Junior Year – Spring Semester-B.S., B.A.

CEM 411 – Inorganic Chemistry

Description: Valence bond and molecular orbital approaches to bonding in inorganic molecules; acid-base chemistry, solid state structures; properties of the representative elements; coordination chemistry of the transition elements; aspects of organometallic, bio-inorganic and environmental chemistry.

Credit: 4 credits (four hours lecture)

Prerequisite: CEM 383 or CEM 391

Topics:

1. Atomic Structure: Quantum numbers and atomic wave functions; The Aufbau Principle; Shielding; Periodic Properties.
2. Simple Bonding Theory: Lewis electron dot diagram; Valence shell Electron Pair Repulsion Theory; Electronegativity; Polar Bonds; Hydrogen Bonding.
3. Symmetry and Group Theory: Symmetry Elements and Operations; Point Groups; Properties and Representations of groups; Examples and applications of Symmetry.
4. Molecular Orbitals: Formation of Molecular Orbitals from *s* and *p* Orbitals; Homonuclear Diatomic Molecules; Heteronuclear Diatomic Molecules; Molecular Orbitals for Larger Molecules.
5. Acid-Base and Donor-Acceptor Chemistry: Acid and Base Strength; Hard and Soft Acids and Bases; Frontier Orbitals and Acid-Base Reactions.
6. The Crystalline Solid State: Formulas and Structures; Thermodynamics of Ionic Crystal Formation; Molecular Orbitals and Band Structure; Superconductivity.
7. Chemistry of the Main Group Elements: Hydrogen; Group I (IA): The Alkali Metals; Group 2 (IIA): The Alkaline Earths; Group 13 (IIIA); Group 14 (IVA); Group 15 (VA); Group 16 (VIA); Group 17 (VIIA): The Halogens; Group 18 (VIIA); The Noble Gases.
8. Coordination Chemistry I: Structures and Isomers: Nomenclature; Isomerism; Coordination Numbers and Structures.
9. Coordination Chemistry II: Bonding: Theories of Electronic Structure; Ligand Field Theory; Angular Overlap; The Jahn-Teller Effect.
10. Coordination Chemistry III: Electronic Spectra: Spin-Orbit Coupling; Correlation Diagrams; Tanabe-Sugano Diagrams; Jahn-Teller Distortions and Spectra.
11. Coordination Chemistry IV: Reactions and Mechanisms: Substitution Reactions; Kinetic Consequences of Reaction Pathways; Experimental Evidence in Octahedral Substitution; Stereochemistry of Reactions; Substitution Reactions of Square-Planar Complexes.
12. Organometallic Chemistry: The 18-Electron Rule; Ligands in Organometallic Chemistry; Bonding Between Metal Atoms and Organic Pi Systems; Complexes Containing M-C, M=C, and M_Bonds.

13. Organometallic Reactions and Catalysis: Reactions Involving Gain or Loss of Ligands; Reactions Involving Modification of Ligands; Organometallic Catalysts; Heterogeneous Catalysts.
14. Parallels Between Main Group and Organometallic Chemistry: Main Group Parallels with Binary Carbonyl Complexes; The Isolobal Analogy; Metal-Metal Bonds; Cluster Compounds.
15. Bioinorganic and Environmental Chemistry: Porphyrins and Related Complexes; Other Iron Compounds; Inorganic Medicinal Compounds.