Name of the Programme: M.Sc. Part-II (Inorganic Chemistry)

Course Code: CHI-621 **Title of the course:** Bioinorganic Chemistry

Number of Credits: 4

Effective from AY: 2023-24

Prerequisites for the course:	Students have studied chemistry/biochemistry courses at M.Sc. Part-I.	
Course Objective:	1. To understand the role of inorganic elements especially metal ions in biology. 2. To introduce metallobiolecules, metalloproteins & metalloenymes. 3. To understand the role of small molecule model compounds. 4. To introduce the concept of Biomimetic chemistry.	
Content	**1. Essential elements in biology** Periodicity of elements, distribution of elements in biosphere, bio-availability, bio-stability, building blocks of the biosphere; carbohydrates, nucleic acids and proteins, biological importance of water, and brief review of the chemistry of biopolymers. Metallobiomolecules: classification, metalloproteins (enzymes), metal activated proteins (enzymes), metal functions in metalloproteins, Principles of coordination chemistry related to bioinorganic research, physical methods in bioinorganic chemistry.	No of hours 12
	2. Alkali and alkaline earth metals in biology Introduction, biological importance of the alkali and the alkaline earth cations, Cation transport through membranes (ion pumps). Photosynthesis, Hill reaction, Chlorin macrocycle and chlorophyll, Absorption of light by chlorophyll, role of metals in photosynthesis, in vitro photosynthesis.	12
	3. Non-redox metalloenzymes Zinc metalloenzymes like carboxypeptidase, carbonic anhydrase and alcohol dehydrogenase, Bio-functions of zinc enzymes, active site structure and model complexes.	12
	4. Biochemistry of a few transition metals Role of Fe, Mo, Cu and Ni. Oxygen carriers and oxygen transport proteins, iron porphyrins (Haemoglobin and myoglobin). Haemocyanins and Haemerythrins, Synthetic models for oxygen binding haemproteins. Cytochrome C, catalase, peroxidase, and superoxide dismutase, blue copper proteins, vitamin B_{12} coenzymes, nitrogen fixation and iron-sulfur proteins, biological nitrogen fixation, nitrogenase and dinitrogen complexes, iron-sulfur proteins, synthetic analogues for Fe-S proteins, core extrusion reactions. Metal transport and storage: A brief review of iron transport. transferrin, ferritin, hemosiderin, siderophores, iron biomineralization	12
	5. Biomimetic Inorganic Chemistry Fundamentals of biomimetic chemistry, metal – oxygen intermediates, techniques used to probe the active sites of oxygen carriers, redox chemistry	12

	of free molecular dioxygen, spectroscopy of Fe-O-Fe moiety, geometry and electronic structure of coordinated dioxygen, other ligands for biological oxygen carriers, reactions of metal-oxygen compounds, oxygenases, Cytochrome P-450, synthetic procedures of simple ligands, isolation of S-containing amino acidor extraction of chlorophyll from green leaves, recrystallization of carboxylic acids. Non-Heme and heme ligands.	
Pedagogy	Mainly lectures / tutorials / assignments /group discussion / self-study /presentations or a combination of some of these could also be used to some extent.	
Reference / Readings	1. S. J. Lippard & J. M. Berg, Principles of Bioinorganic chemistry, Panima Publishing Corporation 2. B. I. Britini, H. B. Gray, S. J. Lippard & J. S. Valentine, Bioiorganic chemistry, University Science books, Mill Valey, CA, 1994. 3. D. E. Fenton, Biocoordination Chemistry, Oxford Chemistry Printers, 25 Oxford University Press, 1995 4. E. E. Conn, P.K. Stumpf, G. Bruening & R. H. Doi, Outlines of Bioinorganic Chemistry, 5th Ed.; Wiley Eastern, 1983. 5. F.A. Cotton, G. Wilkinson, P.L. Gaus, Basic Inorganic Chemistry, 3rd Ed. (Chapter 31); WileyIndia, 2007. 6. M. Weller, T. Overton, J. Rourke & F. Armstrong Inorganic Chemistry, Int. Ed. (Chapter 25); Oxford University Press, 2018. 7. P Atkins, T Overton, J Rourke, M Weller & F Armstrong, Shriver & Atkins' Inorganic Chemistry, 5th Ed. (Chapter 27); Oxford University Press, 2010. 8. J. E. Huheey, E. A. Keiter, R. L. Keiter, Inorganic Chemistry: Principles of Structure and Reactivity, 5th Ed. (Chapter 19); Addison Wesley Publishing. 9. R. W. Hay, Bioinorganic chemistry, Ellis Horwood Chichester, 1984. 10. M.N. Hughes, The Inorganic Chemistry of Biological processes, 2nd Ed.; Wiley (Interscience), 1984. 11. R. R. Crichton, Biological Inorganic Chemistry, Elsevier, 2012. 12. R. Breslow, Biomimetic Chemistry: Biology as an Inspiration, The Journal of Biological Chemistry, vol. 284, no. 3, pp. 1337–1342, 2009. 13. C. Housecroft, A. G. Sharpe, Inorganic Chemistry, 4th Ed; Pearson Publishing, 2012.	
Course Outcome:	1. Students will be in a position to clarify the significance of essential elements in biology. 2. Students will be able to explain the role played by metal ions in vital processes like i) oxygen storage and transport and ii) electron transfer. 3. Students will be able to explain basic concepts in Biomimetic chemistry. 4. The students will be able use different techniques in Bioinorganic Chemistry.	