CHEMISTRY OVERVIEW
GRADES XI AND XII

Delhi Board of School Education (DBSE)

Directorate of Education, Government of National Capital Territory of Delhi

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABBREVIATIONS AND ACRONYMS

ASoSE	Ambedkar School of Specialised Excellence
DBSE	Delhi Board of School Education
TA	Term-end Assessment
IA	Internal Assessment
IB	International Baccalaureate
IGCSE	International General Certificate of Secondary Education
KP	Knowledge Partners
MYP	Middle Years Programme

1. Introduction

1.1. Importance of Chemistry

Science is an attempt to understand the universe as an independent and external reality. Pure science helps in building common understanding of this external universe and applied science and engineering help in developing new processes and products to understand and ease human existence in this universe. However, it is difficult to draw boundaries around the two form of sciences. It is difficult to separate them in isolation.

During the senior secondary stage of school education, students' transit from general approach towards sciences to discipline-based approach. They study theories, laws and hypotheses specific to their domain of study. The science is built upon experiments. Chemistry is an experimental science that combines academic study with the acquisition of practical and investigational skills. It is often called the central science, as chemical principles underpin both the physical environment in which we live and all biological systems. Apart from being a subject worthy of study in its own right, Chemistry is a prerequisite for many other courses in higher education, such as medicine, biological science and environmental science, and serves as useful preparation for employment. Chemistry is an experimental science that combines academic study with the acquisition of practical and investigational skills.

1.2. Aims

The aims of Chemistry courses at senior secondary level are to enable students to:

- appreciate scientific study and creativity within a global context through stimulating and challenging opportunities
- acquire a body of knowledge, methods and techniques that characterize science and technology
- apply and use a body of knowledge, methods and techniques that characterize science and technology by promotion of process-skills, problem-solving abilities and applications
- develop an ability to analyse, evaluate and synthesize scientific information
- develop a critical awareness of the need for and the value of effective collaboration and communication during scientific activities
- develop experimental and investigative scientific skills including the use of current technologies
- develop and apply 21st-century communication skills by promoting problem solving abilities and creative thinking in learners.
- become critically aware, as global citizens, of the ethical implications of using science and technology
- develop an appreciation of the possibilities and limitations of science and technology
- develop an understanding of the relationships between scientific disciplines and their influence on other areas of knowledge by exposing the learners to different processes used in industrial and technological applications.

1.3. Objectives of Chemistry Education

The objectives of Chemistry education encompass the factual, conceptual, procedural and metacognitive dimensions of knowledge. These objectives relate directly to the assessment criteria used in assessments.

Followed a DBSE Chemistry Senior Secondary Course, students will be expected to demonstrate the following.

Objective A – Knowledge and Understanding

Students would have knowledge and understanding of –

- facts, concepts and terminology
- methodologies and techniques
- communicating scientific information

Objective B – Application

Students would be able to apply:

- facts, concepts and terminology
- methodologies and techniques
- methods of communicating scientific information.

Objective C – Higher Order Thinking Skills

Students would be able to –

- hypothesise and make predictions
- evaluate and analyse methodologies and techniques
- give scientific explanations

Criteria D – Investigation and observation skills

Students would be able to use –

- science as investigative and exploration tool
- design and conduct experiments
- draw conclusions

2. Chemistry as a subject

2.1. Physical Chemistry

STOICHIOMETRY

Stoichiometry refers to **the quantitative study of the reactants and products involved in a chemical reaction**. The word " stoichiometry" is derived from the Greek word "stoikhein" meaning element and "metron" meaning measure. **It helps you predict how much of a reactant participates in a chemical reaction, how much product you'll get, and how much reactant might be left over**. Stoichiometry calculations **help scientists and engineers working in industry to estimate the amount of products they will obtain from a given procedure**: they can also help decide whether the product is profitable to produce or not.

THERMODYNAMICS

Thermodynamics is **the study of the relations between heat, work, temperature, and energy**. The laws of thermodynamics describe how the energy in a system changes and whether the system can perform useful work on its surroundings. Thermodynamics **gives the foundation for heat engines, power plants, chemical reactions, refrigerators, and many more important concepts that the world we live in today relies on**.

STATES OF MATTER

There are four natural states of matter: **Solids, liquids, gases and plasma**. The fifth state is the man-made Bose-Einstein condensates. Other, more exotic states of matter can occur at extremely high energy levels or at extremely low temperatures, where atoms and molecules (or their components) arrange in unusual ways. Scientists also sometimes distinguish between **crystalline solids** (where the atoms and molecules are lined up in a regular pattern) and **glassy solids** (where the atoms and molecules are attached in a random fashion). The gas laws have been around for a long time, and they greatly assist scientists in determining quantities, pressure, volume, and temperature when it comes to gas

SURFACE CHEMISTRY

Surface chemistry is the branch of chemistry in which we study those chemical reactions or chemical changes which are taking place at the interface of two phases which can be solid-gas, solid-liquid, liquid – gas etc. Surface Chemistry has various applications in analytical work, medicinal field, paint industry etc. There are a variety of phenomena that occur on the surface of substances, including Adsorption Heterogeneous Catalysis, Corrosion, and Crystallization

ELECTROCHEMISTRY

Electrochemistry is the branch of Physical Chemistry concerned with the relationship between electrical potential difference, as a measurable and quantitative phenomenon, and identifiable chemical change, with the potential difference as an outcome of a particular chemical change, or vice versa. Electrochemistry has many common applications in everyday life. **All sorts of batteries, from those used to power a flashlight to a calculator to an automobile, rely on chemical reactions to generate electricity**. Electricity is used to plate objects with decorative metals like gold or chromium.

CHEMICAL KINETICS

Chemical kinetics, also known as reaction kinetics, is the branch of Physical Chemistry that is concerned with understanding the rates of chemical reactions. Chemical kinetics, as one of the

pillars of Physical Chemistry, **contributes importantly to understanding and describing natural environments and technical processes** and is becoming increasingly relevant for interactions in and with the real world.

2.2 Inorganic Chemistry

Inorganic Chemistry is concerned with the properties and behavior of inorganic compounds, which include metals, minerals, and organometallic compounds. Many inorganic compounds are used as catalysts, pigments, coatings, surfactants, medicines, fuels, and more. They often have high melting points and specific high or low electrical conductivity properties, which make them useful for specific purposes. For example ammonia, hydrogen peroxide, borax, cerium oxide, alum etc. Many cleaning agents such as soap, detergent, floor cleaner, and glass cleaner contain inorganic compound either as solvent, cleaner itself, or bubble producer.

Inorganic Chemistry deals with the chemistry of all non-organic compounds, and mainly involves the chemistry of metals and especially transition metals. These elements play a crucial role in industrial catalytic processes that are required to produce substances and new materials at a rate far exceeding that of natural chemical reactions.

2.3 Organic Chemistry

Organic Chemistry plays an important part in our daily life because **food, clothes, paper, ink, rubber, soap, perfumes, medicines etc. are indispensable to us for proper living**. Organic compounds are important constituents of many products e.g., paint, food, plastic, explosive, medicine, petrochemical, pesticide etc. Organic Chemistry plays an important part in our daily life because food, clothes, paper, ink, rubber, soap, perfumes, medicines etc. are indispensable to us for proper living. Organic compounds are important constituents of many products e.g., paint, food, plastic, explosive, medicine, petrochemical, pesticide etc. Further, the study of Organic Chemistry is important for chemists and pharmacists in order to synthesize medicines for the alleviation of human suffering. Heterocyclic compounds are one of the most important classes of compounds which are of great importance in pharmaceutics because of their specific chemical reactivity. Nitrogen containing heterocycles are structural constituent of a variety of active pharmaceuticals, biologically active natural and non-natural compounds. Hydrocarbons are the principal constituents of petroleum and natural gas. They **serve as fuels and lubricants as well as raw materials for the production of plastics, fibres, rubbers, solvents, explosives, and industrial chemicals**.

3. Curriculum overview for grades XI and XII

An academic year at DBSE consists of two terms. Grade XI and XII curriculum is clustered into units. These units are delivered in two terms of an academic year. Unit names, content, duration and the learning resources are provided in the subsequent sections.

3.1. Grade XI curriculum overview

Table 1: Unit names, content, duration and the learning resources in grade XI

Grade XI			
Term 1			
Unit	**Content**	**Duration**	**Resources**
STOICHIOMETRY- I	• Basic Ideas, Concept of gram mole, Concept of gram equivalent, Equivalent mass of different substances • Relation between moles and gram equivalents • Expressing concentration of solutions • Important concepts in stoichiometric calculations, • Effect of heating on some important compounds, • Neutralization, Double titration	1 week	NCERT Books
ATOMIC STRUCTURE	• Discovery of electron, proton and neutron; atomic number, isotopes and isobars. • Thompson'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 exclusion principle and Hund's rule • Electronic configuration of atoms, stability of half-filled and completely filled orbitals.	1 weeks	NCERT Books
PERIODIC CLASSIFICATION	• Significance of classification, brief history of the development of periodic table, modern periodic law and the present form of periodic table, periodic	1 week	NCERT Books

	trends in properties of elements –atomic radii, ionic radii, inert gas radii, ionization enthalpy, electron gain enthalpy, electronegativity, valence. • Nomenclature of elements with atomic number greater than 100.		
CHEMICAL BONDING – I & I	• 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	3 weeks	NCERT Books
STATES OF MATTER	• 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, Charle's law, Gay Lussac's law, Avogadro's law • Ideal behaviour, empirical derivation of gas equation • Avogadro number, ideal gas equation. • Kinetic energy and molecular speeds (elementary idea), deviation from ideal behaviour, liquefaction of gases, critical temperature. • Liquid State – Vapour pressure, viscosity and surface tension (qualitative idea only, no mathematical derivations).	2 weeks	
THERMO CHEMISTRY	• Concepts of system, 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 ΔU and ΔH • Hess's law of constant heat summation, enthalpy change of reactions: bond dissociation	2 weeks	

	• Born Haber's cycle, Concept of colorimeter, Resonance energy		
THERMO DYNAMICS	• Pressure – volume work, Isothermal and Adiabatic process, Heat capacity, Determination of w, q, H and combustion, formation, atomization, sublimation, phase transition, ionization, solution and dilution. • Introduction of entropy as a state function • Second law of thermodynamics, Gibbs energy change for spontaneous and non-spontaneous process, criteria for equilibrium. • Third law of thermodynamics –Brief introduction	2 weeks	
Term 2			
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 • Henderson equation, solubility product, common ion effect (with illustrative examples).	1 week	NCERT Books
IONIC EQUILIBRIUM	• Concepts of acids and bases, Arrhenius concept, Bronsted concept and Lewis concept • Basics of ionic equilibrium • Weak acids and Weak base and their dissociation constant, • Self-ionization of water, pH of weak acid and weak base • Dissociation constant of conjugate ion of weak acid and base • Common ion effect, Buffer solutions, Acidic buffer and basic buffer • Hydrolysis of salt • Precipitation through H2S, • Solubility product and precipitation of salts, Selective precipitation	2 weeks	NCERT Books

	• Acid – base titrations, Equivalent point and end point.		
STOICHIOMETRY-II (REDOX REACTIONS)	• Concept of oxidation and reduction, redox reactions, • Oxidation number, balancing redox reactions in terms of loss and gain of electron and change in oxidation numbers • Applications of redox reactions.	1 week	NCERT Books
INTRODUCTION TO ORGANIC CHEMISTRY	• 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. • Homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions; electrophiles and nucleophiles, types of organic reactions.	4 weeks	NCERT Books
HYDROCARBON	• Classification of Hydrocarbons. • Aliphatic Hydrocarbons: Alkanes – Nomenclature, isomerism, conformations (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,	3 weeks	

	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 mono-substituted benzene; carcinogenicity and toxicity		
HYDROGEN	• Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen; hydrides – ionic, covalent and interstitial; physical and chemical properties of water, heavy water; hydrogen peroxide-preparation, reactions, use and structure; hydrogen as a fuel.	1 week	
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. • Preparation and Properties of Some Important Compounds: Sodium carbonate, sodium chloride, sodium hydroxide and sodium hydrogen carbonate, biological importance of sodium and potassium. • CaO, CaCO3, and industrial use of lime and limestone, biological importance of Mg and Ca.	1 week	
p-BLOCK ELEMENTS -1	• 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; Boronphysical and chemical properties, some important compounds: borax, boric acids, boron hydrides. • Aluminium: uses, reactions with acids and alkalies. • Group 14 elements: General	1 week	

	introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first element. • Carbon - catenation, allotropic forms, physical and chemical properties; uses of some important compounds: oxides. • Important compounds of silicon and a few uses: silicon tetrachloride, silicones, silicates and zeolites, their uses.		
ENVIRONMENTAL CHEMISTRY	• Environmental pollution – Air, water and soil pollution, chemical reactions in atmosphere, smogs, major atmospheric pollutants; acid rain, ozone and its reactions, effects of depletion of ozone layer, greenhouse effect and global warming – pollution due to industrial wastes; green chemistry as an alternative tool for reducing pollution, strategy for control of environmental pollution.	1 week	

3.2. Grade XII curriculum overview

Table 2: Chapter names, content, duration and the learning resources in grade XII

Grade XII			
Term 1			
Unit	**Content**	**Duration**	**Resources**
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, electrical and magnetic properties, Band theory of metals ,conductors, semiconductors and insulators and n and p type semiconductors .	4 weeks	NCERT Books

Liquid Solutions	• Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties – relative lowering of vapour pressure, Raoult's law, elevation	4 weeks	NCERT Books
Chemical Kinetics	• Rate of a reaction (average and instantaneous), factors affecting rates 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, Arrhenious equation.	4 weeks	NCERT Books
Alkyl and Aryl Halides	• Preparation of alkyl halides, Physical properties of alkyl halides chemical, Properties of alkyl halides • Preparation of aryl halides, • Preparation and properties of dihalides, Properties of aryl halides Trihalogen derivative of methane, Preparation of haloforms, Properties of haloform Chemical reactions of vinyl halide, allyl halide and benzyl halides	2 weeks	NCERT Books
Organic Concepts	• Basics of reaction mechanism of organic compounds • Mechanism of free radical substitution reactions, Mechanism of allylic substitution reactions • Mechanism of electrophilic substitution reactions, Mechanism of free radical addition reactions • Mechanism of electrophilic addition reactions mechanism of dehydrohalogenation of alkyl halides, • Mechanism of acid catalyzed dehydration of alcohols, Characteristics of E1, E2 and E1 CB reaction mechanism	1 week	
Alcohol, Phenol 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, with special reference to methanol and ethanol. • Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophillic substitution reactions, uses of phenols. • Ethers: Nomenclature, methods of	2 weeks	

	preparation, physical and chemical properties, uses		

Term 2			
Aldehyde and Ketones	• Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, and mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes; uses.	2 weeks	NCERT Books
Carboxylic Acids	• Nomenclature, acidic nature, methods of preparation, physical and chemical • properties; uses.	1 week	NCERT Books
Amines	• Classification of amines, Methods of preparation of amines, Physical properties of amine, Basic strength of amines • Chemical properties of amine, Preparation and properties of aromatic amines, Preparation and properties of benzene diazonium chloride, Preparation and properties of nitro compounds	2 weeks	NCERT Books
Acidity and Basicity	• Concept of acidity of organic compounds, Relative acidic strength of organic compounds. • Concept of basicity of organic compounds, Relative basic strength of organic compounds.	1 week	NCERT Books
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 cells and Galvanic cells; lead accumulator, 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, fuel cells; corrosion	2 weeks	NCERT Books
d and f block	• 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	1 week	NCERT Books

	property, magnetic properties, interstitial compounds, alloy formation. Preparation and properties of K2, Cr2, O7, and KMnO4 • Lanthanoids – electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and its consequences. • Actinoids – Electronic configuration, oxidation states and comparison with lanthenoids.		
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).	1	
P-Block-II	• 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 (PCl3, PCl5) 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; 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 • Group 17 elements7: 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).	2	

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

4. Assessment Overview

Criterion based assessments enable students to self-monitor and build self-belief as they can see the evidence of the progress they are making over time. Students can track their progress using level descriptors; they can clearly understand how their work can be improved over time.

The four core criteria assessed in Physics Education are:

1. Criterion A – Knowing and understanding
2. Criterion B – Applying
3. Criterion C – Higher Order Thinking Skills
4. Criterion D – Observation and Investigation Skills

The assessment tasks and methods used in internal assessment are criterion related, student-centric and provide feedback for further enhancement of learning. There are two types of assessments used for reporting student performance.

- Internal assessments (IA) (20%)
- Term-end assessments (TA) (80%)

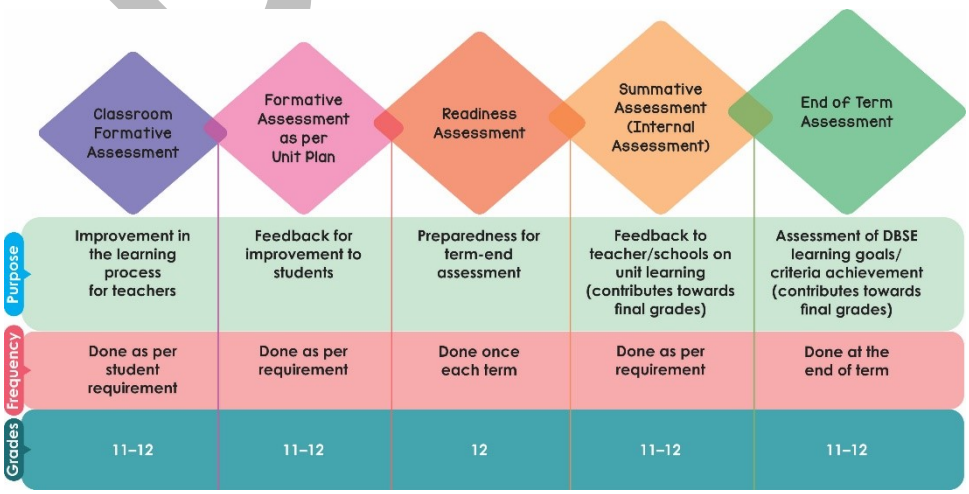
The assessment tasks and methods used in internal assessments provide opportunities for students to show their academic achievements in multiple ways and provide feedback for further enhancement of learning. Term-end assessment tasks are based on curriculum objectives defined for Chemistry.

DBSE assessments used for reporting for grades 11 & 12 can be School-led and/or Board-led. School-led assessments are based on an item pool provided by DBSE and Board-led assessments are developed and administered by DBSE. In grade 12, DBSE monitors internal assessments and readiness assessments. Term-end assessments are conducted by DBSE.

4.1. Assessment structure

Global best practices suggest a multifaceted assessment structure. That is, students should be assessed in multiple ways and at multiple times without increasing the workload of teachers or students, to the extent possible. A schematic representation of the DBSE assessment structure is presented below:

Figure 1: Assessments in DBSE



4.2. Assessment calendar

The assessment calendar for internal and external assessments for academic year 2022- 23 grade 11 and 12 assessments is given below.

Table 3: Grade XI assessment calendar

Chapter	Duration		Assessment	Criteria Assessed	Assessment Strategies
1	04 Jul 2022	08 Jul 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz • Competency based test
2	11 Jul 2022	16 Jul 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
3	18 Jul 2022	23 Jul 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
4	25 Jul 2022	13 Aug 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
5	16 Aug 2022	27 Aug 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
6	29 Aug 2022	9 Sep 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	

7	12 Sep 2022	24 Sep 2022	Internal Assessment	A. Criteria A – Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
10 – 24 October 2022			**Term-end 1**	**All 4 Criteria**	**Competency based assessment**
8	01 Nov 2022	5 Nov 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz • Competency based test
9	7 Nov 2022	19 Nov 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
10	21 Nov 2022	26 Nov 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
11	28 Nov 2022	31 Dec 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
12	16 Jan 2023	4 Feb 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
13	6 Feb 2023	10 Feb 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Applying C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	

14	13 Feb 2023	16 Feb 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
15	17 Feb 2023	22 Feb 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
16	23 Feb 2023	28 Feb 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
1 - 20 March 2023			**Term-end 2**	**All 4 Criteria**	**Competency based assessment**

Table 4: Grade XII Assessment calendar

Chapter	Duration		Assessment	Criteria Assessed	Assessment Strategies
1	04 Apr 2022	30 Apr 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz • Competency based test
2	2 May 2022	27 May 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Applying C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
3	4 Jul 2022	30 Jul 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
4	1 Aug 2022	12 Aug 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
5	16 Aug 2022	23 Aug 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
6	24 Aug 2022	10 Sep 2022	Internal Assessment	A. Criteria A – Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
			Readiness Assessment	**All 4 Criteria**	Competency based assessment
10 – 24 October 2022			**Term-end 1**	**All 4 Criteria**	**Competency based assessment**
7	01 Nov 2022	15 Nov 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	• Student Portfolio • Viva, and • Performance or Demonstration of task/skill • Quiz • Competency based test
8	16 Nov 2022	24 Nov 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding	

				B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
9	25 Nov 2022	10 Dec 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
10	12 Dec 2022	17 Dec 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
11	19 Dec 2022	31 Dec 2022	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
12	16 Jan 2023	23 Jan 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
13	24 Jan 2023	30 Jan 2023	Internal Assessment	A. Criteria A - Knowlledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	
14	31 Jan 2023	12 Feb 2023	Internal Assessment	A. Criteria A - Knowledge and Understanding B. Criteria B - Application C. Criteria C - Higher Order Thinking Skills D. Criteria D- Investigation and observation skills	•
			Readiness Assessment	All 4 Criteria	Competency based assessment
1 - 20 March 2023			**Term-end 2**	**All 4 Criteria**	**Competency based assessment**

4.3. Assessment levels and grades

The assessment criteria directly relate to the objectives of the Chemistry curriculum and carry equal weightage. The student achievement levels will be reported as a number grade as described in the grade descriptions.

The grade descriptions are based on assessment criteria levels. The level descriptors of an assessment criterion depict clear progression of improvement of skills and competencies for a learning period.

All the assessment tasks used to report students' achievements are based on task specific, hierarchical, and qualitatively defined rubrics. The categories used in rubrics represent increasing quality or sophistication of response to a task. They provide a basis for evaluating and recording students' responses to an assessment task. A rubric makes assessment expectations transparent.

In order to show the degree of competence in each criterion, fine grained descriptions of various levels are used. These descriptions indicate the progression of achievement in each criterion.

Criterion A: Knowing and understanding

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student is able to: i. state/recall the basic facts/concept ii. state/recall laws and theories iii. apply knowledge and understanding to suggest solutions to numerical problems
3-4	The student is able to: i. describe the major facts/concepts ii. describe laws and theories iii. apply knowledge and understanding to solve numerical problems
5-6	The student is able to: i. explain the major facts/concepts related to the domain ii. explain laws and theories of physics iii. apply knowledge and understanding to solve numerical problems set in familiar situations and suggest solutions to problems set in unfamiliar situations
7-8	The student is able to: i. demonstrate in-depth and systematic understanding of knowledge of facts and concepts ii. work with theoretical / research-based knowledge and has a comprehensive understanding of laws and theories of physics iii. apply knowledge and understanding to solve numerical problems set in familiar and unfamiliar situations

Criterion B: Applying

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student is able to: i. identify scientific ideas and concepts in familiar context ii. recognize or identify explanations of simple scientific phenomenon related to physics iii. use basic or everyday scientific knowledge to recognize aspects of familiar or simple phenomenon
3-4	The student is able to: i. use scientific ideas and concepts in familiar and unfamiliar context ii. state hypothesis of simple scientific phenomenon related to physics iii. draw on everyday content knowledge and basic procedural knowledge to identify an appropriate scientific explanation
5-6	The student is able to: i. use interrelated scientific ideas and concepts in variety of context ii. describe hypotheses of scientific phenomena, events and processes related to physics iii. draw upon moderately complex content knowledge to identify or construct explanations of familiar phenomena
7-8	The student is able to: i. use a range of interrelated scientific ideas and concepts in variety of context ii. explain hypotheses of novel scientific phenomena, events and processes related to physics iii. use more complex or more abstract content knowledge, to construct explanations of complex events and processes

Criterion C: Higher Order Thinking Skills

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student is able to: i. analyse given information with guidance using given parameters ii. collect and categorise simple ideas and information in a predictable and standard format iii. distinguish between scientific and non-scientific issues and identify the evidence supporting a scientific claim
3-4	The student is able to: i. analyse a range of information with minimum guidance using given parameters and can compare alternative methods and techniques for obtaining information ii. collect and categorise complex ideas and information appropriately developing the required formats iii. evaluate the reliability and relevance of information using limited guidance.
5-6	The student is able to: i. analyse new and/or abstract information and situations without guidance, using a range of techniques appropriate to the subject ii. collect and categorise complex ideas and information aligning with a purpose iii. evaluate the reliability and relevance of information using very limited guidance and can identify contradictory information
7-8	The student is able to: i. critically analyse complex, incomplete or contradictory information and communicate the outcome effectively ii. transform and present abstract ideas and information in a format appropriate for the audience and purpose iii. evaluate the reliability and relevance of information independently and can investigate and resolve contradictory information

Criterion D: Observations and investigation

Levels	Level Description
0	The student does not reach a standard described by any of the descriptors below.
1-2	The student: i. replicate a simple experiment in a constrained context ii. draw simple inferences from experiment data iii. identifies questions that can be investigated scientifically iv. investigations demonstrate an ability to undertake basic investigative v. approaches investigations in an ethical manner, but shows very limited awareness of environmental impact and safety vi. work requiring considerable guidance and instruction, and attempts at conclusions that are largely irrelevant
3-4	The student: i. can conduct experiment involving two or more independent variables in a constrained context ii. interpret data drawn from a moderately complex data set or less familiar context iii. states question that can be investigated scientifically iv. investigations demonstrate an ability to complete fairly routine practical work v. generally, approaches investigations in an ethical manner, with some awareness of environmental impact and safety vi. work requiring limited guidance and instruction, and draw appropriate conclusions
5-6	The student: i. can conduct experiments competently ii. interpret data drawn from a complex data set or unfamiliar context iii. can evaluate ways of exploring a given question scientifically iv. investigations demonstrate some innovative thinking and independence v. approaches to investigations in an ethical manner, paying significant attention to environmental impact and safety where applicable. vi. work independently and can draw reasonable conclusions to resolve authentic problems and identify limitations in interpretations of data sets including sources and the effects of uncertainty in scientific data.
7-8	The student: i. can conduct experiments competently ii. interpret data drawn from a complex data set and identify limitations in interpretations of data sets including sources and the effects of uncertainty in scientific data iii. can distinguish between arguments that are based on scientific evidence and theory and those based on other considerations iv. investigations demonstrate insight and independence to design and complete innovative practical work v. approaches to investigations in an ethical manner, paying full attention to environmental impact and safety where applicable. vi. work independently and can draw reasonable conclusions to resolve authentic problems

Table 5: Description of Grade points

Grade	Grade Description
7	Displays comprehensive subject knowledge and a thorough command of concepts and principles. Selects and applies relevant information, concepts and principles in a wide variety of contexts. Analyses and evaluates quantitative and qualitative data thoroughly. Constructs detailed explanations of complex phenomena and makes appropriate predictions. Evidences great proficiency in solving problems, including those that are challenging or unfamiliar. Communicates logically and concisely using appropriate terminology and conventions. Shows insight or originality. Approaches investigations in an ethical manner, paying full attention to environmental impact and safety where applicable. Investigations demonstrate insight and independence to design and complete innovative practical work with highly competent investigative and analytical techniques, and with innovative and effective conclusions to resolve authentic problems.
6	Displays very broad subject knowledge and a thorough understanding of concepts and principles. Selects and applies relevant information, concepts and principles in most contexts. Analyses and evaluates quantitative and qualitative data with a high level of competence. Constructs explanations of complex phenomena and makes appropriate predictions. Solves basic or routine problems and evidences competency in solving those that are challenging or unfamiliar. Communicates effectively using appropriate terminology and conventions. Shows occasional insight or originality. Approaches to investigations in an ethical manner, paying significant attention to environmental impact and safety where applicable. Investigations demonstrate some innovative thinking and independence to design and complete practical work with competent investigative and analytical techniques, and with highly competent and reasonable conclusions to resolve authentic problems.
5	Displays broad subject knowledge and shows sound understanding of most concepts and principles and applies them in some contexts. Analyses and evaluates quantitative and qualitative data competently. Constructs explanations of simple phenomena. Solves most basic or familiar problems and some new or difficult quantitative and/or qualitative problems. Communicates clearly with little or no irrelevant material. Approaches investigations in an ethical manner, paying attention to environmental impact and safety where applicable. Investigations demonstrate appropriate investigative and analytical techniques with relevant and pertinent conclusions to resolving authentic problems.
4	Displays reasonable subject knowledge (though possibly with some gaps) and shows adequate understanding of most basic concepts and principles, but with limited ability to apply them. Demonstrates some analysis or evaluation of quantitative or qualitative data. Solves some basic or routine problems but shows limited ability to solve challenging or unfamiliar problems. Communicates adequately, although responses may lack clarity and include some repetitive or irrelevant material. Generally approaches investigations in an ethical manner, with some attention to environmental impact and safety where applicable. Investigations demonstrate an ability to complete fairly routine practical work with some appropriate investigative and analytical techniques, and with some conclusions relevant to the problem under study.

3	Displays limited subject knowledge and shows a partial understanding of basic concepts and principles, and weak ability to apply them. Shows some ability to manipulate data and solve basic or routine problems. Communicates with a lack of clarity and some repetitive or irrelevant material. Sometimes approaches investigations in an ethical manner, with some attention to environmental impact and safety where applicable. Investigations demonstrate an ability to complete a basic investigation with simple analytical techniques, and with some partial conclusions of some relevance to study
2	Displays little subject knowledge and shows weak understanding of basic concepts and principles, and little evidence of application. Exhibits minimal ability to manipulate data and little or no ability to solve problems. Offers responses which are often incomplete or irrelevant. Occasionally approaches investigations in an ethical manner but shows very limited awareness of environmental impact and safety. Investigations demonstrate an ability to undertake basic investigative work requiring considerable guidance and instruction, and attempts at conclusions that are largely incorrect/irrelevant.
1	Fragmentary subject knowledge and shows very little understanding of any concepts or principles. Rarely demonstrates personal skills, perseverance or responsibility in investigative activities. Rarely approaches investigations in an ethical manner or shows an awareness of environmental impact and safety. Investigations demonstrate an ability to undertake very basic practical work with complete dependence on supervised instruction, with attempts at conclusions are either absent or completely incorrect/irrelevant.

5. LIST OF PRACTICALS

Term1

1. **Volumetric analysis**

   Determination of concentration/ molarity of KMnO4 solution by titrating it against a standard solution of Ferrous ammonium sulphate

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

2. **Salt analysis**

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

   Cations- Pb2+, Cu2+, Al3+, Fe3+, Zn2+, Mg2+, NH4+

   Anions – (CO3)2- , S2- ,SO3*2- , SO4*2- , NO3-, CH3COO-

   Note: Insoluble salts excluded

3. **Content based experiments**

   Separation of constituents present in an inorganic mixture containing two cations only (constituents having a large difference in Rf values to be provided).

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

Term 2

1. **Volumetric analysis**

   Determination of concentration/ molarity of KMnO4 solution by titrating it against a standard solution of:

   Oxalic acid

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

2. **Salt analysis**

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

   Cations- As3+, Mn2+, Ni2+, Co2+, Ca2+, Sr2+, Ba2+, Mg2+,

   Anions – NO2- ,Cl- , Br- , I- , PO4*3- , C2O4*2-

   Note: Insoluble salts excluded

3. **Content based experiments**

   Tests for the functional groups present in organic compounds:

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