II SEMESTER, 2015-2016

Course Handout (Part- II)

Date: 06.01.2016

Course No. : CHEM F241

Course Title : Inorganic Chemistry-II

Instructor-in-charge : INAMUR RAHMAN LASKAR

Instructors : SUROJIT PANDE

1. Course Description

Coordination Chemistry: Bonding - Valence Bond, Crystal Field, and Molecular Orbital theories; Complexes - nomenclature, isomerism, coordination numbers, structure, electronic spectra, magnetic properties, chelate effect; Reactions - nucleophilic substitution reactions, kinetics, mechanisms; descriptive chemistry of Lanthanides and Actinides; Organometallic Chemistry: structure and reaction of metal carbonyls, nitrosyls, dinitrogens, alkyls, carbenes, carbynes, carbides, alkenes, alkynes, and metallocenes; catalysis by organometallic compounds; stereochemically nonrigid molecules.

2. Course objectives:

Throughout the semester representative topics from inorganic chemistry will be discussed to expose the students to the theories of bonding, electronic spectra and magnetic properties of complexes, reactions of metal complexes, detailed description of organometallic compounds and chemistry of lanthanides and actinides. Various theories such as VBT, CFT followed by MOT will explain many topics encompassed by electronic spectra, magnetic properties and finally in organometallic complexes in the field of Inorganic Chemistry. However, we will strive in this course to address the most important theories and applications of Inorganic Chemistry with the state of the art level which may motivate the students towards research.

By the end of the semester, you will be able to
- Predict structure and geometry of inorganic complex
- Envisage spinel structure and chelate effect
- Learn the application of character table
- Investigate the origins of color and transitions in inorganic complexes
- Indentify the magnetic properties of inorganic compounds
- Be familiar with the organometallic reactions, mechanism, structure & bonding, catalytic properties
- Explore the chemistry of bridging ligands
- Be trained in *f*-block elements from the periodic table

3. Text Book:

T1. "Inorganic Chemistry – Principles of Structure and Reactivity" Huheey, J. E.; Keiter, E. A.; Keiter, R. L.; Medhi O. K.; 4th Edition, Pearson.

4. Reference Books:

R1. "Concise Inorganic Chemistry", Lee, J.D. 5th Edition,Wiley India Edition.
R2. "Inorganic Chemistry", Shriver, D.F.; Atkins, P.W.; Overton T. L., Rourke, J. P., Weller, M. T., Armstrong, F. A. 4th edition, Oxford.
R3. "Concepts & Models of Inorganic Chemistry" Douglas, B.; McDaniel, D. Alexander, and J. 3rd Edition, Wiley India.

5. Course Plan:

Lec. No.	Topics to be covered	Learning Objectives	Reference (Page no. of T1)
1	Coordination Chemistry: Bonding	VB theory applied to coordination compounds; electro neutrality principle	424-428
2-4	Crystal Field Theory (CFT)	Crystal field splitting; *d* orbitals in different crystal fields; applications of CFT such as predicting stability of spinels	428-444
5	Coordination Chemistry: Structure	Nomenclature; Geometry of the complexes based on coordination number	495-506 508-511 520-526
6-7	Coordination Chemistry: Isomerism & Chelate Effect	Geometrical and Optical isomerism Linkage, Ligand, Ionization, Solvate, Coordination isomerism, Stabilization due to entropy factors and electron delocalization in the rings	507-508 511-520 526-539
8	Magnetic Properties of Complexes	Para, ferro and antiferromagnetisms; Spin transitions	485-492
9-12	Coordination Chemistry: Reactions	Substitution reactions in square planar complexes, Trans Effect, Mechanism; Thermodynamic and Kinetic Stability, Kinetics of Octahedral Substitution, Mechanism of Redox reactions	542-569
13-14	Introduction to organometallic chemistry, Metal carbonyl complexes	The 18 electron rule, Preparation & properties of carbonyl complexes; Polynuclear Carbonyl Complexes; Carbonylate ions; Carbonyl hydride complexes; Parallels with non metal chemistry	572-600
15	Metal nitrosyl and dinitrogen complexes	Terminal and Bridging ligands; Geometry of complexes	601-606
16-17	Metal Alkyls, Carbenes, Carbynes and Carbides	Synthesis; Structure of ligands in complexes; Orbital representations of Fischer and Schrock Carbenes; structural examples of carbido complexes;	606-615
18-19	Metallocenes	Molecular Orbitals of Metallocenes; Structures and Synthesis of Cyclopentadienyl compounds; Covalent versus ionic bonding; Arene complexes; Cycloheptatriene and tropylium complexes; Cyclooctatetraene and Cyclobutadiene complexes	615-627
20-23	Reactions of organometallic complexes	Substitution reactions in carbonyl complexes; Ligand Cone Angles; Oxidative Addition and Reductive Elimination; Insertion and Elimination; Nucleophilic and electrophilic attack of coordinated ligands; Carbonylate anions as	634-649

		nucleophiles;	
24-27	Catalysis by organometallic compounds	Alkene hydrogenation; Tolman Catalytic Loops; Synthesis Gas; Hydroformylation; Monsanto Acetic acid process; The Wacker Process; Synthetic Gasoline; Ziegler-Natta Catalysis; Immobilized homogeneous catalyst; photodehydrogenation catalyst;	649-661
28	Stereochemically non-rigid molecules	Fluxional molecules; Techniques to study Fluxional molecules;	196-202
29-30	The Lanthanides and Actinides	Stable oxidation states; Lanthanide and Actinide Contractions; the *f* orbitals; Absorption Spectra; Magnetic Properties; Coordination Chemistry; Lanthanide Chelates; Transactinide elements; Periodicity of Translawrencium elements	407- 419 Lecture notes
31-33	Character Table and its Applications:	Reducible and Irreducible Representations and Character Tables, Optical Activity, Dipole Moments, Infrared and Raman Spectroscopy, Bonding	52-65
34-37	MO theory of Coordination Compounds	σ MO diagrams of octahedral, Tetrahedral and sq. planar complexes; π MOs relation to crystal field splitting	444-459
38-40	Electronic spectra of complexes	Term symbols; *d-d* transitions; Tanabe-Sugano diagrams	461-475
41	Octahedral distortion; charge transfer	Stability through distortions; Allowed charge transfer transitions	475-485

6. Evaluation Scheme:

Component	Duration	Weightage	Date Time	Remarks
Mid Semester Test	1.5 hrs.	30%	15/3 2:00 -3:30 PM	Closed Book
Tutorials*	----	25%		Closed Book
Comprehensive Exam.	3 hrs.	15% + 30%	6/5 FN	30% Open Book

***Tutorials**: The tutorial hour will be used for a quick review of the highlights of the material covered in the lectures, clarification of doubts, and problem solving and conducting tests.

7. Chamber Consultation Hours: To be announced later.

8. Notices: Notices, if any, will be displayed **in Nalanda website.**

9. Make up policy: Make up would be considered only for **genuine cases.**

Instructor in-Charge

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