

## Category II

### BSc. Life Science with Chemistry as one of the Core Discipline

#### DISCIPLINE SPECIFIC CORE COURSE – 4:

#### CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
Chemical Bonding and Elements in Biological System CHEM-DSC-02	4	2	0	2	Class XII Pass	----

#### Learning Objectives

The Learning Objectives of this course are as follows:

- Students gain basic knowledge of chemical bonding in compounds which is a necessary pre-requisite in understanding the general properties of the compound.
- Unit 2 reviews the importance of inorganic chemical species, especially metals in biological systems, their classification and detailed discussion of toxic metals.
- The discussions also provide them the details of sodium-potassium pump, role of some metal ions such as calcium, magnesium and the role of iron in transport and storage system

#### Learning outcomes

By the end of the course, the students will be able to:

- Understand the concept of lattice energy using Born-Landé and Born Haber Cycle and their applications
- Rationalize the conductivity of metals, semiconductors and insulators based on the Band theory.
- Understand the importance and application of chemical bonds, inter-molecular and intramolecular weak chemical forces and their effect on melting points, boiling points, solubility and energetics of dissolution.
- Know about the essential, non-essential, trace and toxic metal ions and their role in biological system and effects of their deficiency. They will also learn their dose response relationship curves.
- Understand active and Passive transport and diagrammatically explain the working of

the sodium-potassium pump in organisms and the factors affecting it

- Explain the sources and consequences of excess and deficiency of trace metals and learn about the toxicity of certain metal ions, the reasons for toxicity
- Storage and transport of iron in bio-systems

## **SYLLABUS OF DSC-4**

### **Unit I: Chemical Bonding**

**(18 Hours)**

**Ionic Bonding:** General characteristics of ionic bonding, Lattice Enthalpy and Solvation Enthalpy and their relation to stability and solubility of ionic compounds, Born-Landé equation for calculation of Lattice Enthalpy (no derivation), Born-Haber cycle and its applications, polarizing power and polarizability, Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

**Covalent Bonding:** Valence Bond Approach, Hybridization and VSEPR Theory with suitable examples, Concept of resonance and resonating structures in various inorganic and organic compounds, Molecular Orbital Approach: Rules for the LCAO method, bonding, nonbonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules of 1<sup>st</sup> and 2<sup>nd</sup> periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO<sup>+</sup>.

Brief introduction to Metallic Bonding, Hydrogen Bonding, van der Waals forces

### **Unit II: Elements in Biological System**

**(12 Hours)**

Classification of elements in biological system, Geochemical effect on the distribution of metals, Metal ions present in biological systems with special reference to Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Fe<sup>2+</sup>, Cu<sup>2+</sup> and Zn<sup>2+</sup>, Sodium / K-pump, Role of Ca<sup>2+</sup> (blood clotting and structural), Role of Mg<sup>2+</sup> in chlorophyll and energy production, Excess and deficiency of some trace metals, Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Dose response relationship curves of metal ions, Iron and its application in bio-systems, Storage and transport of iron.

### **PRACTICALS:**

**60 Hours**

1. Preparation of standard solutions.
2. Estimation of Sodium carbonate using HCl by acid base titration.
3. Estimation of carbonate and hydroxide present together in a mixture.
4. Estimation of carbonate and bicarbonate present together in a mixture.
5. Estimation of free alkali present in different soaps/detergents
6. Estimation of oxalic acid using KMnO<sub>4</sub> by redox titration.
7. Estimation of Mohr's salt using KMnO<sub>4</sub> by redox titration.
8. Determination of dissolved oxygen in water.
9. Estimation of Fe (II) ions by titrating it with K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> using internal and external indicators.
10. Estimation of Cu (II) ions iodometrically using Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub>
11. Paper Chromatographic separation of mixture of metal ions

- a.  $\text{Cu}^{2+}$ ,  $\text{Cd}^{2+}$
- b.  $\text{Ni}^{2+}$ ,  $\text{Co}^{2+}$ .

12. Any suitable experiment (other than the listed ones) based upon neutralisation/redox reactions.

**References:**

**Theory:**

1. Lee, J.D.; (2010), **Concise Inorganic Chemistry**, Wiley India.
2. Huheey, J.E.; Keiter, E.A.; Keiter; R. L.; Medhi, O.K. (2009), **Inorganic Chemistry-Principles of Structure and Reactivity**, Pearson Education.
3. Douglas, B.E.; McDaniel, D.H.; Alexander, J.J. (1994), **Concepts and Models of Inorganic Chemistry**, John Wiley & Sons.
4. Atkins, P.W.; Overton, T.L.; Rourke, J.P.; Weller, M.T.; Armstrong, F.A. (2010), Shriver and Atkins **Inorganic Chemistry**, 5th Edition, Oxford University Press.
5. Crichton, R.; (2019), **Biological inorganic chemistry: a new introduction to molecular structure and function**, third edition, Elsevier, Academic Press.
6. Kaim, W; Schwederski, B.; Klein, A. (2013), **Bioinorganic Chemistry - Inorganic Elements in the Chemistry of Life: An Introduction and Guide**, 2<sup>nd</sup> Edition, Wiley.

**Practical:**

1. Jeffery, G.H.; Bassett, J.; Mendham, J.; Denney, R.C. (1989), **Vogel's Textbook of Quantitative Chemical Analysis**, John Wiley and Sons.

**Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**