CORE COURSE 13

Semester	**6**
Paper Number	**HCHCR6132T (60 MARKS) & HCHCR6132P (40 MARKS)**
Paper Title	**CORE COURSE 13: INORGANIC CHEMISTRY**
No. of Credits	**Theory-04, Practicals-02**
Theory/Composite	Composite
No. of periods assigned	Th: 4 Pr: 3
Name of Faculty member(s)	Dr. Sanjib Ganguly Dr. Rahul Sharma
Course description/objective	***Theory:*** ***1. To comprehend the role of metalloproteins and metallozymes in the biological systems.*** ***2. To be aware of the role of metal ions in biology*** ***3. To appreciate the synthesis and chemistry of certain specific organometallic complexes*** ***4. To understand the role of certain coordination complexes as organometallic catalyst.*** ***5. To have some basic idea of inorganic reaction kinetics and mechanism.*** ***Practical:*** ***1. To develop skills in order to detect the presence of several cations and anions from aqueous solution by semi-micro analysis.*** ***2. To understand the basic principles involved in the qualitative analysis.***
Syllabus	Annexure Core Course: 13
Texts	
Reading/Reference Lists	**Theory:** 1.Lippard, S.J. & Berg, J.M. *Principles of Bioinorganic Chemistry* Panima Publishing Company 1994. 2. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. *Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed.,* Harper Collins 1993, Pearson,2006. 3. Cotton, F.A., Wilkinson, G., Murrillo, C. A., Bochmann, M., *Advanced Inorganic Chemistry 6th Ed. 1999.,* Wiley. 4. Bertini, I., Gray, H. B., Lippard, S.J., Valentine, J. S., Viva, 2007. 5. Basolo, F, and Pearson, R.C. *Mechanisms of Inorganic Chemistry*, John Wiley & Sons, NY, 1967. 6. Purecell, K.F. and Kotz, J.C., *An Introduction to Inorganic Chemistry*, Saunders: Philadelphia, 1980. 7. Powell, P. *Principles of Organometallic Chemistry*, Chapman and Hall, 1988. 8. Collman, J. P. *et al. Principles and Applications of Organotransition Metal Chemistry*. Mill Valley, CA: University Science Books, 1987. 9. Crabtree, R. H. *The Organometallic Chemistry of the Transition Metals*. New York, NY: John Wiley, 2000. **Practical:** Svehla, G., *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
Evaluation	**Theory: 60 marks** CIA: 10 End-Sem: 50 **Practical: 40 marks** *(Continuous Assessment)* Internal Assessment Exams: 30 Viva (End Sem): 8 Attendance: 2

Paper Structure for the End Sem **Theory Exam** (50 marks)	6 (SIX) Questions (each of 10 marks) will be set and the students will have to answer any 5 (FIVE). Each of the Questions (10 marks) will consist of 2 or 3 parts (of 2/ 3/ 4/ 5)

Annexure Core Course (CC): 13

(Credits: Theory-04, Practicals-02)

CC: 13 (Theory) 52 Lectures

Module 1: Organometallic Chemistry (26 Lectures)

Definition and classification of organometallic compounds on the basis of bond type. Concept of hapticity of organic ligands. 18-electron and 16-electron rules (pictorial MO approach). Applications of 18-electron rule to metal carbonyls, nitrosyls, cyanides. General methods of preparation of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls. pi-acceptor behaviour of CO, synergic effect and use of IR data to explain extent of back bonding. Zeise's salt: Preparation, structure, evidences of synergic effect. Ferrocene: Preparation and reactions (acetylation, alkylation, metallation, Mannich Condensation). Reactions of organometallic complexes: substitution, oxidative addition, reductive elimination and insertion reactions.

Catalysis by Organometallic Compounds

Study of the following industrial processes

1. Alkene hydrogenation (Wilkinson's Catalyst)
2. Hydroformylation
3. Wacker Process
4. Synthetic gasoline (Fischer Tropsch reaction)
5. Ziegler-Natta catalysis for olefin polymerization.

Module 2: Bioinorganic Chemistry (26 Lectures)

(i) Elements of life: essential and beneficial elements, major, trace and ultratrace elements. Basic chemical reactions in the biological systems and the role of metal ions (specially Na+, K+, Mg2+, Ca2+, Fe3+/2+, Cu2+/+, and Zn2+). Metal ion transport across biological membrane Na+/ K+-ion pump. Dioxygen molecule in life. Dioxygen management proteins: Haemoglobin, Myoglobin, Hemocyanine and Hemerythrin. Electron transfer proteins: Cytochromes and Ferredoxins. Hydrolytic enzymes: carbonate bicarbonate buffering system and carbonic anhydrase and carboxyanhydrase A. Biological nitrogen fixation, Photosynthesis: Photosystem-I and Photosystem-II. Toxic metal ions and their effects, chelation therapy (examples only), Pt and Au complexes as drugs (examples only), metal dependent diseases (examples only)

(ii) Introduction to inorganic reaction mechanisms. Substitution reactions in square planar complexes, Trans- effect and its application in complex synthesis, theories of trans effect, Mechanism of nucleophilic substitution in square planar complexes,

Thermodynamic and Kinetic stability, Kinetics of octahedral substitution, Ligand field effects, Mechanism of substitution in octahedral complexes.

CC: 13 (Practical) 42 Lectures

Qualitative semimicro analysis of mixtures containing four radicals. Emphasis should be given to the understanding of the chemistry of different reactions and to assign the most probable composition.

Cation Radicals: K^+, Ca^{2+}, Sr^{2+}, Ba^{2+}, Al^{3+}, Cr^{3+}, Mn^{2+}/Mn^{4+}, Fe^{3+}, Co^{2+}, Ni^{2+}, Cu^{2+}, Zn^{2+},, Cd^{2+}, Sb^{3+}, NH_4^+, Mg^{2+}.

Anion Radicals: F^-, Cl^-, Br^-, BrO_3^-, I^-, IO_3^-, SCN^-, S^{2-}, SO_4^{2-}, NO_3^-, NO_2^-, PO_4^{3-}, BO_3^{3-}, CrO_4^{2-} / $Cr_2O_7^{2-}$, $Fe(CN)_6^{4-}$, $Fe(CN)_6^{3-}$.

Insoluble Materials: Al_2O_3(ig), Fe_2O_3(ig), Cr_2O_3(ig), SnO_2, $SrSO_4$, $BaSO_4$, CaF_2, $PbSO_4$.