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