Subject Code : P8CH6

CORE COURSE VI - INORGANIC CHEMISTRY II
BIOINORGANIC AND ORGANOMETALLIC CHEMISTRY

UNIT – I

General Principles of Bioinorganic Chemistry

Occurrence and availability of Inorganic elements in biological systems.

Biomineralisation

Control and assembly of advanced materials in Biology - Nucleation and crystal growth – various biominerals – calcium phosphate – calcium carbonate – Amorphous silica, Iron biominerals – strontium and barium sulphate.

Function and Transport of Alkali and Alkaline Earth Metal Ions

Characterization of K^+, Na^+, Ca^{2+} and Mg^{2+} - complexes of alkali and alkaline earth metal ions with macrocycles - Ion channels – ion pumps. Catalysis and regulation of bioenergetic processes by the Alkaline Earth Metal ions Mg^{2+} and Ca^{2+}.

Metals at the Center of Photosynthesis

Primary Processes in Photosynthesis – Photosystems I and II - Light Absorption (Energy Acquisition) – Exciton transport (Direct Energy Transfer) – Charge separation and electron transport – Manganese catalyzed oxidation of water to O_2.

UNIT – II

Cobalamines

Reactions of the alkyl cobalamins – One-electron Reduction and Oxidation – Co-C Bond Cleavage – coenzyme B_{12} – Alkylation reactions of methylcobalamin.

Heme and Non-heme Proteins

Hemoglobin and Myoglobin – Oxygen transport and storage – Electron transfer and Oxygen activation.Cytochromes, Ferredoxins and Rubredoxins – Model systems, mononuclear non-heme iron enzymes.

Copper Containing Proteins

Classification and examples - Electron transfer – Oxygen transport - Oxygenation – oxidases and reductases – Cytochrome c oxidase – Superoxide dismutase (Cu, Zn).

Nickel containing Enzyme: Urease.

UNIT – III

Medicinal Bioinorganic Chemistry

Bioinorganic Chemistry of quint essentially toxic metals. Lead, Cadmium, Mercury, Aluminium, Chromium, Iron, Copper, Plutonium. Detoxification by metal chelation. Drugs that act by binding at the metal sites of Metalloenzymes.

Chemotherapy

Chemotherapy with compounds of certain non-essential elements. Platinum complexes in Cancer therapy – Cisplatin and its mode of action – Cytotoxic compounds of other metals – Gold containing drugs as anti-rheumatic agents and their mode of action - Lithium in Pschycopharmocological drugs. Radiopharmaceuticals – Technetium.

UNIT IV

Hapticity, Ligand classification, synthesis and structure – The 18 electron rule – application and limitation- isolobal concept and its usefulness. Uses of typical organomettallics in organic synthesis such as metal alloys and organomettallic hydrides.Structure and bonding in metal carbonyls (simple and polynuclear) nitrosyl complexes – bridging and terminal nitrosyls, bent and linear nitrosyls. Dinitrogen complexes. Metallocene and arene complexes.Metal carbenes , carbynes, carboxylate anions.

UNIT – V

Reactions and Catalysis by Organomatallics

Organometallic reactions – Ligand association and dissociation – oxidative addition and reductive elimination – Insertion reactions – Reactions of coordinated ligands in organometallics - Hydrogenation, hydroformylation, epoxidation, metathesis, polymerization of olefins, olefin oxidation (Wacker process) and carbonylation of methanol.

Text Books and Reference Books

1. J. E. Huheey, Inorganic Chemistry, 3rd ed., Harper & Row Publishers, Singapore.
2. Purcell and Kotz, Inorganic Chemistry, Saunders Golden Sunburst Series, W. B. Saunders Company, Philadelphia.
3. S. J. Lippard and J. M. Berg, Principles of Bioinorganic Chemistry , Panima Publishing Company, New Delhi, 1997.
4. W. Kaim and B. Schewederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life , John Wiley & Sons, New York, USA.
5. Cotton and Wilkinson, Advanced Inorganic Chemistry, 5th ed., Wiley Interscience
1. Publication, John Wiley & Sons, New York, USA.
6. Chem. Education, 62, No. 11, 1985, Bioinorganic Chemistry , State of the Art.
7. G. L. Eichorn, Inorganic Biochemistry, Volumes 1 & 2, 2nd ed., Elsevier Scientific Publishing Company, New York, 1973.
8. F. A. Cotton and G. Wilkinson, Inorganic Chemistry, John Wiley & Sons, New York.
9. R. H. Crabtree, The Organometallic Chemistry of the Transition Metals, John Wiley & Sons, New York.
10. S. E. Kegley and A. R. Pinhas, Problems and Solutions in Organometallic Chemistry, University Science Books, Oxford University Press.
11. A. J. Pearson, Metalloorganic Chemistry,
12. A. W. Parkins and R. C. Poller, An Introduction to Organometallic Chemistry
13. I. Haiduc and J. J. Zuckerman, Basic Organometallic Chemistry
14. P. Powell, Principles of Organometallic Chemistry, 2nd ed., Chapman and Hall, London.
15. B. Douglas, D. H. McDaniel and J. J. Alexander, Concepts and Models of Inorganic Chemistry, 2nd ed, John Wiley & sons, New York.
16. Oxford Chemistry Primers Series, No. 12, M. Bochmann Organometallics 1: Complexes with transition metal-carbon σ bonds and No. 13 M. Bochmann Organometallics 2: Complexes with transition metal-carbon π-bonds
17. J. P. Collman, L. S. Hegedus, J. R. Nortan and R. G. Finke, Principles and Applications of Organotransition Metal Chemistry, University Science Books. Mill Valley, California.
18. R. Hoffmann, Angew. Chem. Int. Ed., Engl. 21, 711-800 1982.