KTT 313/3 - Inorganic Chemistry III

Course Objectives :
1) To learn about bioinorganic chemistry and role of inorganic chemistry in biological processes.
2) To learn about organometallic compounds in relation to metal groups and the chemistry of organometallic complexes.
3) To introduce organometallic catalysis.

Topic	**Content**	**Number of lecture hours**	**Expected outcome – upon completion of this course, the student should be able to:**
1. Introduction on Bioinorganic Chemistry	• Role of metal ions in biological systems • Bioinorganic catalysis especially the Metaloenzymes • Structure and Function of metaloporphyrins in relation to photosynthetic process	3	• To describe the functions of the array of metals present in biological systems. • To identify metals that are coordinated to enzymes acting synergistically as coenzymes. • To draw the structure of chlorophyll and describe the biochemical reactions occurring during the photosynthetic process.
2. Reactions in Biological Reactions	• Electron transfer reactions in biological systems with emphasis on the chemistry and function of feredoxin • Nitrogen Fixation referring to the Metaloenzymatic reduction of molecular nitrogen	2	• To describe structure and functions of feredoxin. • To describe the biochemical reactions occurring during the nitrogen fixation process and identify the enzymes involved in the process.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
3. Biological Roles of Some Transition Elements, Alkaline Metals and Phosforus-Containing System Including ATP and ADP	• Structure and function of haemoglobin, myoglobin and cobalamin • The sodium and potassium channel • High energy compounds – interconversion of adenine diphosphate (ADP) and adenine triphosphate (ATP)	4	• To describe structure and functions of haemoglobin and myoglobin. • To describe structure and functions of cobalamin (Vitamin B12). • To describe the active transport of Na^+ and K^+ across the cell membrane. • Describe the controlled release of energy needed for the biological processes via the hydrolysis of adenine triphosphate to adenine diphosphate.
4. Main Group Organometallic Compounds – Introduction, Classification, Stability and Preparation	• Direct M-C linkages • Historical development • Nomenclature • Bonding types • Thermal, oxidative and hydrolytic stability • Metal and organic halide reaction • Insertion reaction • Decarboxylation reaction • Mercuration and thallation reaction	4	• Define an organometallic compound, trace the historical development and name any organometallic compound according to the IUPAC nomenclature. • Classify organometallic compounds according to the bonding types and correlate the physical and chemical properties to the thermal, oxidative and hydrolytic stability. • Effect the formation of a metal carbon bond.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
5. Organometallic Compounds from Group 1 to 5	• Synthesis, structure, bonding • Grignard reactions – structure and bonding in relation to the mechanism and reaction intermediates • Synthesis, structure and bonding	5	• Synthesize and describe the structure and bonding from Group 1 to 5 organometallic compounds. • Write the mechanism and the structure of the reaction intermediate of Grignard reactions.
6. Organometallic Chemistry of the Transition Elements – Introduction, Types and Preparation of Complexes	• Review of 18-electron rule • Complexes with σ-donor ligands • Preparation of transition-metal alkyls and aryls • Selected properties of transition-metal σ-organometallics • Thermodynamic stability versus kinetic stability • Transition-metal perfluorocarbon σ-complexes • Complexes with σ-donor/ π-acceptor ligands • Transition-metal alkenyls • Transition-metal alkynyls • Transition-metal carbene complexes • Transition-metal carbyne complexes • Metal carbonyls • Complexes with σ, π-donor/ π-acceptor ligands	10	• Correlate the structure and bonding according to the 18 electron rule. • Synthesize organotransition compounds with σ-donor ligands and understand the properties of the compounds by determining their thermodynamic and kinetic stability. • Synthesize organotransition compounds with σ-donor/ π-acceptor ligands and describe the structure and bonding of the organotransition complexes. • Synthesize organotransition compounds with σ,π-donor/ π-acceptor ligands and describe the structure and bonding of the organotransition complexes.

Topic	Content	Number of lecture hours	Expected outcome – upon completion of this course, the student should be able to:
	• Olefin complexes • Alkyne complexes • Allyl and enyl complexes • Complexes of cyclic π-perimeters C_nH_n • Metal π-complexes of heterocycles •		
7. Organometallic Catalysis	• Catalytic reactions and the 16/18 VE rule • Transition metal assisted valence isomerization • Isomerization of unsaturated molecules • Heck Reaction • Alkene metathesis • Oligomerization and polymerization • Wacker process • Hydrogenation of alkenes • Fischer-Tropsch reaction • The water-gas shift • Monsanto acetic acid process • Hydroformylation • Hydrocyanation	8	• Predict the mechanism of the catalytic reaction on the basis of the 16/18 valence electron rule. • Carry out transition metal assisted valence isomerization. • Carry out the isomerization of unsaturated molecules, alkene metathesis, oligomerization and polymerization via organotransition catalysis. • Carry out other organic transformation reactions using transition metal catalysts.
	TOTAL	**36**	