

CHEMISTRY

INORGANIC CHEMISTRY UNIT – I

A. ATOMIC STRUCTURE AND PERIODIC CLASSIFICATION

- I) Atomic models: Rutherford, Bohr and Sommerfeld-Origin of hydrogen spectrum-Electromagnetic radiation-Dualism of light-Black body radiation- Planck's quantum theory-Photoelectric effect-Compton effect-de Broglie equation-Heisenberg uncertainty principle.
- II) Periodic properties of elements: Atomic ionic radii, Ionization potential, electron affinity, electronegativity (Pauling and Mulliken's scale) of elements along period and groups, -Effective nuclear charge, screening effect, Slater rule
- III) Postulates of quantum mechanics-operators: linear, non-linear, commutator- Schrodinger wave equation and derivation)-6LJQLILFDQFHRIzDQGz², wave mechanical concept of atomic orbitals.

B. CHEMICAL BONDING

- I) Ionic bond-Factors influencing the ionic bond-Lattice energy- Inert pair effect-Fajan's rules-Born-Haber cycle-Born-Lande equation (derivation not required)
- II) Covalent bond-Lewis theory-VSEPR theory-Shapes of BeF₂, BCl₃, SnCl₂, CCl₄, PF₅, Valence bond theory-Coordinate bond-Hybridization: sp³, dsp², sp³d², d²sp³
- III) Shapes of orbitals, -quantum numbers-Zeeman effect-Pauling's exclusion principle, Hund, rule, Aufbau Principle, Electronic configuration of elements- MO theory, MO diagrams of O₂, N₂
- IV) Intermolecular forces: hydrogen bond, van der Waals forces
- V) Dipole moment

UNIT II

C. p-Block elements

- i) General characteristic of p-block elements- Diborane-borax, borazine, Alums, alloys of aluminium, allotropes of carbon
- ii) Chemistry of oxides of carbon, silicon
- iii) Compound of N and P-NH₂-NH₂, NH₂ OH, Fixation of N₂, PH₃, P₂O₅

D. d-BLOCK & f-BLOCK ELEMENTS

- i) General characteristics of d-block elements: Melting points, Ionization energies, oxidation states, magnetic properties
- ii) Alloys of iron, copper, Nickel, chromium- Gemstones: Ruby, Emerald, Sapphire iii) General characteristics of f-block elements
- iv) Lanthanide, actinide contraction- consequences- UV spectra v) Separation and applications of lanthanides and actinides

UNIT III

E. COORDINATION CHEMISTRY

- i) Classification of ligands, Complexes- IUPAC nomenclature, Isomerism. Mono and bidentate ligands and their complexes- outer orbital inner orbital complexes
- ii) Theories of coordination compounds: Werner's theory, VB theory, Crystal field theory, EAN rule iii) Applications of coordination compounds

F. NUCLEAR CHEMISTRY

- i) Theory of nuclear reactions- alpha, beta and gamma rays- n/p ratio, isotopes. Isobars, isotones- Laws of radio activity- Radioactive equilibrium
- ii) Types of nuclear reactions: Fission, fusion and spallation-Nuclear reactors iii) Applications of radio isotopes in industry, medicine and agriculture

G. ANALYTICAL CHEMISTRY

Principles of volumetric analysis, gravimetric analysis, Separation and purification techniques- Redox titrations, complexometric titrations and Conductometric titrations.

PHYSICAL CHEMISTRY

UNIT-IV H. GASEOUS STATE

Gas laws: Boyle's law, Charles law, Avogadro's law- kinetic theory- ideal gas equation- deviation from ideal behaviour- Maxwell distribution of molecular velocities(no derivation)- mean, root mean square and most probable velocities- Calculation of molecular velocities-collision diameter- mean free path- collision number behaviour of real gases-deviation from ideal behaviour--Inversion temperature-Liquefaction of gases

I. SOLID STATE

- i) Classification of solids, Isotropic and anisotropic crystals- Crystal systems- Laws of crystallography Miller indices, Bravais lattices- Unit cell- Crystal symmetry- X-ray diffraction- Structures of NaCl, CsCl and ZnS- Bragg's equation- Radius ratio- Packing in crystals- defects in crystals
- ii) Semiconductors: n and p -type, intrinsic and extrinsic semiconductors

UNIT-V

J. THERMODYNAMICS

- i) Definitions: System and surrounding, isolated, closed and open systems- state of the system- intensive and extensive properties- Thermo dynamic processes: reversible and irreversible, isothermal and adiabatic processes, state and path functions
- ii) First law of thermodynamics, Internal energy, enthalpy, heat capacity, Relationship between C_p and C_v , Hess's law of constant heat summation- Kirchoff's equation- Second law of thermodynamics- Carnot theorem, entropy and probability-free energy and chemical equilibrium- Third law- Gibb's & Helmholtz functions

K. CHEMICAL KINETICS

- i) Rate of reactions, rate law, Rate constant- order and molecularity of reactions- Derivation of first order rate constant, Zero order reaction, Effect of temperature on reaction rates- Half-life period, Activation energy- Arrhenius equation
- ii) Theory of reaction rates, failure of collision theory- Significance of entropy and free energy of activation

UNIT-VI

L. COLLOIDS AND SURFACE CHEMISTRY

- i) Classification of colloids- Preparation and purification of colloids- Properties of colloids- Stability of colloids- Gold number, gels- emulsion- types, emulsifiers- Application of colloids
- ii) Adsorption- Physisorption, chemisorption, difference between them- Factors influencing adsorption- Adsorption isotherm, Langmuir isotherm (no derivation)

M. ELECTROCHEMISTRY

- i) Galvanic cells- Types of reversible and irreversible electrodes- conventional representation of electrochemical cells. Nernst equation- reference electrodes, Computation of cell emf, Calculation of thermodynamic parameters of cell reactions- Over potential, Hydrogen over voltage.
- ii) Arrhenius theory, Debye-Huckel equation- Kohlrausch law, Ostwald's dilution law - Determination of pH and pKa of acids by potentiometric methods- Corrosion- Types of corrosion- Prevention of corrosion

UNIT-VII

N. SPECTROSCOPY:

- i) Electromagnetic spectrum- Different regions of spectra- Microwave spectra of diatomic molecules, rotational constants, selection rules- Infrared spectroscopy- Applications- Raman spectroscopy- Principles and applications
- ii) Principles, instrumentation and applications of UV Vis, NMR, ESR and Mass spectrometry.

ORGANIC CHEMISTRY UNIT-VIII

O. TYPES OF REACTIONS

- i) Aliphatic nucleophilic substitution reactions –Aromatic electrophilic substitution reactions-Free radical reactions-Addition to C=C and C=O compounds – Elimination Reactions.
- ii) Reduction and oxidation reactions – Oxidation with osmium tetroxide, ozone- reduction with NaBH₄, LiAlH₄

P. ELECTRON DISPLACEMENT METHODS

Inductive effects- Mesomeric effects, Hyper conjugation- Steric effects in substitution, addition and elimination reactions

Q) NOMENCLATURE OF ORGANIC COMPOUNDS

Classification of organic compounds-IUPAC nomenclature:alkanes, alkenes, alkynes, alcohols, aldehydes and ketones.

UNIT- IX

R. NATURE OF BONDING

- 1) Hybridization and geometry of simple organic compounds- Breaking of bonds- homolytic and heterolytic cleavage of C – C bonds-Reaction intermediates- free radicals : generation and stability- Carbocation and carbanion: formation and stability

S. STEREOCHEMISTRY

Stereoisomerism, definition and types- optical activity-asymmetric carbons, D and L notations, Enantiomerism, Diastereomerism- Racemization methods- Resolution methods-Walden inversionFisher, sawhorse and Newman projections-R and S notation of optical isomers: Cahn-Inhold and Prelog rules- Geometrical isomerism Z and E notations

UNIT X

T. MECHANISM IN AROMATIC SUBSTITUTION

- i) Aromatic electrophilic substitution: Arenium ion mechanism: nitration, halogenation, sulphonation, Friedel Crafts reaction- Orientation and reactivity in monosubstituted benzene rings-Activating and deactivating groupsii) Aromatic nucleophilic substitution: S_NAr mechanism, Benzyne mechanism

U. CARBOHYDRATES

Classification of carbohydrates-Monosaccharides-D family sugars-L family sugars- EpimersMutarotation- Interconversion of glucose to fructose and vice versa, Reactions of monosaccharidesDisaccharides – Lactose, Maltose, Gentiobiose, Sucrose, Manufacture of sucrose, properties and uses.

V. MATERIAL CHEMISTRY

- i) Polymers-Types of polymerization-Homopolymers- copolymers- Thermosetting and thermoplastic polymers-Vulcanization of rubber
- ii) Dyes: Classification and Properties of dyes, Chromophores, auxochromes, Preparation of methyl orange, cangored, malachite green, fluorescein, indigo.