CHEMISTRY

PHYSICAL CHEMISTRY

UNIT I: SOME BASIC CONCEPTS IN CHEMISTRY

Matter and its nature, Dalton's atomic theory: Concept of atom, molecule, element. and compound:: Laws of chemical combination; Atomic and molecular masses, mole concept, molar mass, percentage composition, empirical and molecular formulae: Chemical equations and Stoichiometry.

UNIT 2: ATOMIC STRUCTURE

Nature of electromagnetic radiation, photoelectric effect; Spectrum of the hydrogen atom. Bohr model of a hydrogen atom - its postulates, derivation of the relations for the energy of the electron and radii of the different orbits, limitations of Bohr's model; Dual nature of r,latter, de Broglie's relationship. Heisenberg uncertainty principle. Elementary ideas of quantum mechanics, quantum mechanics, the quantum mechanical model of the atom, its important features. Concept of atomic orbitals as one-electron wave functions: Variation ofY and Y2 with r for ls and 2s orbitals: various quantum numbers (principal, angular momentum, and magnetic quantum numbers) and their significance; shapes of s, p, and d - orbitals, electron spin and spin quantum number: Rules for filling electrons in orbits - Aufbau principle. Pauli's exclusion principle and Hund's rule, electronic configuration of elements, extra stability of half-filled and completely filled orbitals'.

UNIT 3: CHEMICAL BONDING AND MOLECULAR STRUCTURE

Kossel - Lewis approach to chemical bond formation, the concept of ionic and covalent bonds' Ionic Bonding: Formation of ionic bonds, factors affecting the formation of ionic bonds; calculation of lattice enthalpy. covalent Bonding: concept of electronegativity. Fajan's rule, dipole moment: valence Shell ElectronPairRepulsion(VSEPR)theoryandshapesofsimplemolecules. Quantum mechanical approach to covalent bonding: Valence bond theory - its important features. the concept of hybridization involving s, p, and d orbitals; Resonance'
Molecular orbital Theory - Its important features. LCAOs, 'types of molecular orbitals (bonding, antibonding), sigma and pi-bonds, molecular orbital electronic configuralions of homonuclear diatomic molecules, the concept of bond order, bond length, and bond energy' Elementaryideaofmetallicbonding.Hydrogenbondingandisapplications.

UNIT 4: CHEMICAL THERMODYNAMICS

Fundamentals of thermodynamics: system and surroundings, extensive and intensive properties' state functions, types of processes' The first lew of thermodynamics - concept of work, heat internal energy and enthalpy, heat Capacity, molar heat. Hess’s law of constant heat summation; Enthalpies of bond dissociation, combustion' formation, atomization. sublimation. phase transition, hydration. ionization. and solution.

The second law of thermodynamics - Spontaneity of processes: AS of the universe and AC of the system as criteria for spontaneity. AG" (Standard Gibbs energy change) and equilibrium constant.

UNIT 5: SOLUTIONS

Types of solutions, expression of concentration of solutions of solids in liquids, the 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 Hoff factor

UNIT 6: EQUILIBRIUM

Equilibrium in Physical and chemical processes, dynamic nature of equilibrium, law of chemical equilibrium, equilibrium constant, factors affecting equilibrium Le Chatelier's principle, ionic equilibrium – ionisation of acids and bases, strong and weak electrolytes, degree of ionisation, ionisation 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).

UNIT 7: 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.

UNIT 8: REDOX REACTIONS AND ELECTROCHEMISTRY

Concept of oxidation and oxidation and reduction, redox reactions oxidation number, balancing redox reactions in terms of loss and gain of electron and change in oxidation numbers

INORGANIC CHEMISTRY

UNIT 9: CLASSITICATION OF ELEMENTS AND PERIODICITY IN PROPERTIES

Modem periodic law and present form of the periodic table. s, p. d and f block elements-periodic trends in properties of elements atomic and ionic radii. ionisation enthalpy, electron gain enthalp)'. valence. oxidation states. and chemical reactivity'.

UNIT IO: P- BLOCK ELEMENTS

Group -13 to GrouP 18 Elements

General Introduction: Electronic configuration and general trends in physical and chemical properties of elements across the periods and down the groups; unique behaviour of the first element in each group.

UNIT II: d - and f- BLOCK ELEMENTS

Transition Elements

General introduction, electronic configuration, occurrence and characteristics, general trends in

properties of the first.row transition elements - physical properties, ionisation enthalpy, oxidation states. atomic radii. colour. catalytic behaviour. magnetic properties, complex formation. interstitial compounds alloy formation:Preparation,properties,and uses of $K_2Cr_2O_7$.and $KMnO_4$.

Inner Transition Elements

Lanthanoids-Electronicconfiguration,oxidationstates,andlanthanoidcontraction.
Actinoids - Electronic configuration and oxidation states.

UNIT I2: CO-ORDINATION COMPOUNDS

Introductiontocoordinationcompounds.Wemer theory, ligands,coordination number. denticity. chelation; IUPAC nomenclature of mononuclear co-ordination compounds' isomerism: Bonding.Valencebondapproachandbasicideasof Crystaltieldtheory,colourandmagnetic properties; importance of co-ordination compounds (in qualitative analysis. extraction of metals and in biological systems).

ORGANIC CHEMISTRY

UNIT 13: PURIFICATION AND CHARACTERISATION OF ORGANIC COMPOUNDS

Purification - Crystallisation. Sublimation'
chromatography - principles and their applications'
distillation, differential extraction, and
Qualitative analysis - Detection of nitrogen, sulphur' phosphorus' and halogens
Quantitative analysis (basic principles only) - Estimation of carbon. hydrogen. nitrogen. halogens. sulphur. Phosphorus. calculations of empirical formulae and molecular formulae: Numerical problems in organic quantitative analysis.

UNIT I4:SOME BASIC PRINCIPLES OF oRGANIC CHEMISTRY

Tetra\ralency of carbon: Shapes of simple molecules - hybridization (s and p): classification of organic compounds based on functional groups: and those containing halogen(oxygen, nitrogen and sulphur; Homogenous series: Isomerism - structural and stereoisomerism. Nomenclature (Trivial and IUPAC):
Covalent bond fission - Homolytic and heterolytic: free radicals. carbocations. and carbanions: stability of carbocations and free radicals.
Electronic displacement in a covalent bond
- Inductive effect, electromeric effect. resonance. and hyperconjugation.
Common types of organic reactions- Substitution. addition. Elimination, and rearrangement.

UNITS 15: HYDROCARBONS

Classification' isomerism. IUpAC nomenclature, general methods of preparation, properties, and reactions.
Alkanes - Conformations: Sawhorse and Newman
halogenation of alkanes.
projections (of ethane): Mechanism oi

Alkenes - Geometrical isomerism: Mechanism of electrophilic addition: addition of hydrogen. halogens, water. hydrogen halides (Markownikoffs and peroxide and polymerization. Polymerization.
Alkynes - Acidic character: Addition of hydrogen. halogens. water. and hydrogen harides: electrophilic
Aromatic hydrocarbons - Nomenclature. benzene - structure and aromaticity: Mechanism of substitution: halogenation, nitration.
Friedel - craft's alkylation and acylation, directive influence of the functional group in mono-substituted benzene.

UNIT I6: ORGANIC COMPOUNDS CONTAINING HALOGENS
substitution
General methods of preparation, properties, and reactions; Nature of C_X bond: Mechanisms ol reactions.
Uses; Environmental effects of chloroform, iodoform, and DDT

UNIT 17: ORGANIC COMPOUNDS CONTAINING OXYGEN
General methods of preparation, properties, reactions, and uses.
ALCOHOLS, PHENOLS, ETHER
Alcohols: Identification of primary, secondary, and tertiary alcohols: mechanism of dehydration.
Phenols: Acidic nature, electrophilic substitution reactions: halogenation. nitration and sulphonation. Reimer - Tiemann reaction.
Ethers: Structure.
Aldehyde and Ketones: Nature of carbonyl group; Nucleophilic addition to >c:o group' relative reactivities of aldehydes and ketones; Important reactions such as - Nucleophilic addition reactions (addition of HCN. NH:. and its derivatives), Grignard reagent; oxidation: reduction (wolf Krishner and clemmensen); the acidity of cr.-hydrogen. aldol condensational cannizzaro reaction. Haloform reaction, Chemical tests to distinguish between aldehydes and Ketones' Carboxylic Acids Acidic strength and factors affecting it.

UNIT I8: ORGANIC COMPOUNDS CONTAINING NITROGEN
General methods of preparation. Properties, reactions, and uses'
Amines: Nomenclature, classification structure, basic character, and identification of primary, secondary, and tertiary amines and their basic character'
Diazonium Salts: Importance in synthetic organic chemistry'

UNIT 19: BIOMOLECULES
General introduction and importance of biomolecules'
CARBOHYDRATES - classification; aldoses and ketoses: monosaccharides (glucose and fructose) and constituent monosaccharides of oligosaccharides (sucrose, lactose, and maltose)'
PROTEINS: Elementary Idea of amino acids,peptide bond,polypeptides.Proteins:primary. secondary, tertiary, and quaternary structure (qualitative idea only), denaturation of proteins' enzymes.
VITAMINS - Classification and functions

NUCLEIC ACIDS - Chemical constitution of DNA and RNA'
Biological functions of nucleic acids'
Hormones (General introduction)

UNIT 20: PRINCIPLES RELATED TO PRACTICAL, CHEMISTRY
Detection of extra elements(Nitrogen,sulphur,halogens) inorganic compounds;Detection of the following functional group, hydrolysis alcoholic and phenolic), carbonyl (aldehyde and ketones) carboxyl, and amino groups in organic compounds. The chemistry involved in the preparation of the following: Inorganic compounds: Mohr's salt. potash alum.
Organic compounds: Acetanilide. p-nittro acetanilide' aniline yellow iodoform.
The chemistry involved in the titrimetric exercises - Acids. bases and the use of indicators. oxalicacid vs KMnO+. Mohr's salt vs $KMnO_4$
Chemical principles involved in the qualitative salt analysis:
cations - pb^{2+}. cu^{2+}. Al^{2+}, Fe^{3+}. zn2+, Ni2+, $C0^{2+}$, Ba^{2+}, Mg^{2-}. NH^{+}
Anions- CO^{2-}, No^{2-}, CI^{-}, Br^{-}. I^{-} (Insoluble salts excluded).
Chemical principles involved in the following experiments:
l. Enthalpy of solution of CuSO,r
2. Enthalpy of neutralisation of strong acid and strong base.
3. Preparation of lyophilic and lyophobic sols.
4. Kinetic study of the reaction or iodide ions with hydrogen peroxide at room temperature.