NATIONAL OPEN SCHOOL

Senior Secondary Curriculum in Chemistry

RATIONALE

According to present scheme of school education at Senior Secondary stage, chemistry emerges out as a separate discipline. It is this stage where major emphasis is to be laid on providing suitable conceptual foundation

The present chemistry course has been developed basically around the themes: Why do chemical reactions occur? What is the quantitative relationship among reacting constituents in a chemical reaction? How far andhow fast will a chemical reaction proceed under a given set of conditions? Can we predict whether a chemical reaction willoccur or not? What is the relation between the structure of a chemical substance and its functions/properties? In What way is a chemical reaction relevant for getting new types of substances and materials for dialylife and chemical industries?

In the present course, there in no compartmentalisation like physical, inorganic and organic chemistry. However, basic chemical concept considered necessary in the study of descriptive chemistry (inorganic and organic) are provided in the beginning of the course and an effort has been made to provide a disciplinary structure to chemistry and, therefore, a logical sequencing of concepts in provided. Applications of chemistry in daily life have been interwoven with the conceptual themes in such a way that learners can appreciate the importance of the study of chemistry relevant to daily life and in the economic development of the country. Some interdisciplinary aspects have also been provided to make the course more meaningful and cunctional.

OBJECTIVES OF THE COURSE

It is expected that a learner will be able to:

- *understand* the principles, theories and laws of chemistry responsible for various chemical processes/ reactions,
- *realise* the role of chemistry in production of many elements (metals/non-metals) and compounds useful in industries and daily life,
- *appreciate* the chemical nature of inorganic and organic substances around him/her,
- *choose* various vocational, professional and applied courses of his/her choice based on knowledge of chemistry gained.

Apart from this, the present course also aims at developing the following capacity in the learner:

- *perform* chemical calculations to know about the chemical reactions and chemical compounds,
- *explain* chemical reactions, concepts and phenomenon,
- *develop* awareness about uses and abuses of chemical substances,
- *develop* skills arranging/setting aparatus, handling apparatus and chemicals properly, and
- *analyse* and synthesise simple compounds.

SPECIAL FEATURES OF THE COURSE

The academic standard of the present chemistry course in comparable with the chemistry course of any State Education Board or Central Board of Secondary Education, New Delhi. Considering the nature of open learning system, it has not been found desirable to divide the course into class XI and class XII. The rationale behind the course is that every lesson has a role to play in understanding the holistic view of chemistry.

The course also provides optional modules 'mostly of applied nature' out of which a student can choose one module according to his/her choice of career. Thus, there are seven core modules and two optional modules. A student appearing for senior secondary examination is expected to offer all the seven core modules, one Module out of two optional modules, and practicals. All the core and optional modules are listed below:

CORE MODULES

S.No.	*Module*	*Marks Alloted*	*Study Hours*
1.	Atom Molecule and Chemical Arithmatics	7	14
2.	Atomic Structure and Chemical Bonding	12	33
3.	States of Matter	12	18
4.	Chemical Energetics	8	23
5.	Chemical Dynamics	8	19
6.	Chemistry of Elements	10	48
7.	Chemistry of Organic Compounds	12	48

OPTIONAL MODULES

I.	Environmental Chemistry	15	
II.	Chemistry and Industry		37
	Total	80	240

A detailed curriculum is given for your ready reference

Sr. Secondary Chemistry Curriculum

CORE MODULES

MODULE 1:ATOMS MOLECULES AND CHEMICAL ARITHMATICS

Lesson 1 Mole Concept

- A simple idea of basic SI units
- Counting and weighing of atoms and molecules
- Avogadro constant
- Molar quantities

Lesson 2 Chemical Arithmetic

- Chemical formula and percentage composition
- Empirical and molecular formulae
- Mole, Mas, Volume relationships in chemical reactions
- Limiting reagent concept and percentage yield

MODULE 2:ATOMS STRUCTURE AND CHEMICAL ARITHMATICS

Lesson 3 Chemical Arithmaties

- Fundamental particles of an atom (electron, Proton, Neutron)
- Rutherford's nuclear model
- Electromagnetic spectrum
- Line spectra of H-atom: Bohr model (no derivation)
- Wave-particle duality: Heisenberg's uncertainty principle
- The wave mechanical model-orbitals (probability picture may be emphasised),
- Quantum numbers
- Pauli's exclusion principle
- Aufbau Principle-electronic configuration of atoms
- Types of orbitals (s,p,d,f): shapes of s,p,d orbitals
- Hund's rule

Lesson 4 Periodic Table and Atomic Properties

- Long Form of periodic table and IUPAC nomenclature for elements with Z > 110 (brief mention)
- Variation in atomic properties (size, jonization energy, electron affinity, valency and electro negativity)

Lesson 5 Chemical Bonding

- Why do atoms combine? (potential-energy diagram)
- Types of bonds and their characteristics (logic, Covalent, Coordinate, Metallic)
- Shapes of molecules, Introduction to VSEPR theory (upto 6 electron pairs only)
- Hybridization of atomic orbitals
- Multiple covalent bonds (σ,π) e.g. C_2H_4,C_2H_2
- M.O. Theory, Homonuclear molecule (H_2,N_2,O_2,F_2), Bond Parameters
- Hydrogen Bonding

MODULE 3: STATES OF MATTER

Lesson 6 Gaseous State

- Properties
- Boyle's Law
- Charles law-Kelvin Temperature Scale
- Avogadro's Law
- Dalton's law of partial pressures
- Ideal gas equation
- The kinetic molecular theory of gases (no derivation)
- Graham's law of diffusion
- real gases-deviations from ideal gas behavior, Vansder Waal equation Liquefaction of gases, critical Constants

Lesson 7 Liquid State

- Properties of liquids
- Vapour pressure
- Surface tension
- Viscosity

Lesson 8 Solid State

- Properties of solids
- Classification of solids
- Unit cell and their types
- Packing in crystals
- Structure of simple ionic compounds
- Imperfections in solids (Frenkel, Schottky defects)

Lesson 9 Solutions

- Solution, solute and solvent
- Concentration of solutions-molarity, molality, mole fraction, percentage and Strength
- Types of solutions
- Raoult's law
- Ideal and non-ideal solutions
- Colligative properties of solutions

- Van't Hoff factor

Lesson 10 Colloids

- The Colloidal Solution
- True solution, colloidal solution and suspension
- Classification of colloids
- Preparation and properties of colloidal solutions
- Applications of colloids

MODULE 4: CHEMICAL ENERGETICS

Lesson 11 Chemical Thermodynamics

- System : Isolated, closed and open systems
- Processes: cyclic, isothermal, adiabatic, reversible and irreversible
- Standard state of a substance
- Exothermic and endothermic reactions
- Thermochemical equations
- Concept of internal energy and enthalpy change, relationship between ΔH and ΔU,
- I^{st} law of thermodynamics
- Standard enthalpy of reactions
- Enthalpy changes during a reaction: enthalpy of formation, enthalpy of combustion, enthalpy of neutralization
- Hess's law and its applications
- Bond enthalpy

Lesson 12 Spontaneity of Chemical Reactions

- Concept of entropy, entropy change and spontaneity
- II^{nd} law of thermodynamics
- Concept of free energy, relationship between G,H and S
- Free energy change and spontaneity of a chemical reaction
- Standard free energy of formation
- Free energy change and chemical equilibrium
- III^{rd} law of thermodynamics and its significance (illustrative)

MODULE 5: CHEMICAL DYNAMICS

Lesson 13 Chemical Equilibrium

- Dynamic nature of equilibrium; Factors affecting equilibrium
- Reversible and irreversible reactions
- Types of equilibrium system: Homogeneous and heterogeneous systems
- Laws of chemical equilibrium
- Relationship between Kc and Kp
- Le Chatelier's Principle and its applications

Lesson 14 Ionic Equilibria

- Acid-base equilibrium
- Ionisation constant of lead acids and bases
- Ionization of water
- pH value
- Common Ion effect
- Buffer solutions, Henderson equation
- Solubility equilibrium, solubility product and its applications
- Salt Hydrolysis
- Acid base titration

Lesson 15 Electrochemistry

- Oxidation and Reduction (Electron transfer concept)
- Oxidation number, balancing of Redox reaction by oxidation number method
- Types of cells: Electrolytic and electrochemical
- Electrolytic conduction (Conductance, conductivity molar conductivity, effect of dilution, Kohlrausch's law)
- Standard electrode potential
- Electrochemical series and its applications
- Effect of concentration of electrode potentials (Nernst equation)
- Relationship between emf and free energy change

Lesson 16 Chemical Kinetics

- Rate of Reaction: Average and Instantaneous
- Expressions for reaction rates
- Factors affecting rate of reaction
- Rate law
- Order of a reaction
- First order reaction
- Half change period
- Effect of temperature on reaction rate

Lesson 17 Adsorption and Catalysis

- Adsorption-Physical and Chemical
- Adsorption Isotherms (Freundlich and Langmuir)
- Catalysis-Homogenous and Heterogeneous
- Activation energy

MODULE 6 Chemistry of Elements

Lesson 18 Occurrence And Extraction of Metals

- Occurrence of metals
- Important ores of some common elements : Na,Al, Sn, Pb, Ti, Fe, Cu, Ag and Zn

- General principles involved in the isolation of metals from their ores (concentration of the ore, reduction and refining)

Lesson 19 Hydrogen and s-Block Elements

- Unique position of H_2 in Periodic
- Properties reactions and uses
- Isotopes of hydrogen
- Water structure and aggregation of water molecules, Heavy Water
- Hydrogen peroxide
- Alkali Metals and Alkaline earth metals-occurrence, electronic configuration trends in atomic and physical properties, reactivity electrode potential,
- Reaction with oxygen, hydrogen, halogens and water
- Solubility and thermal stability of their oxo salts.

Lesson 20 General characteristics of The p-block elements

- Occurrence in nature and electronic configuration, (physical and chemical properties)
- Inert pair effect
- Anomalous properties of first element

Lesson 21 p-Block elements and Their Compounds-I

- Boron family-borax, boric acid, boron hydrides, halides.
- Carbon family-allotropes (graphite, diamond, elementary idea of fullerens)
- Oxides, carbides, halides
- Nitrogen family-Ammonia, Nitric acid, fertilizer (N,P) and fixation of nitrogen industrial and biological
- Nitrogenous and phosphatic fertilisers

Lesson 22 p-Block Elements and their compounds-II

- Oxygen family-oxxides, acidic, basic and amphoteric, Ozone (Oxidizing Properties)
- Halogens- Hydrides, oxides and oxoacids of chlorine.
- Bleaching powder-preparation and properties, Interhalogen compounds.
- Noble gases-compounds of xenon: xenon fluorides, oxides (preparation, structure)

Lesson 23 d-Block and f-Block elements

- Electronic configuration
- General trends in the Chemistry of first row transition elements
- Properties-metallic character, oxidation state, ionic radii, catalytic properties, coloured ions, complex formation, magnetic properties, interstitial compounds alloy formation.
- Preparation, properties and applications some important compounds:
- $KMnO_4$, $K_2Cr_2O_7$
- f-Block elements-configuration, properties and lanthanide contraction

Lesson 24 Coordination Compounds

- Werner's theory
- Nomenclature
- Bonding-V.B. Approach
- Applications (qualitative analysis, extraction of metals and biological systems)

MODULE 7 CHEMISTRY OF ORGANIC COMPOUNDS

Lesson 25 Nomenclature and General Principles

- Rules of IUPAC Nomenclature
- Types of bond fission
- Types of reactions: substitution, addition, elimination, oxidation/reduction (electrophilic and nucle ophillic)
- Electron displacement in a covalent bond: inductive effect, electromeric effect,
- resonance and hyperconjugation, steric effect
- Isomerism–Structural isomerism, stereoisomerism

Lesson 26 Hydrocarbons

- Definition and types of hydrocarbons (Alkane, Alkene, alkyne, Arene)
- IUPAC nimenclature
- Preparation and Properties of Hydrocarbons
- Physical properties of hydrocarbons
- Chemical properties of hydrocarbons (addition, substitution, elimination, oxidation)

Lesson 27 Compounds of Carbon ContainingHalogens (Haloalkanes and Haloarenes)

- IUPAC Nomenclature of halogen compounds
- Preparation of haloalkanes and haloarenes
- Physical and chemical properties and uses

Lesson 28 Alcohol, Phenols and Ethers

- Classification
- IUPAC Nomenclature
- Methods of preparation

- Physical and Chemical properties

Lesson 29 Aldehydes, Ketones and Carboxylic acids.

- Carboxylic Acids and acid derivatives
- IUPAC Nomenclature
- Preparation and Properties
- Interconversion of acid derivations

Lesson 30 Compounds of Carbon Containing Nitrogen

- Nitro compounds, amines
- Classification of amines
- IUPAC nomenclature
- Preparation and properties

Lesson 31 Biomolecules

- Difference between DNA and RNA
- Biomolecules in biological systems.
- Structures of proteins and carbohydrates

OPTIONAL MODULES
MODULE 1: ENVIRONMENTAL CHEMISTRY
Lesson 32 Environment at concerns

- Idea of environment
- Threats to environment
- Pollutants

Lesson 33 Air Pollution

- Composition of air
- Respiration, photosynthesis and decay cycle
- Air pollutants
- Green house effect
- Global warming
- Depletion of ozone layer
- Acid rain

Lesson 34 Water Pollution

- Water resources
- Water pollutants
- Biological oxygen demand
- Prevention of water pollution
- Legislative measures for prevention of water pollution

Lesson 35 Heavy Metal Contamination

- Heavy metals
- Effects of heavy metal contamination
- Preventive measures

Lesson 36 Radioactive Pollution

- Radioactive sources
- III effects of radiation
- Preventive measures
- Regulation regarding safety

MODULE 2: CHEMISTRY AND INDUSTRY
Lesson 32 Petrochemicals

- Generations of petrochemicals
- Soaps and detergents
- Rocket propellants
- Pollutants and Indian Space Programs.

Lesson 33 Polymers

- Classification
- Teflox, polyester and nylons
- Biodegradable polymers
- Biopolymers

Lesson 34 Dyes. Paints and Pigments

- Composition
- Classification
- Process of dying
- Applications

Lesson 35 Drugs and Medicines

- Distinction between drugs and medicines
- Classification
- Analgesics and antipyretics
- Antibiotics and anaestheties

Lesson 36 Building Materials

- Cement and its manufacture
- Mortar, Concrete and R.C.C
- Manufacture of glass
- Ceramics and day products