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DEPARTMENT OF CHEMISTRY

SEMESTER – II

B.Sc in Life Science

Bachelor of Sciences in Life Sciences

Category II

Life Science Course for Undergraduate Programme of study with Chemistry as one of the Core Disciplines

STRUCTURE OF SECOND SEMESTER

A student who pursues undergraduate programme with Life Science is offered the following courses:

3 Discipline Specific Cores (DSCs) - 3 courses of 4 credits = 12 credits (offered by the parent Departments i.e. Botany, Chemistry, Zoology,)
0 Discipline Specific Electives (DSE) – No DSE courses in Semester II
1 Generic Elective (GE) – 1 course of 4 credits = 4 credits (one course to be chosen from the common pool of GE courses offered by Departments other than the parent Department)
1 Ability Enhancement Course (AEC) – 1 course of 4 credits = 4 credits (one course to be chosen from either 'Environmental Science: Theory to Practice' or one of the 22 Indian Languages listed in the 8th Schedule of the Constitution in the pool of AEC courses)
1 Skill Enhancement Course (SEC) - 1 course of 4 credits = 4 credits (one course to be chosen from the common pool of SEC courses offered by any Department)
1 Value Addition Course (VAC) - 1 course of 4 credits = 4 credits (one course to be chosen from the common pool of VAC courses offered by any Department)

Semester	Core (DSC) 4 credits	Elective (DSE) 4 credits	Generic Elective (GE) 4 credits	Ability Enhance-ment Course (AEC) – 2 credits	Skill Enhance-ment Course (SEC) – 2 credits	Internship/ Apprentice-ship/Project/ Community outreach 2 credits	Value addition course (VAC) 2 credits	Total Credits
I	DSC – 4 DSC - 5 DSC – 6	NIL	Choose one from a pool of courses GE-2 (4)	Choose one from a pool of AEC courses (2)	Choose one from a pool of SEC courses (2)	NIL	Choose one from a pool of VAC courses (2)	22 credits

DISCIPLINE SPECIFIC CORE COURSE – 4: CHEM DSC-02- Chemical Bonding and Elements in Biological System

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 with Physics, Chemistry And Biology/ Biotechnology	NA

Learning Objectives

The Learning Objectives of this course are:

- Acquire basic knowledge of chemical bonding which is a necessary pre-requisite in understanding the general properties of the compound.
- Understand the importance of inorganic chemical species, especially metals in biological systems, their classification and detailed discussion of toxic metals.
- Understand 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:

- Explain and apply the concept of lattice energy using Born-Landé and Born Haber Cycle.
- Rationalize the conductivity of metals, semiconductors and insulators based on the Band theory.
- Use the concepts of chemical bonding, inter-molecular and intramolecular weak chemical forces to explain their effect on melting points, boiling points, solubility and energetics of dissolution.
- Describe the role of essential, non-essential, trace and toxic metal ions in biological system and utilize them for physiological and diagnostic applications.
- Explain the active and Passive transport in biological system and their role in working of the sodium-potassium pump.
- 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.

SYLLABUS OF DSC-4

Unit 1: Chemical Bonding **(9 Weeks)**

Ionic Bonding: General characteristics of ionic bonding, Lattice Enthalpy and Solvation Enthalpy and their relation to stability and solubility of ionic compounds, Born-Lande 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 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+.

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

Unit 2: Elements in Biological System **(6 Weeks)**

Classification of elements in biological system, Geochemical effect on the distribution of metals, Metal ions present in biological systems with special reference to Na^+, K^+, Ca^{2+}, Mg^{2+}, Fe^{2+}, Cu^{2+} and Zn^{2+}, Sodium / K-pump, Role of Ca^{2+} (blood clotting and structural), Role of Mg^{2+} 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: **Credits: 02**

(Laboratory periods: 30)

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 $KMnO_4$ by redox titration.
7. Estimation of Mohr's salt using $KMnO_4$ by redox titration.
8. Determination of dissolved oxygen in water.
9. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal and external indicators.
10. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$
11. Paper Chromatographic separation of mixtureof metal ions
    a. Cu^{2+}, Cd^{2+}
    b. Ni^{2+}, 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**, 2nd 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.