Course Code	Course Name	Credits
26CH506	BIO-INORGANIC AND ORGANOMETALLIC CHEMISTRY	04

Course Objectives

- To develop understanding of the chemistry of metal complexes, metallocenes, and reactions of organometallic compounds.
- To appreciate the role of organometallic reagents in organic synthesis.
- To acquire basic knowledge of the structure and functions of metalloenzymes.
- To understand binding and transport mechanisms in metalloenzymes.

Learning Outcomes

Upon successful completion of this course, it is intended that a student will be able to:

- Understand the uniqueness in various bonding behavior of organometallic compounds.
- Select and integrate the chemistry of metalloenzymes and the mechanical aspects of organometallics.
- Understand the key function of metal ions in biological system.
- Acquire intense knowledge about various biological roles taking place at the active site of metalloproteins.

Unit-1 – Organometallic compounds (12 Hrs.)

Definition; effective atomic number (EAN); 18-electron rule; classification of organometallic compounds; synthesis; structure and reactions of metal carbonyls; metal carbonyl anions; metal carbonyl hydrides; metal nitrosyls; metallocenes – preparation, properties, structure and bonding of ferrocene-like compounds; complexes of cyclohexadienyl molecules.

Unit 2 – Organometallic Complexes: Structure, Bonding and Reactivity (12 Hrs.)

Synthesis and structure of metal complexes with alkyls, alkenes and alkynes; bonding in such complexes; use of organometallic reagents in hydrogenation; hydroformylation; acetic acid synthesis; hydrosilylation; isomerization; cyclooligomerization; Wacker process; Fischer–Tropsch reaction; Ziegler–Natta polymerization.

Unit 3 - Metals in Biological Systems (12 Hrs.)

Introduction; essential chemical elements; essential and trace elements and their biological roles; importance of Na^+ and K^+ ions in biology; Na–K pump; calcium ATPase pump; ferritin; hemosiderin; transferrin; blue copper proteins; photosynthesis – chlorophyll.

Unit 4 – Phorphyrin system (12 Hrs.)

Structure and functions of hemoglobin and myoglobin; dioxygen binding, transport and utilization; hemocyanin; hemerythrin; vitamin B_{12} co-enzyme; non-heme iron–sulphur proteins – ferredoxins, rubredoxins; cytochromes.

Unit 5 - Metalloenzymes (12 Hrs.)

Active sites; carboxypeptidase; carbonic anhydrase; superoxide dismutase; xanthine oxidase; peroxidase and catalase; photosynthesis; water oxidation; nitrogen fixation; nitrogenase; ion pumps; metallodrugs.

References:

1. J.E. Huheey, E.A. Keiter and R.L. Keier, Harper and Row, Inorganic Chemistry, 4th Edn., 1993.
2. Ajai Kumar, Coordination Chemistry, 2014, Aarysh Educations, Ghaziabad, India.
3. R. Copalan, V. Ramalingam, Concise Coordination Chemistry, 2001, Vikas Publishing House Pvt. Ltd, New Delhi.
4. Dr Asim K Dass, Bioinorganic Chemistry, 2007, Books and Allied (P) Limited.
5. Wolfgang Kaim, Brigitte schwederski, Axel klein, Bioinorganic chemistry: Inorganic Elements in the chemistry of life, 2nd edition.
6. R. W. Hay, Ellis Horwood, Bio Inorganic Chemistry, 1987.
7. R. M. Roat-Malone, Bio Inorganic Chemistry, 2002, John Wiley.

Websites and eLearning Sources:

1. https://nptel.ac.in/courses/104105031
2. https://youtu.be/N8IXAcewALc?si=mjgsywhJzYJ1P2rP
3. https://www.slideshare.net/slideshow/metalloenzymes/259356311

COs and Bloom's Taxonomy Mapping – 26CH506		
Course Outcomes	**On completing P.G. program the students will be able to**	**BTL**
CO1	Define and classify organometallic compounds, including their synthesis, structure, reactions, metal carbonyls and metallocenes; understand the synthesis, bonding and applications of metal complexes with alkenes, alkynes and alkyl groups.	K1, K2
CO2	Apply organometallic reagents in industrial processes such as hydrogenation, hydroformylation and polymerization.	K3
CO3	Analyze the biological roles of essential and trace metals in processes such as the Na–K pump and calcium ATPase.	K4
CO4	Examine structural and functional differences of metalloproteins such as hemoglobin, myoglobin, cytochromes and blue copper proteins.	K5
CO5	Design organometallic or bioinorganic systems with proposed structure, mechanism and function.	K6

BTL K1 and K2 – remembering and understanding, K3- Applying, K4 – Analyse, K5- Evaluate and K6- Create

Relationship Matrix – 26CH506												
Course Outcomes	**Programme Outcomes (POs)**						**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	2	2	1	1	3	2	2	2	2	2.09
CO2	3	3	3	2	1	1	3	2	3	2	2	2.27
CO3	2	2	3	2	2	1	2	1	3	2	2	2.00
CO4	3	3	2	3	3	1	2	2	2	3	2	2.36
CO5	2	3	2	3	2	3	2	2	3	3	3	2.54
											Total	2.25

Mean Score: 3- High, 2- Medium/Moderate, 1-Low