CHEMISTRY

Course Structure

Units	Topics	Marks
I	Basic Concepts of Chemistry	11
II	Structure of Atom	
III	Classification of Elements & Periodicity in Properties	4
IV	Chemical Bonding and Molecular Structure	21
V	States of Matter: Gases and Liquids	
VI	Thermodynamics	
VII	Equilibrium	
VIII	Redox Reactions	16
IX	Hydrogen	
X	s-Block Elements	
XI	Some p-Block Elements	
XII	Organic Chemistry: Basic Principles & Techniques	18
XIII	Hydrocarbons	
XIV	Environmental Chemistry	
Total		**70**

Course Syllabus

Unit I: Some Basic Concepts of Chemistry

- General Introduction:
  - Importance of Chemistry
  - Scope of chemistry
- Nature of matter

- Laws of chemical combination
- Dalton's atomic theory
- Concept of:
    - Elements
    - Atoms
    - Molecules
- Atomic and molecular masses:
    - Mole concept
    - Molar mass
    - Percentage composition
    - Empirical and molecular formula
    - Chemical reactions
    - Stoichiometry and calculations based on stoichiometry

Unit II: Structure of Atom

- Discovery of:
    - Electron
    - Proton
    - Neutron
    - Atomic number
    - Isotopes
    - Isobars
- Models:
    - 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
    - Hund's rule
    - Electronic configuration of atoms
    - Stability of half-filled and completely filled orbitals

Unit III: Classification of Elements and Periodicity in Properties

- Significance of classification
- Brief history of the development of periodic table
- Modern periodic law
- 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

- 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
- Shapes of some simple molecules
- Molecular orbital theory of homonuclear diatomic molecules (qualitative idea only)
- Hydrogen bond

Unit V: 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 behavior
- Empirical derivation of gas equation
- Avogadro's number
- Ideal gas equation
- Deviation from ideal behavior

- Liquefaction of gases
- Critical temperature
- Kinetic energy and molecular speeds (elementary idea)
- Liquid state
- Vapour pressure
- Viscosity
- Surface tension

Unit VI: Chemical Thermodynamics

- System
  - Concept
  - Types
  - Surroundings
  - Work
  - Heat
  - Energy
  - Extensive
  - 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 of bond dissociation
- Combustion
- Formation
- Atomization
- Sublimation
- Phase transition

- Ionization
- Solution
- 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

- 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
- Henderson equation
- Hydrolysis of salts (elementary idea)
- Buffer solution
- Solubility product
- Common ion effect (with illustrative examples)

Unit VIII: Redox Reaction

- Concept of oxidation and reduction
- Redox reactions
- Oxidation number
- Balancing redox reactions
- In terms of loss and gain of electrons and change in oxidation number
- Applications of redox reactions

Unit IX: 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 and structure and use
- Hydrogen as a fuel

Unit X: s -Block Elements (Alkali and Alkaline Earth Metals)

Group 1 & 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
  - Halogens
- Preparation and Properties of Some Important Compounds:
  - Sodium Carbonate
  - Sodium Chloride
  - Sodium Hydroxide
  - Sodium Hydrogen carbonate
- Biological importance of:
  - Sodium
  - Potassium
  - Magnesium
  - Calcium
- Industrial uses of:
  - Calcium Oxide
  - Calcium Carbonate

Unit XI: 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
- Some important compounds Borax, Boric acid, Boron Hydrides, Aluminum
- Reactions with acids and alkalis

- 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
  - Uses of some important compounds: oxides
  - Important compounds of Silicon and a few uses
  - Uses of Silicon Tetrachloride, Silicones, Silicates and Zeolites

Unit XII: Organic Chemistry

- Some Basic Principles and Technique
- 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
- Nucleophile
- Types of organic reactions

Unit XIII: Hydrocarbons - Classification

- Aliphatic Hydrocarbons
- Alkanes
    - Nomenclature
    - Isomerism
    - Conformation (ethane only)
    - Physical properties
    - Chemical reactions including free radical mechanism of halogenation
    - Combustion
    - Pyrolysis
- Alkenes
    - Nomenclature
    - Structure of double bond (ethene)
    - Geometrical isomerism
    - Physical properties
    - Methods of preparation
    - Chemical reactions
    - Addition of hydrogen, halogen, water, hydrogen halides (markownikov'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 mono-substituted benzene
  - Carcinogenicity and toxicity

Unit XIV: Environmental Chemistry

- Environmental pollution:
  - Air
  - Water
  - Soil pollution
- Chemical reactions in atmosphere
- Smog

- 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
- Strategies for control of environmental pollution

Practical Syllabus

Course Structure

Units	Topics	Marks
I	Volumetric Analysis	8
II	Salt Analysis	8
III	Content Based Experiment	6
IV	Project Work	4
V	Class record and viva	4
Total		**30**

Practical Syllabus

A. Basic Laboratory Techniques

- Cutting glass tube and glass rod
- Bending a glass tube
- Drawing out a glass jet
- Boring a cork

B. Characterization and Purification of Chemical Substances

- Determination of melting point of an organic compound.
- Determination of boiling point of an organic compound.
- Crystallization of impure sample of any one of the following: Alum, Copper Sulphate, Benzoic Acid.

C. Experiments based on pH

(a) 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.

(b) Study the pH change by common-ion in case of weak acids and weak bases.

D. Chemical Equilibrium

One of the following experiments:

- Study the shift in equilibrium between ferric ions and thiocyanate ions by increasing/decreasing the concentration of either of the ions.
- Study the shift in equilibrium between $[Co(H_2O)_6]^{2+}$ and chloride ions by changing the concentration of either of the ions.

E. Quantitative Estimation

- Using a chemical balance
- Preparation of standard solution of Oxalic acid

- Determination of strength of a given solution of Sodium Hydroxide by titrating it against standard solution of Oxalic acid
- Preparation of standard solution of Sodium Carbonate
- Determination of strength of a given solution of Hydrochloric acid by titrating it against standard Sodium Carbonate solution

F. Qualitative Analysis

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

Cations-$Pb^{2+,}$ Cu^{2+} As^{3+}A13^{+}, Fe^{3+}, Mn^{2+}, Ni^{2+}, Zn^{2+}, $Co^{2+}Ca^{2+}$, Sr^{2+}, Ba^{2+}, Mg^{2+},

Anions - $C_{3,}^{2-}$ S^{2-}, S_3^{2-} , SO_4^{2-}, NO_3^-, Cl^-, Br, I^-, PO^{3+}, $C2O_4^{2-}$, CH_3 COO^-

(Note: Insoluble salts excluded)

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

PROJECT WORK

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.*