

# Advanced Inorganic and Bioinorganic Chemistry

## (Spring semester-2019)

- I. The basics [4L]
- A. An introduction to coordination chemistry of metals in biology
1. Coordination Chemistry
  2. Biomolecular ligands (to metals)
  3. Metal ion binding motifs
  4. Structure of bio-molecules and effects of metal ion association
- II. Survey of some important metal ions in Biology
- A. Sodium, Potassium and Calcium: mobile metal ions from the s-block, Calmodulin in cell-signaling pathways, P-type ATPases. [2L]
- B. Zinc: Lewis acidity [1L]
- Carboxypeptidase A , Carbonic anhydrase
- C. Iron, copper and manganese: Redox properties
- Ferritin and transferrin, metallothionines, siderophore [2L]
    1. Heme iron and heme proteins [3L]
      - Oxygen and Electron transfer processes by heme proteins
      - Cytochrome P-450
      - Cytochrome c oxidase
      - Peroxidases
    2. Iron-sulfur clusters [1L]
    3. Blue copper centers in electron transport [1L]
    4. Non-heme iron, manganese , cobalt, and copper as catalysts [2L]
      - Methane monooxygenase
      - Superoxide dismutase
      - Methionine Synthase
- D. Molybdenum: Sulfite Oxidase, xanthine oxidase, nitrogenase [1L]
- III. Medicinal Chemistry [4L]
- Basics, drug development pipeline, industrial and academic research
  - Pharmacokinetics and pharmacodynamics
  - Lipophilicity vs membrane permeability
  - Important tools and cell biology assays
- IV: Medicinal aspects of metal complexes
- A. Anticancer metal complexes [7L]
- Historical overview, Salvarsan, Platinum-based anticancer drugs
  - Mechanism of action, resistance to platinum drugs
  - Recent developments and targeted delivery
  - Ruthenium and other non-platinum anticancer drugs
  - Metal complexes in photodynamic therapy
- B. Antibacterial and antiparasitic metal complexes [2L]
- Silver complex, ferrocene-peptide conjugates
  - Ferroquine
- C. Structural Metal Complexes [1L]
- Ruthenium, iridium-based kinase inhibitors
  - Organometallic carbonic anhydrase inhibitors
- D. Metal Based Diagnostic Tools [3L]
- Luminescent metal complexes and biological imaging
  - Tc, Ga, Zr complexes for imaging of cancer and infectious diseases
- III. Physical Methods used in Inorganic and Bioinorganic Chemistry [4L]

1. Electronic, vibrational and Raman spectroscopy.
2. NMR and EPR techniques.
3. CD and MCD techniques.
4. Time resolved methods.
5. X-ray diffraction and EXAFS.

#### IV. Recent developments in Bioinorganic Chemistry

[2L]

- Inorganic Chemical Biology

Instructors: S. Mazumdar and Malay Patra

Days: Monday (9:30-11:00), Wednesday (9:30-11:00), Friday (9:30-11:00)

Venue: AG80

First lecture: January 21, 2019

Mode of Evaluation: Attendance, Assignments, Surprise Quiz, Project proposal and Exams (TWO).

#### **Reference books and review.**

- (i) The Biological Chemistry of the Elements- Inorganic Chemistry of Life, J.J.R. Frasco da Silva and R.J.P. Williams.
- (ii) Biological Inorganic Chemistry- An Introduction, Robert R. Crichton.
- (iii) Principles of Bioinorganic Chemistry, S.J. Lippard and J. M. Berg
- (iv) Bioinorganic Medicinal Chemistry, Editor(s): Prof. Dr. Enzo Alessio
- (v) Medicinal Organometallic Chemistry, Editors: Gérard Jaouen, Nils Metzler-Nolte
- (vi) Metallomics insights into the programmed cell death induced by metal-based anticancer compounds, Metallomics. 2014 , 6(5), 978-95.