- Pb^{2+} , Cu^{2+} , As^{3+} , Al^{3+} , Fe^{3+} , Mn^{2+} , Ni^{2+} , Zn^{2+} , Co^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , NH_4^+

Anions – $(\text{CO}_3)^{2-}$, S^{2-} , NO_2^- , SO_3^{2-} , SO_4^{2-} , NO_3^- , Cl^- , Br^- , I^- , PO_4^{3-} , $\text{C}_2\text{O}_4^{2-}$, CH_3COO^- (Note:

Insoluble salts excluded)

(3) Content Based Experiments (2 marks)

A. Chromatography

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

B. Characteristic tests of carbohydrates, fats and proteins in pure samples and their detection in given foodstuffs.

SYLLABUS FOR SESSION 2021-22 CLASS XII Term-II

S.No	UNIT	No. of Periods	MARKS
1	Electrochemistry	7	13
2	Chemical Kinetics	5	
3	Surface Chemistry	5	
4	d-and f-Block Elements	7	9
5	Coordination Compounds	8	
6	Aldehydes, Ketones and Carboxylic Acids	10	13
7	Amines	7	
	TOTAL	49	35

Electrochemistry: 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.

Chemical Kinetics: 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).

Surface Chemistry: Adsorption - physisorption and chemisorption, factors affecting adsorption of gases on solids, colloidal state: distinction between true solutions, colloids and suspension; lyophilic, lyophobic, multi-molecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation.

d-and f-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.

Lanthanoids - Electronic configuration, oxidation states and lanthanoid contraction and its consequences.

Coordination Compounds: Coordination compounds - Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, VBT, and CFT.

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.

Amines:

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

PRACTICALS

Term II: At the end of Term II, a **15-mark Practical** would be conducted under the supervision of Board appointed external examiners. This would contribute to the overall practical marks for the subject.

OR

In case the situation of lockdown continues beyond December 2021, a *Practical Based Assessment (pen-paper) of 10 marks and Viva 5 marks* would be conducted at the end of Term II jointly by the external and internal examiners and marks would be submitted by the schools to the Board. This would contribute to the overall practical marks for the subject.

TERM-II Evaluation Scheme

S. No	Practical	Marks
1.	Volumetric Analysis	4
2.	Salt Analysis	4
3	Content Based Experiment	2
4	Project Work and Viva (Internal and External Both)	5
	TOTAL	15

1) Volumetric analysis (4 marks)

Determination of concentration/ molarity of KMnO_4 solution by titrating it against a standard solution of:

- Oxalic acid,
- Ferrous Ammonium Sulphate

(Students will be required to prepare standard solutions by weighing themselves).

2) Salt analysis (Qualitative analysis) (4 marks)

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

Cations- Pb^{2+} , Cu^{2+} , As^{3+} , Al^{3+} , Fe^{3+} , Mn^{2+} , Ni^{2+} , Zn^{2+} , Co^{2+} , Ca^{2+} , Sr^{2+} , Ba^{2+} , Mg^{2+} , NH_4^+

Anions – $(\text{CO}_3)^{2-}$, S^{2-} , NO_2^- , SO_3^{2-} , SO_4^{2-} , NO_3^- , Cl^- , Br^- , I^- , PO_4^{3-} , $\text{C}_2\text{O}_4^{2-}$, CH_3COO^- (Note: Insoluble salts excluded)

3) Content based experiment

- Preparation of Inorganic Compounds
Preparation of double salt of Ferrous Ammonium Sulphate or Potash Alum.
Preparation of Potassium Ferric Oxalate.
- Tests for the functional groups present in organic compounds:
Unsaturation, alcoholic, phenolic, aldehydic, ketonic, carboxylic and amino (Primary) groups.

Guidelines on Syllabus for Visually Handicapped students.

Schools are expected to rationalise and divide the syllabus of practicums for visually handicapped students into two halves on the basis of collective guidelines given for the same in the complete syllabus and as per the convenience of their students. This flexibility is given in view of the special condition of visually handicapped students. They will, however, be assessed on 15 marks in practical examination in both the terms as rest of their peers.

General Instructions for Investigatory Project

In Chemistry the students of class XI and XII are supposed to conduct a scientific investigations involving laboratory testing and collecting information from other sources. This project is assessed as a part of practical examination at the end of year.

At the outset, teachers must map appropriate competencies or learning outcomes with real world problems (projects) that are age appropriate for their students. Students in consultation with their teacher finally determine the project question for them depending upon their interest and proclivity. A project should ideally arise out of the need felt by the student. Students explore their areas of interest and narrow down their ideas to a testable hypothesis or problem question.

For example: Abdul waits for summers as his favourite fruit watermelon is available in plenty. This year he noticed that every time he bought a watermelon its colour was dark red and was exceptionally sweet from inside. This never happened in earlier years. Some watermelons would be sweet some would not. Abdul were surprised by this observation and worried if the fruit was adulterated. He thought of conducting a test to find out if fruits and vegetables available in his locality were adulterated. He reviewed articles and papers on adulteration and found out simple tests to check adulteration at home. Abdul conducted the test and shared his results with his friend and teacher. He developed a small manual to help other check adulteration in fruits.

There are many issues in our immediate surroundings which need to be addressed. Keen observation will help identify the problem.

Before developing a problem question, students must do research on topics and find out what other people have already done in the selected area to avoid repetition. During this phase, students should be encouraged to record the reference of every bit of information they got from different sources. After developing problem question, students should write down precise testable hypothesis and design an experiment or procedure to test their hypothesis by collecting and analysing the data followed by writing conclusion and limitation of the study. Students must also develop a timeline and checklist about accessibility to resources required, safety of experiment/procedure, harmlessness of experiments to environment, organisms and other people. Teacher must ensure that it is doable within a specified period of time and available resources and is appropriately challenging to a particular student (neither be very complex or longer nor be very easy and short). It should not culminate into finding information from a book or website.

A project could have the following outline:

1. **Statement of Problem-** A clear statement of the problem/need that has given rise to the project
2. **Objectives-**General and specific objectives of topic

3. **Introduction**-The introduction should describe the relevance of problem or why the problem is the most appropriate for your inquiry. It should also describe previously known facts about your problem question with proper bibliography. Introduction towards end briefly includes hypothesis your hypothesis and the method to test it.
4. **Problem question** (specific, concrete questions to which concrete answers can be given) and/ or hypotheses
5. **Methods/Procedures** Methodology (will your research be based on survey, an experimental investigation, historical study, ethnographic study or content analysis).Methods describe the experiments proposed or the observations planned to make and the detailed process of analysis of data/observations. Methods proposed should be feasible and be able to adequately answer problem question.
6. **Materials/Resources required**
7. **Observations/Data gathered**
Using the procedures mentioned in introduction, experiments should be conducted and data should be recorded. Interesting things that happened during the conduct of experiments should also be recorded.
8. **Analysis of data and discussion of result**
Data should be interpreted in terms of proposed hypothesis. Data should be tabulated and interpreted with the help of graphs if possible. The interpretation should be done in an honest manner even if it does not support proposed hypothesis.
9. **Conclusion** Reporting and writing up the report
Discussion of new learning from the study may be covered under conclusion. This may have possible suggestions for future studies.
10. **Limitation of the study**
The limitations of the study are those features of design or procedure that might have affected the interpretation of the results of study. The limitations are alternatively interpreted as flaws or shortcomings due to flawed methodology, observations, small number of experiments or non-peer reviewed nature of study etc.
11. **Bibliography**

Rubric for Assessment of Project

PARAMETER	Exemplary (4)	Accomplished (3)	Developing (2)	Beginner (1)
Factual information	Content covers the research well	Content from all eras but has few inaccuracies	Content does not cover all eras and has few inaccuracies	Content does not cover all eras and is historically inaccurate
Sources	Multiple sources (6 or more) used (library, books, interview with people, different websites, blogs etc.)	Many sources (4-5) used (Books, websites, blogs)	Few sources used (2-3)	Relied on only one source
Data collection	Collected data from a large random sample (50 people or more from different age group, gender, social status) OR collected data for different samples and at least 5 reading for each set of experiment	Collected data from a fairly large random sample (30 -50 people from different age group, gender, social status) OR collected data for different samples and 3 reading for each set of experiment	Collected data from a small random sample (20 people from different age group, gender, social status) OR collected data for one sample and 3-5 readings	Collected data from a small sample (10 or less people) OR collected data for one sample and 1-2 readings
Interpretations and conclusion	In correlation with data and aim of the project. Clear conclusions based on findings	In correlation with data and aim of the project. Conclusions not based on findings	Not in correlation with data but in correlation with the aim Random conclusions	Not in correlation with data and aim, No conclusions
Journal	Daily entries with details of discussions and brainstorming sessions with the teacher.	Most of the entries done with details of discussions with the teacher	Daily entries without details	Random entries
Project report	Exceptionally attractive, organized sequentially and logically, creatively presented with data and clear conclusions	Attractive, organized sequentially and logically, presented some data and conclusions	Information is organized sequentially and logically but not in an attractive manner. Random Data without conclusions	Presentation is confusing. There is no sequence.
Academic Honesty	Sites all sources and gives due credits	Most of the sources cited	Few sources cited	Uses other people's ideas without giving credit