POOL OF DISCIPLINE SPECIFIC ELECTIVES (DSEs)

SEMESTER III

DISCIPLINE SPECIFIC ELECTIVE COURSE CHEM-DSE -1: Chemistry of Major and Minor Biogenic Elements

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		
Chem-DSE-1: Chemistry of Major and Minor Biogenic Elements	**04**	**02**	**-**	**02**	**Class XII with Science**	

Learning Objectives

The Learning Objectives of this course are as follows:

- To introduce learners to review periodic properties of main group elements and their role in the biological systems. It further discusses the patterns and trends exhibited by main group elements and their compounds with emphasis on synthesis, structure, bonding and their diverse applications in the environment, industry and in the biological system.
- To develop the interest of students in the frontier areas of inorganic and material chemistry, it gives an insight into how these compounds such as oxides of N and S affect our day-to-day life. Students learn about inorganic polymeric compounds borazine, silicates, silicones, phosphonitrilic compounds and their applications.

Learning outcomes

By studying this course, students will be able to:

- Understand the periodicity in atomic and ionic radii, electronegativity, ionization enthalpy, electron gain enthalpy of elements of the periodic table.
- Understand oxidation states with reference to the existence of elements in unusual and rare oxidation states in alkalides, carbides and nitrides.

- Understand vital role of sodium, potassium, calcium and magnesium ions etc. in biological systems and the role of oxides of N and S in our environment.
- Distribution of major and minor biogenic elements in human beings

Syllabus

Unit 1: Periodic Properties **(Hours: 6)**

Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, the concept of exchange energy, inert pair effect.
General group trends of main group elements with special reference to size (atomic and ionic), Ionization Enthalpy, Electron Gain Enthalpy, Electronegativity, oxidation states (including rare oxidation states of alkali metals, carbides and nitrides), melting and boiling points, flame colour, metallic character and complex formation tendency (crown ethers and cryptates), Alkali metal solutions in liquid ammonia
Distribution of major and minor biogenic elements in human beings

Unit 2: Structure, Bonding and Properties **(Hours: 16)**

Structure, bonding and properties: Acidic/Basic nature, stability, ionic/covalent nature, oxidation/reduction, hydrolysis, thermal stability of the following:
Hydrides: hydrides of Group 13 (only diborane), Group 14, Group 15 (EH_3 where E = N, P, As, Sb, Bi), Group 16 and Group 17.
Oxides: Oxides of nitrogen, phosphorus and sulphur
Oxoacids: oxoacids of phosphorus, sulphur and chlorine
Halides of phosphorus
Relevance of above compounds in industrial/environmental/biological systems wherever applicable

Unit 3: Preparation, Properties, Structure and Uses **(Hours: 8)**

Preparation, properties, structure and uses of the following compounds: Borazine, Silicates, silicones, Phosphonitrilic halides $\{(PNCl_2)_n$ where n = 3 and 4$\}$

Practicals **Credits:02**
(Laboratory periods: 60)

Qualitative semi-micro analysis of mixtures containing 2 anions and 2 cations (preferably 7-8 mixtures). Emphasis should be given to the understanding of the chemistry of different reactions. The following radicals are suggested:
CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-}, SO_4^{2-}, $S_2O_3^{2-}$, CH_3COO^-, F^-, Cl^-, Br^-, I^-, NO_3^-, BO_3^{3-}, $C_2O_4^{2-}$, PO_4^{3-},
NH_4^+, K^+, Pb^{2+}, Cu^{2+}, Cd^{2+}, Bi^{3+}, Sn^{2+}, Sb^{3+}, Fe^{3+}, Al^{3+}, Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}
The mixtures may contain combination of anions/one interfering anion.
Spot tests should be preferred wherever applicable.

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. Housecraft, E. H.; Sharpe, A.G. (2018), **Inorganic Chemistry**, 5th Edition, Pearson.

Practicals:

4. Vogel, A.I. (1972), **Qualitative Inorganic Analysis**, Longman.
5. Svehla, G. (1996), **Vogel's Qualitative Inorganic Analysis**, Prentice Hall.
6. Dua A, Manav N, **Practical Inorganic Chemistry,** (2017), Manakin Press.

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