Semester	**6**
Programme	**CHEMISTRY**
Course	**MAJOR (INORGANIC CHEMISTRY 6)**
Paper Code	**C3CH230622T / C3CH230622P**
Credits	**4 (THEORY: 3 PRACTICAL: 1)**
Hours/week	**6 (THEORY: 6 PRACTICAL: 3)**
Category: Core/MDC/SEC/VEC	**CORE**
Theory/Practical/Composite	**COMPOSITE**
Number of Modules	**3**
Syllabus	**Module I: Electronic Spectra in transition metal complexes (12 Lectures)** Term symbols, Selection rules for electronic transition, ligand field transitions (d-d), Orgel Diagrams and prediction of the electronic transitions; Charge Transfer spectra and comparison of colours of different compounds/ complexes. **Module II: Bioinorganic Chemistry-1 (12 Lectures)** Metal ions in life; oxygen binding proteins: myoglobin, hemoglobin, hemerythrin, hemocyanin and synthetic oxygen carriers; electron transport proteins: cytochromes (structure and functions), Rubredoxins, (2Fe, 2S) Ferredoxins, (4Fe, 4S) Ferredoxins and (8Fe, 8S) Ferredoxins (structure and function) **Module III: Organometallic Chemistry-2 (12 Lectures)** Chemistry of metal nitrosyls: synthesis, structure and stereo chemical control of valence; Zeise salt: synthesis, structure, and bonding; metallocene: synthesis, structure and reactivity of ferrocene; Fluxionality in organometallic complexes (examples only) **Practical** Inorganic Qualitative Analysis
Course Overview	**Theory:** 1. **Electronic Spectroscopy & Term Symbols:** Derive ground-state term symbols using Hund's rules; understand spin and Laporte selection rules, and how vibronic coupling relaxes the latter to make d-d transitions weakly allowed. 2. **Orgel Diagrams:** Use Orgel diagrams to predict the number of spin-allowed d-d bands 3. **Charge Transfer (CT) Spectra:** Understand the different aspects of CT spectroscopy and its importance and applications. 4. **Oxygen Carriers – Structure & Function:** Compare and contrast heme-based, non-heme di-iron, and di-copper proteins; explain cooperative O_2 binding in hemoglobin via allosteric conformational changes.

	5. **Electron Transfer Metalloproteins:** Describe the structure and function of different electron transfer proteins. 6. **Organometallic Bonding & Structures:** Apply the 18-electron rule to Metal Nitrosyls and how this affects bonding, structure and reactivity; explain the Dewar-Chatt-Duncanson model for Zeise's salt and the aromatic stability/reactivity of Ferrocene. 7. **Fluxionality & Dynamic Processes:** Understand and appreciate the role of fluxionality in the context of organometallic chemistry. **Practical:** To understand the basic principles of qualitative inorganic analysis and its utilization in the detection of ions in mixtures
Course Outcomes (Cos)	Upon successful completion of this course, students will be able to: **CO1:** Recall the fundamental principles of electronic spectra, including term symbols, selection rules, and the Dewar-Chatt-Duncanson model for organometallic bonding. **CO2:** Explain the electronic transitions in transition metal complexes using Orgel diagrams, and differentiate between d-d and charge-transfer spectra. **CO3:** Apply the 18-electron rule and selection rules to predict the structure, bonding, and stability of metal nitrosyls, Zeise's salt, and ferrocene. **CO4:** Analyze the structure-function relationships in bioinorganic systems by comparing oxygen transport proteins (Hb, Mb, Hemerythrin, Hemocyanin) and electron-transfer metalloproteins. **CO5:** Evaluate the effects of ligand field strength, metal oxidation state, and fluxional behavior on the spectroscopic and chemical properties of coordination and organometallic compounds. **CO6:** Design synthetic routes for organometallic compounds (e.g., Zeise's salt, ferrocene) and correlate their reactivity with electronic structure and bonding models. **CO7:** Integrate knowledge of spectroscopy, bioinorganic chemistry, and organometallics to explain the role of metal ions in biological systems and industrial catalytic processes. **CO8:** Execute systematic qualitative analysis to separate and identify inorganic cations and anions from a given mixture, applying confirmatory tests with accuracy and proper laboratory safety.
Program Outcomes (POs)	PO1: Fundamental Knowledge: Demonstrate a comprehensive understanding of core concepts in chemistry, including organic, inorganic, physical, analytical, and biochemistry. PO2: Laboratory Skills: Acquire hands-on experience in laboratory techniques and instrumentation, applying safety protocols and proper methodologies to conduct experiments and analyse results. PO3: Problem Solving: Develop critical thinking and problem-solving skills by applying chemical principles to real-world

	scenarios, including the ability to design experiments and interpret data. PO4: Research Competency: Engage in independent and collaborative research projects, employing scientific methods to formulate hypotheses, conduct experiments, and communicate findings effectively. PO5: Interdisciplinary Applications: Understand the interdisciplinary nature of chemistry, exploring its applications in fields such as medicine, environmental science, materials science, and nanotechnology. PO6: Communication Skills: Effectively communicate scientific information, both verbally and in written form, to diverse audiences, demonstrating the ability to present complex ideas clearly and concisely. PO7: Ethics and Sustainability: Recognize the ethical implications and responsibilities of scientific research and practice in chemistry, emphasizing the importance of sustainability and environmental stewardship in chemical practices.

CO #	**Course Outcome Summary**	**Bloom's Taxonomy (K-Level)**	**Mapped POs**
CO1	Foundational Concepts Recalled	K1 (Remember)	PO1
CO2	Spectra & Diagrams Explained	K2 (Understand)	PO1, PO5
CO3	Rules Applied to Structures	K3 (Apply)	PO3
CO4	Bioinorganic Systems Analyzed	K4 (Analyze)	PO1, PO5
CO5	Properties & Fluxionality Evaluated	K5 (Evaluate)	PO1
CO6	Synthetic Routes Designed	K6 (Create)	PO1, PO3,PO4
CO7	Interdisciplinary Integration Achieved	K6 (Create)	PO4,PO5
CO8	Qualitative Analysis Executed	K3 (Apply)	PO2, PO6, PO7

Reading/Reference Lists	**Theory:** 1. Douglas, B.E. and McDaniel, D.H. Concepts & Models of Inorganic Chemistry Oxford, 1970. 2. Atkin, P. Shriver & Atkins' Inorganic Chemistry, 5th Ed., Oxford University Press (2010). 3. Cotton, F.A., Wilkinson, G. and Gaus, P.L., Basic Inorganic Chemistry 3rd Ed.; Wiley India. 4. Sharpe, A.G., Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005. 4. Huheey, J. E.; Keiter, E.A. & Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson,2006. 5. Mingos, D.M.P., Essential trends in inorganic chemistry. Oxford University Press (1998). 6. Housecraft, C. E.; Sharpe, A. G., (2018), Inorganic Chemistry, 5th Edition, Pearson. 7. Wulfsberg, G (2002), Inorganic Chemistry, Viva Books Private Limited. **Practical** 1. University Hand Book of Undergraduate Chemistry Experiments, edited by Mukherjee, G. N. University of Calcutta, 2003. 2. Practical Workbook Chemistry (Honours), UGBS, Chemistry, University of Calcutta, 2015	
Evaluation	Theory: 60 Internal: 15 (CIA: 10; Other form of Assessment: 2; Attendance: 3) Semester Exam: 45	Practical: 40 CA: 38; Attendance:2
Paper Structure for Theory Semester Exam	Answer THREE out of FOUR questions, of 15 marks each.	