CHEMISTRY

Course Structure

Units	Topics	Marks
I	Solid State	11
II	Solutions	
III	Electrochemistry	4
IV	Chemical Kinetics	21
V	Surface Chemistry	
VI	Isolation of Elements	
VII	p-Block Elements	
VIII	d-and f-Block Elements	16
IX	Coordination Compounds	
X	Haloalkanes and Haloarenes	
XI	Alcohols, Phenols & Ethers	
XII	Aldhydes, Ketones & Carboxylic Acids	18
XIII	Organic Compounds containing Nitrogen	
XIV	Biomolecules	
XV	Polymers	
XVI	Chemistry in Everyday Life	
Practical Work		**30**
I	Volumetric Analysis	10
II	Salt Analysis	8
III	Content Based Experiment	6
IV	Class record, project work & viva	6
Total		**100**

Course Syllabus

Unit I: 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
  - Insulators
  - n & p type semiconductors

Unit II: 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 of boiling point
- Depression of freezing point
- Osmotic pressure
- Determination of molecular masses using colligative properties
- Abnormal molecular mass
- Van't hoff factor

Unit III: Electrochemistry

- Redox reactions
- Conductance in electrolytic solutions
- Specific and molar conductivity
- Variations of conductivity with concentration
- Kohlrausch's law
- Electrolysis and law 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

Unit IV: 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)
- Concept of collision theory (elementary idea, no mathematical treatment)
- Activation energy
- Arrhenious equation

Unit V: Surface Chemistry

- Adsorption:
  - Physisorption
  - Chemisorption
- Factors affecting adsorption of gases on solids
- Catalysis
- Homogenous and heterogeneous activity and selectivity
- Enzyme catalysis 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
- Emulsion:
  - Types of emulsions

Unit VI: General Principles and Processes of Isolation of Elements

- Principles and methods of extraction - concentration, oxidation, reduction - electrolytic method and refining

- Occurrence and principles of extraction of:
  - Aluminium
  - Copper
  - Zinc
  - Iron

Unit VII: p - Block Elements

Group 15 Elements:

- General introduction
- Electronic configuration
- Occurrence
- Oxidation states
- Trends in physical and chemical properties
- Nitrogen preparation properties & uses
- Compounds of nitrogen
- preparation and properties of ammonia and nitric acid
- oxides of nitrogen (Structure only)
- Phosphorus - allotropic forms, compounds of phosphorus
- 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, sulphure - allotropic forms
- Compounds of sulphure
- Preparation properties and uses of sulphur-dioxide, sulphuric acid
- Industrial process of manufacture, 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

Unit VIII: 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
  - Preparation and properties of k2cr2o7 and kmno4
- Lanthanoids:
  - Electronic configuration
  - Oxidation states
  - Chemical reactivity and lanthanoid contraction and its consequences
- Actinoids:
  - Electronic configuration
  - Oxidation states
  - Comparison with lanthanoids

Unit IX: 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
- Structure and stereo isomerism
- Importance of coordination compounds (in qualitative inclusion, extraction of metals and biological system)

Unit X: Haloalkanes and Haloarenes

- Haloalkanes:
  - Nomenclature
  - Nature of c-x bond
  - Physical and chemical properties
  - Mechanism of substitution reactions
  - Optical rotation
- Haloarenes:
  - Nature of C -X bond
  - substitution reactions (Directive influence of halogen in monosubstituted compounds only.
- Uses and environmental effects of:
  - Dichloromethane
  - Trichloromethane
  - Tetrachloromethane
  - Iodoform freons
  - DDT

Unit XI: 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
- 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 preparation
- Physical and chemical properties
- Uses

Unit XII: Aldehydes, Ketones and Carboxylic Acids

➢ Aldehydes and Ketones:
- Nomenclature
- Nature of carbonyl group
- Methods of preparation
- Physical and chemical properties
- Mechanism of nucleophillic addition
- Reactivity of alpha hydrogen in aldehydes
- Uses

➢ Carboxylic Acids:
- Nomenclature
- Acidic nature
- Methods of preparation
- Physical and chemical properties

- Uses

Unit XIII: Organic compounds containing Nitrogen

- Amines:
  - Nomenclature
  - Classification
  - Structure
  - Methods of preparation
  - Physical and chemical properties
  - Uses
  - Identification of primary, secondary and tertiary amines
- Cyanides and Isocyanides - will be mentioned at relevant places in context
- Diazonium salts:
  - Preparation
  - Chemical reactions
  - Importance in synthetic organic chemistry

Unit XIV: Biomolecules

- Carbohydrates:
  - Classification (aldoses and ketoses)
  - Monosaccahrides (glucose and fructose)
  - D-l configuration
  - Oligosaccharides (sucrose, lactose, maltose)
  - Polysaccharides (starch, cellulose, glycogen) importance
- Proteins:
  - Elementary idea of α - amino acids, peptide bond, polypeptides, proteins
  - Structure of proteins - primary, secondary, tertiary structure and quaternary (qualitative idea only)
  - Denaturation of proteins

- Enzymes
- Hormones:
  - Elementary idea excluding structure
- Vitamins:
  - Classification
  - Functions
- Nucleic Acids:
  - DNA
  - RNA

Unit XV: Polymers

- Classification:
  - Natural
  - Synthetic
- Methods of polymerization (addition and condensation)
- Copolymerization
- Some important polymers: natural and synthetic like:
  - Polythene
  - Nylon polyesters
  - Bakelite
  - Rubber
- Biodegradable and non-biodegradable polymers

Unit XVI: Chemistry in Everyday life

- Chemicals in medicines:
  - Analgesics
  - Tranquilizers antiseptics
  - Disinfectants
  - Antimicrobials

- Antifertility drugs
- Antibiotics
- Antacids
- Antihistamines

- Chemicals in food:
  - Preservations
  - Artificial sweetening agents
  - Elementary idea of antioxidants
- Cleansing agents:
  - Soaps
  - Detergents
  - Cleansing action

Practical Syllabus

Section A. Surface Chemistry

a) Preparation of one lyophilic and one lyophobic

sol Lyophilic sol - starch, egg albumin and gum

Lyophobic sol - aluminium hydroxide, ferric hydroxide, arsenous sulphide.

b) Dialysis of sol-prepared in (a) above.
c) Study of the role of emulsifying agents in stabilizing the emulsion of different oils.

Section B. Chemical Kinetics

a) Effect of concentration and temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.
b) Study of reaction rates of any one of the following:
   i. Reaction of iodide ion with hydrogen peroxide at room temperature using different concentration of iodide ions.

ii. Reaction between potassium iodate, (KIO3) and sodium sulphite: (Na2SO3) using starch solution as indicator (clock reaction).

Section C. Thermochemistry

Any one of the following experiments

a) Enthalpy of dissolution of copper sulphate or potassium nitrate.
b) Enthalpy of neutralization of strong acid (HCI) and strong base (NaOH).
c) Determination of enthaply change during interaction (Hydrogen bond formation) between acetone and chloroform.

Section D. Electrochemistry

a) Variation of cell potential in $Zn/Zn^{2+}||\ Cu^{2+}/Cu$ with change in concentration of electrolytes ($CuSO_4$ or $ZnSO_4$) at room temperature

Section E. Chromatography

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

Section F. Preparation of Inorganic Compounds

a) Preparation of double salt of ferrous ammonium sulphate or potash alum.
b) Preparation of potassium ferric oxalate.

Section G. Preparation of Organic Compounds

Preparation of any one of the following compounds

a) Acetanilide
b) Di -benzal acetone
c) p-Nitroacetanilide
d) Aniline yellow or 2 - Naphthol aniline dye.3

Section H. Tests for the functional groups present in organic compounds

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

Section I. Characteristic tests of carbohydrates, fats and proteins in pure samples and their detection in given food stuffs.

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

b) Oxalic acid
c) Ferrous ammonium sulphate

K. Qualitative analysis

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

Cation - Pb^{2+}, Cu^{2+}, As^{3+}, Fe^{3+}, Mn^{2+}, Zn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}, $NH4^{+}$

Anions - $Co^{2-}{}_3$, S^{2-} , $SO^{2-}{}_3$, $SO^{2-}{}_4$, $NO^{-}{}_2$, $NO^{-}{}_3$, Cl^{-}, Br^{-}, I^{-}, $PO^{3-}{}_4$, $C_2O^{2-}{}_4$, CH_3COO^{-}

PROJECT

Scientific investigations involving laboratory testing and collecting information from other sources.

Students can choose a project from the following topics with their teachers' approval:

- Study of the presence of oxalate ions in guava fruit at different stages of ripening
- Study of quantity of casein present in different samples of milk
- Preparation of soybean milk and its comparison with the natural milk with respect to curd formation, effect of temperature, etc
- Study of the effect of potassium bisulphate as food preservative under various conditions (temperature, concentration, time etc.
- Study of digestion of starch by salivary amylase and effect of pH and temperature on it.
- Comparative study of the rate of fermentation of following materials: wheat flour, gram flour, potato juice, carrot juice etc.
- Extraction of essential oils present in Saunf (aniseed), Ajwain (carum), Illaichi (cardamom).
- Study of common food adulterants in fat, oil, butter, sugar, turmeric power, chily powder and pepper.