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**SECOND SEMESTER 2020-21**  
**COURSE HANDOUT**

**Date: 17.01.2021**

In addition to part I (General Handout for all courses appended to the Time table) this portion gives further specific details regarding the course.

**Course No** : CHEM F343  
**Course Title** : Inorganic Chemistry III  
**Instructor-in-Charge** : AJAY KUMAR SAH  
**Tutorial/Practical Instructors:** Ajay Kumar Sah

**1. Course Description:**

This course encompasses several aspects of the elements of periodic table encountered in inorganic chemistry typically in numerous application/ functional areas such as, life processes, modern day-to-day living, medical and fine chemical applications etc. Some important key-phrases are as follows,

Bio-inorganic chemistry; metalloenzymes; metalloproteins; role of alkali and alkaline earth metal ions, iron, copper, zinc, molybdenum etc. in life processes; metals in medicine; metal deficiency and toxicity aspects (mercury, cadmium, lead, beryllium, selenium and arsenic etc.); metals used in diagnosis and chemotherapy; electronic, magnetic and photonic materials; emerging research topics in inorganic chemistry, such as catalysis, inorganic polymers, nanomaterials and hybrid materials.

**2. Scope and Objective of the Course:** The most important objective of the course is to acquire knowledge and understanding about the roles and importance of the different elements (majorly metals) in life processes, medicinal purposes and augmenting the quality of life of mankind by breakthrough advancements in human civilization. As an integral part of learning the applications of inorganic chemistry, this course will be utilizing the knowledge and understanding gained in the foundation courses of General Chemistry, IC-I and IC-II for probing deeper in to the chemistry of biological systems, chemistry of modern materials, chemistry in industrial processes for commodity and fine chemicals, medicines, sensors etc. On successful completion of the course, the following learning objectives will be fulfilled

- i) Introduction to bioinorganic chemistry
- ii) Understanding the role of metal centers in biological systems (typically redox systems)
- iii) Metals in medical applications, toxicity and deficiency aspects
- iv) Introduction to electronic, photonic and magnetic materials involving inorganic chemistry
- v) Inorganic chemistry involved in industrial applications such as polymer synthesis, catalysis etc.
- vi) Exposure to the emerging research areas of functional materials chemistry including inorganic polymers, nanomaterials, hybrid materials etc.

**3. Text Books:**

T1. J. A. Cowan, "Inorganic Biochemistry An Introduction", Wiley-VCH, 2nd edition.

T2. The Science and Engineering of Materials, Donald R. Askeland, Pradeep P. Phule, Cengage Learning (Indian edition)



#### 4. Reference Books:

- R1. S. J. Lippard and J. M. Berg, "Principles of Bioinorganic Chemistry", University Science Books  
 R2. I. Bertini, H. B. Gray, S. J. Lippard, J. S. Valentine, Bioinorganic Chemistry", Viva, 1998.  
 R3. William D. Callister, Materials Science and Engineering, Wiley-India Edition, 2007.

#### 5. Course Plan:

Module No.	Lecture Session	Reference	Learning outcomes
1 (Lecture 1)	Introduction	Class notes, T1, Ch-1	
2 (Lecture 2-4)	Metal ion storage and transport: Metal ion uptake and transmembrane ion transport, storage of metal ions	T1; p133-61	The mechanism for trans-membrane ion transport like alkali, alkaline earth metals, transition metal ions.  The mechanism for iron storage
3 (Lecture 5-7)	Metalloproteins and Metalloenzymes: Oxygen carriers and Hydrolase enzymes	T1; p167-194	The role of transition metal ions displaying cooperative binding in proteins and enzymes
4 (Lecture 8-10)	Redox Chemistry of transition metal ions in biology	T1; p203-221 and Class note	The electron-transfer reactions and fundamentals underlying their reactivity
5 (Lecture 11-13)	Involvement of Redox Chemistry in electron transfer pathways	T1; p221-247 and Class not	
6 (Lecture 14-16)	Role of alkali and alkaline earth metal ions	T1; p257-284	The role of metal-ions as enzyme activators and co-factors
7 (Lecture 17-19)	Enrichment strategies and intracellular chemistry of low-abundant metals, Spontaneous self-assembly of metal clusters	Class notes	
8 (Lecture 20)	Introduction and overview, Essential metals, Anemia and Iron, Causes and consequences of zinc deficiency, copper deficiency	Class notes	
9 (Lecture 21)	Toxic effects of Metals: Copper overload and Wilkinson diseases, Iron Toxicity, Toxic effects of other essential elements, Mercury Toxicity and Bacterial resistance, cadmium and lead toxicity	Class notes	Interference of exogenous metal ions and resistance mechanism
10 (Lecture 22)	Metals used in diagnosis and chemotherapy, Radiodiagnostic agents, Magnetic Resonance Imaging, Lithium and mental health, Gold and Rheumatoid Arthritis	Class notes	Coordination Complexes as Therapeutic Agents
11 (Lecture 23-25)	Electronic materials: Band structure of solids, Conductivity in solids,	T2; p677-718	Origin of important properties of conductors,



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	Superconductivity, Semiconductors, Insulators and dielectric properties, Piezoelectricity, Pyroelectricity, Ferroelectricity		semiconductors, insulators, dielectrics and superconductors
<b>12 (Lecture 26-28)</b>	Magnetic materials: Classification of magnetic materials, Magnetization, Permeability, Diamagnetic, Paramagnetic, Ferromagnetic, Superparamagnetic materials, Domain structure and the hysteresis loop, The curie temperature, Metallic and ceramic magnetic materials	T2; p725-751	The interaction of materials with magnetic fields
<b>13 (Lecture 29-31)</b>	Photonic materials :The electromagnetic spectrum, Refraction, Reflection, Absorption and Transmission, Selective absorption, Transmission or Reflection, Example and use of emission phenomena	T2; p757-781	The interaction of electromagnetic radiation or photons with materials
<b>14 (Lecture 32-35)</b>	Polymer synthesis, Catalysis by metals, Types of polymerization reactions using metals, Types of catalysis, variants	Class notes	
<b>15 (Lecture 36-40)</b>	Emerging areas in inorganic chemistry: Inorganic polymers, Nanomaterials, Hybrid materials etc	Class notes	Understanding about the current advancement in the field of materials

**6. Evaluation Scheme:**

Component	Duration	Weightage (Marks)	Date & Time
Mid-Semester Test	90 min.	30% (60)	To be announced by AUGSD
Quizzes/assignments	----	30% (60)	Continuous
Comprehensive Examination	120 min.	40% (80)	As announced in the Timetable (12/05 FN)

**7. Chamber Consultation Hour:** To be announced in the class.

**8. Notices:** Notices concerning the course will be put up on Nalanda and/or the chemistry notice board.

**9. Make-up Policy:** Make up request would be considered only for **genuine** cases.

**Instructor-in-charge**  
**Course No. CHEM 343**