

INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY-III

UNIT – I (Inorganic Chemistry)

(15 Hours)

ELECTRONIC STRUCTURE AND PERIODIC PROPERTIES 15 HRS.

1.1: Quantum numbers : Principal, Azimuthal, Magnetic and Spin quantum numbers and their significance - principles governing the occupancy of electrons in various quantum levels – Pauli's exclusion principle, Hund's rule, Aufbau principle, (n+1) rule, stability of half-filled and fully filled orbitals – inert pair effect.

1.2: PERIODIC PROPERTIES :Variation of atomic volume, atomic and ionic radii, ionic radii, ionization potential, electron affinity and electronegativity along periods and groups – Factors affecting periodic properties.

1.3: Principles of qualitative analysis – solubility product, principle of elimination of interfering radicals common ion effect, complexation reactions including spot tests in Qualitative analysis

UNIT –II (Inorganic Chemistry)

(15 Hours)

2.1 Nitrogen family:

2.1.1 Comparative study of nitrogen family elements and their compounds (oxides, halides, hydrides and oxyacids)

2.1.2 Chemistry of hydrazine, hydrazonic acid, hydroxyl amine and sodium bismuthate.

2.1.3 Non aqueous solvents – classification – Liquid ammonia as solvent.

2.1.4 Zero group elements: Position in the periodic table - isolation of noble gases from the atmosphere and Uses - Compounds of xenon – XeF₂, XeF₄, XeF₆, XeO₃ and XeOF₄ – Preparation, Properties, structure and uses.

2.2 Metals and metallurgy:

2.2.1 Occurrence of metals – concentration of ores – froth floatation, magnetic separation, calcinations, roasting, smelting, flux, aluminothermic process.

2.2.2 Purification of metals – electrolysis, Zone refining Van Arkel de Boer methods.

2.2.3 Mineral wealth of India – Important minerals found in India (Magnetite, haematite, Pyrolusite, bauxite, magnesite, dolomite, gypsum, ilmenite, monazite, pitch blende, mica and common salt) Minerals exported from and imported to India

UNIT –III (Organic Chemistry)

(15 Hours)

3.1. Conformational analysis.

3.1.1. Definition strain, dihedral angle, illustrations for each.

3.1.2. Conformational analysis of ethane and n-butane (with energy diagrams).

Newmann projection, sawhorse formulae, Fischer projection, perspective formula, conformers of cyclohexane (boat, chair and skew-boat forms) – Axial and equatorial bonds – Ring Flipping – conformations of methylcyclohexane and dimethyl cyclohexanes.

3.13 IUPAC Nomenclature of simple and substituted alicyclic bicyclic compounds.

3.2. Aromatic hydrocarbons and aromaticity.

3.2.1. Structure and stability of benzene ring – resonance in benzene – delocalized pi-electron cloud in benzene.

3.2.2. Aromaticity – Huckel's Rule $(4n + 2)$ and examples – Cyclopropenylcation – Benzene, Naphthalene, anthracene, furan, pyrrole, thiophene pyridine and Ferrocene. (15 Hrs).

UNIT –1V (Organic Chemistry)

(15 Hours)

4.1. Electrophilic substitution reactions in aromatic compounds.

4.1.1. General mechanism of electrophilic substitution reactions – Effect of substituents – activating and deactivating groups – orientation.

4.1.2. Nitration, sulphonation, halogenation, Friedel – Craft's alkylation and acylation reactions – Nuclear and side chain halogenation.

4.2. Polynuclear hydrocarbons:

4.2.1. Naphthalene and Anthracene – Isolation, properties, structure and uses.

4.3. Aromatic nucleophilic substitution – Benzyne mechanism and intermediate complex formation mechanism – effect of substituents on reactivity (15 Hrs).

UNIT –V (Physical Chemistry)

(15 Hours)

5.1. Quantum theory and atomic spectra:

5.1.1. Bohr's model of atoms. Bohr's theory of hydrogen atom and spectral lines. Limitations of Bohr model. Sommerfield's extension.

5.1.2. Photoelectric effect and Compton effect. De Broglie's equation and verification. (Davisson and Germer experiment).

5.1.3. Heisenberg's is Uncertainty Principle – Schrodinger wave equation – Eigen values and eigen functions – Significance of ψ and ψ^2 – Radial and angular distribution function – Concept of orbitals and shapes of orbitals. Chemical bonding and molecular structure.

5.1.4. V.B.Theory – postulates – application to the formation of simple molecules like hydrogen and helium. Overlap of atomic orbitals and principles of hybridization.

5.1.5. M.O.Theory – bonding, antibonding molecular orbitals – MO diagrams of simple homonuclear diatomic molecules. (H_2 , H_2 , He_2 , He^+_2 , Li_2 , Be_2 , B_2 , N_2 , O_2 & F_2) and hetero nuclear diatomic molecules – HF and CO.

5.1.6. Comparison of V.B. and M.O. Theories (15 Hrs).

UNIT –VI (Physical Chemistry)

(15 Hours)

6.1. Electric properties of matter.

6.1.1. Electric properties of molecules – polarization, polarizability and dipole moment. Atomic, induced and orientation polarization – Mosotti – Clausius equation – measurement of molar polarization.

6.1.2. Dipole moment – determination by Temperature, Refractivity and Dilute solution methods. Dipole moment of diatomic and polyatomic molecules – Bond moments.

Applications of dipole moment measurements:

1. in determining the percent ionic character of bonds.
 2. shapes of simple inorganic and organic molecules (BCl_3 , H_2O , CO_2 , NH_3 , CCl_4).
 3. dipole moment of substituted benzenes - o, m & p-dichlorobenzene.
- 6.2. Magnetic properties of matter.
- 6.2.1. Magnetic flux - magnetic permeability - magnetic susceptibility. Diamagnetism, paramagnetism, ferro and anti-ferro magnetism - Curie temperature.
- 6.2.2. Determination of magnetic susceptibility - Guoy's method - Number of unpaired electrons - spin only magnetic moment value. Application to structural problems. $\text{K}_3\text{Fe}(\text{CN})_6$, $\text{K}_4\text{Fe}(\text{CN})_6$, $\text{Ni}(\text{CO})_4$ (15 Hrs).

Note Numerical problems wherever possible (all units)

Books Recommended:

1. P.L.Soni & Mohankatyal, Text Book of Inorganic Chemistry 20th revised edition, Sultan Chand 1992.
2. R.B.Puri & L.R.Sharma, "Principles of Inorganic Chemistry", Sultan Chand, 1989.
3. P.L.Soni & H.M.Chawla "Text book of Organic Chemistry" Sultan Chand & Sons 1994, Delhi.
4. K.S.Tewari, S.N.Mehrotra and N.K.Vishnoi, "A Text Book of Organic Chemistry".
5. M.K.Jain, "Organic Chemistry" Shoban Lal Nagin Chand and Co.,
6. B.R.Puri, L.R.Sharma and Madan S.Pathania, "Principles of Physical Chemistry" Shoban Lal Nagin Chand and Co., Delhi.
7. Vogel's "Text Book of Quantitative Chemical Analysis" E.L.B.S.
8. R.D.Madan, "Modern Inorganic Chemistry", 1987, S.Chand and Company (Private) Ltd.,
9. P.L.Soni, "Text book of Organic Chemistry, Sultan Chand & Co., New Delhi.
10. D.A Mc quarrie, "Quantum Chemistry," University Science Books