Inorganic Chemistry - I

Assam University

FYUG · Semester 1 · Credits 3

CHMDSC101T

OBJECTIVES

- To introduce fundamental concepts of atomic structure and periodic properties of elements
- To develop an understanding of chemical bonding theories and intermolecular forces
- To acquaint students with basic principles of redox reactions and metallurgy

COURSE CONTENT

Unit 1: Atomic Structure (9 Hours)

Bohr’s theory, its limitations and atomic spectrum of hydrogen atom, Wave mechanics: de Broglie equation, Heisenberg’s uncertainty principle and its significance, Schrödinger’s wave equation, significance of ψ and ψ², Quantum numbers and their significance, Normalized and orthogonal wave functions, Sign of wave functions, Radial and angular wave functions for hydrogen atom, Radial and angular distribution curves, Shapes of s, p, d and f orbitals, Contour boundary and probability diagrams, Pauli’s exclusion principle, Hund’s rule of maximum multiplicity, Aufbau’s principle and its limitations

Unit 2: Periodicity of Elements (9 Hours)

s-, p-, d- and f-block elements, Long form of periodic table, Effective nuclear charge and shielding or screening effect, Slater rules and variation of effective nuclear charge in periodic table, Atomic radii (van der Waals), Ionic and crystal radii, Covalent radii (octahedral and tetrahedral), Ionization enthalpy, Successive ionization enthalpies and factors affecting ionization energy, Applications of ionization enthalpy, Electron gain enthalpy and its trends, Electronegativity, Pauling’s, Mulliken’s and Allred–Rochow’s electronegativity scales, Variation of electronegativity with bond order, partial charge, hybridization and group electronegativity

Unit 3: Chemical Bonding - I (9 Hours)

Ionic bond: general characteristics, Types of ions and size effects, Radius ratio rule and its limitations, Packing of ions in crystals, Madelung constant, Born–Haber cycle and its applications, Solvation energy, Covalent bond: Lewis structure, Valence Bond theory (Heitler–London approach), Energetics of hybridization, Equivalent and non-equivalent hybrid orbitals, Resonance and resonance energy, Molecular orbital theory, MO diagrams of diatomic and simple polyatomic molecules (N_2, O_2, C_2, B_2, F_2, CO, NO and their ions), MO theory of HCl, BeF_2 and CO_2 (idea of s–p mixing and orbital interaction), Formal charge, VSEPR theory, Shapes of simple molecules and ions containing lone pairs and bond pairs, Multiple bonding (σ and π bond approach) and bond lengths, Covalent character in ionic compounds, Polarizing power and polarizability, Fajan’s rules and consequences of polarization, Ionic character in covalent compounds, Bond moment and dipole moment, Percentage ionic character from dipole moment and electronegativity difference

Unit 4: Chemical Bonding - II (9 Hours)

Metallic bond, Qualitative idea of valence bond and band theories, Semiconductors and insulators, Defects in solids, Weak chemical forces, van der Waals forces, Ion–dipole forces, Dipole–dipole interactions, Induced dipole interactions, Instantaneous dipole–induced dipole interactions, Hydrogen bonding, Theories of hydrogen bonding, Valence bond treatment of hydrogen bonding

Unit 5: Oxidation–Reduction and Principles of Metallurgy (9 Hours)

Redox equations, Standard electrode potential and its application to inorganic reactions, Principles involved in volumetric analysis, Fe(II) and oxalic acid using standardized $KMnO_4$ solution, Fe(II) with $K_2Cr_2O_7$ solution, General principles of metallurgy, Chief modes of occurrence of metals based on standard electrode potentials, Ellingham diagrams for reduction of metal oxides using carbon and carbon monoxide as reducing agents, Electrolytic reduction, Hydrometallurgy, Methods of purification of metals, Electrolytic processes, Mond’s process, Zone refining

LEARNING OUTCOMES

- Explain atomic structure using quantum mechanical principles
- Analyse periodic trends and their applications
- Apply theories of chemical bonding to molecular structure and properties
- Understand redox processes and basic metallurgical principles

REFERENCES

- Principles of Inorganic Chemistry – Puri, Sharma and Kalia
- Concise Inorganic Chemistry – J. D. Lee
- Concepts and Models of Inorganic Chemistry – B. E. Douglas and D. H. McDaniel
- Theoretical Inorganic Chemistry – M. C. Day and J. Selbin