Introductory Inorganic Chemistry - Web course

NPTEL

http://nptel.iitm.ac.in

Chemistry and Biochemistry

Coordinators:

Dr. Chandan Mukherjee
Department of ChemistryIIT Guwahati

COURSE OUTLINE

Introductory Inorganic Chemistry course will deal with the basic knowledge required for the understanding of Inorganic Chemistry.

- Fundamentals of atomic and molecular structure along with periodic table
- The coordination chemistry in terms of Werner´s theory, bonding, electronic spectra, magnetism, and isomerization in coordination compounds
- Acid-base theory, including Pearson´s HSAB concept
- Oxidation-reduction chemistry and electrochemical cells
- Radioactivity
- Bioinorganic chemistry

Contents

Introduction to inorganic chemistry, what is inorganic chemistry, structure of hydrogen atom, many electron atoms, penetration and shielding, Aufbau principle, Pauli exclusion principle, and Hund´s rule, periodic Table of elements; trends in periodic properties. Ionic solids- ionic structures, radius ration, coordination number, limitations of radius ratio rule; lattice defects; semiconductors. Lattice energy, Born-Haber cycle, solvation energy, polarization and polarizing power, Fajan's rule, metallic bond, free electrons, band theory, hydrogen bond, van der Waals forces, VSEPR theory, valance bond theory, covalent bond, hybridization. Molecular orbital theory, MO diagram for homonuclear and heteronuclear diatomic molecules, Bent rule, bond energy, percentage of ionic character. Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism (geometrical and optical), Valance Bond Theory of coordination complexes and its limitations, Crystal Field Theory: d-orbital splitting in various ligand fields. Spectral properties and magnetism of coordination complexes. Acid-base classification: Arrhenius, Bronsted-Lowry, Lux-Flood, Lewis acid and base concept, non-aqueous solvents ($SOCl_2$, NH_3), ionic liquid, hard acid-hard base concept; Pearson's HSAB concept; theoretical basis of hardness and softness. Redox potential, analysis of redox cycle, Frost and Latimer diagram, redox principles involved in extraction of elements, electrochemical cells. Nature of radioactive radiation, n/p ratio, artificial radioactivity, radioactive series, applications. Essentials and trace elements in biological systems, some Fe, Zn, Co, and Cu-containing proteins, photosystems, nitrogenase.

Module No	Module Topic	No. of Hours
1	Atomic structure and periodic table	7
2	Chemical bonding	8
3	Coordination chemistry	7
4	Acids and bases	3
5	Oxidation and reduction	4

6	Radioactivity	3
7	Bioinorganic chemistry	8
	Total	**40**

Sl. No.	Topic	Lecture Hour
	Module I	
1	**Atomic structure and periodic table** • Structure of hydrogen atom • Many electron atoms • Penetration and shielding • Aufbau principle, Pauli exclusion principle, and Hund´s rule Periodic Table of elements; trends in periodic properties	7
	Module II	
2	**Chemical bonding** • Ionic solids- ionic structures, radius ratio, coordination number, limitations of radius ratio rule; Born-Haber cycle. • Lattice energy, lattice defects, semiconductor, solvation energy. • Polarization and polarizing power, Fajan's rule • VSEPR theory, Valance bond theory, covalent bond, hybridization • Molecular orbital theory, MO diagram for homonuclear and heteronuclear diatomic molecules • Bent rule, bond energy, percentage of ionic character • Metallic bond, free electrons, band theory, Hydrogen bond, van der Waals forces.	8
	Module III	
3	**Coordination chemistry** • Werner's coordination theory and its experimental verification • Effective atomic number concept, chelates, chelates effects. • Nomenclature of coordination compounds. • Isomerism (geometrical and optical). • Valance Bond Theory of coordination complexes and its limitations. • Crystal Field Theory: d-orbital splitting in various ligand fields. Magnetism of coordination complexes.	7
	Module IV	

4	**Acids and bases** • Arrhenius, Franklin theory**,** Bronsted-Lowry, Lux-Flood, Usanovich definition, Lewis acid and base concept. • Hard acid-hard base (HSAB) concept; Pearson's HSAB concept; Theoretical basis of hardness and softness. Non-aqueous solvents ($SOCl_2$, NH_3), ionic liquid.	3
	Module V	
5	**Oxidation and reduction** • Redox potential. • Analysis of redox cycle. • Frost and Latimer diagram. • Redox principles involved in extraction of elements, Electrochemical cells.	4
	Module VI	
6	**Radioactivity** • Type of radioactive radiation. • *n*/*p* ratio. • Radioactive series. • Artificial radioactivity, Fission, and Fusion.	3
	Module VII	
7	**Bioinorganic chemistry** • Essentials and trace elements in biological systems. • Some Fe, Zn, Co, and Cu-containing proteins. • Photosystems.	8

References:

1. Inorganic Chemistry: Principles of Structure and Reactivity (4th Edition) by J.E. Huheey, E. A. Keiter and R. L. Keiter; Harper Collins.
2. Inorganic Chemistry (4th Edition) by D. F. Shriver and P. W. Atkins; Oxford.
3. Concepts and Models of Inorganic Chemistry (3rd Edition) by B. E. Douglas, D. H. McDaniel, J. J. Alexander; John Wiley.
4. Chemistry of the elements (2nd Edition) by N. N. Greenwood, A Earnshow and N. Greenwood; Butterworth Heinemann.
5. General & Inorganic Chemistry (Part I & II) by R. Sarkar.