# 20CY101 INORGANIC CHEMISTRY- 1

Hours Per Week :

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| 4 | - | - | 4 |

**COURSE DESCRIPTION AND OBJECTIVES:**

The main objectives of this course are to understand the basics of inorganic chemistry and apply them to various other advanced topics of inorganic chemistry such as transition metal chemistry, Non-transition metals, organometallic chemistry and bio-inorganic chemistry etc. Moreover students should able to understand the bonding, structure and reaction mechanism, later he should able to apply the same knowledge to new inorganic compounds. Finally he students should be able to apply this knowledge to industrial inorganic compounds production, purification and applications.

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to achieve the following outcomes:

| COs | Course Outcomes |
|---|---|
| **1** | Understand the basics of structure and bonding concepts to non-transitions compounds and analyze the concepts of bent rules, hybridization and Walsh diagrams. |
| **2** | Analyze history, synthesis, bonding and structures of various transition metal compounds and apply them to various applications using the photo, electric and magnetic properties. |
| **3** | Analyze inorganic reaction mechanism and characterize them by various spectroscopic techniques. |
| **4** | Apply the knowledge of organometallic chemistry to understand their synthesis, bonding, reaction and structural concepts. |
| **5** | Analyze various bio-inorganic complexes roles in biological process and understand their bonding, structure and reactions involved by them. |

**UNIT I**

**Chemistry of non- transition elements** – Inter-halogen compounds, Halogen oxides and oxyfluorides. Noble gas compounds with special reference to clathrates.

Spectral and magnetic properties of Lanthanides and Actinides-analytical applications of Lanthanides and Actinides.

**Structure and bonding** - $d\pi$ - $p\pi$ bonding - Evidences (in non-transition metal compounds). Concept of Hybridization, Bent's rule, energetics of Hybridization, concept of resonance, Non-valence cohesive forces, hydrogen bonding -Symmetric and unsymmetric, VSEPR theory, Walsh diagrams for linear ($BeH_2$) and bent ($H_2O$) molecules. Molecular orbital theory, symmetry of molecular orbitals, molecular orbitals in triatomic ($BeH_2$) molecules and ions ($NO_2^-$) and energy level diagrams. Some simple reactions of covalently bonded molecules.

**UNIT II**

**Transition Metal Chemistry**: Nomenclature, Isomerism, Chelate effect, Macrocyclic ligands. Bonding in Coordination Complexes: Crystal-Field theory, d-orbital Splitting in Octahedral, Tetrahedral, Square Planar, 5-coordinated complexes; Molecular Orbital Theory of complexes (Octahedral-Co(III)-hexamine and tetrahedral –$Ni(CO)_4$ complexes), pi-bonding; Jahn-Teller effect, Spectrochemical series, nephelauxetic series. Electronic Spectra: d-d transitions, Orgel and Tanabe-Sugano diagrams, charge-transfer spectra. Magnetism: Types, determination of magnetic susceptibility, spin-only formula, spin-orbit coupling, spin crossover.

**UNIT III**

**Inorganic Reaction Mechanism**: Substitution in octahedral and square planar complexes; lability, trans-effect, Conjugate base mechanism, racemization, Electron Transfer Reactions: inner sphere and outer sphere mechanism, Inorganic photochemistry: Photosubstitution and photoredox reactions of chromium, cobalt and ruthenium compounds, Adamson's rules. Lanthanides and Actinides: Spectral and Magnetic Properties, NMR Shift reagents.

**UNIT IV**

**Organo-metallic Chemistry**: 18- electron rule, metal carbonyls, nitrosyls, cabonyl hydrides, isolobal analogy, dioxygen and dinitrogen compounds. Metal alkyls, carbenes, carbynes, alkenes, alkynes, and allyl complexes. Hydrides, metallocenes, metal arene complexes. Carbonylate anions, agostic interaction, oxidative addition and reductive elimination, insertion and elimination reactions. Homogeneous and heterogeneous catalysis. Fluxional molecules, Metal-Metal bonding and Metal clusters ($Fe_3(CO)_{12}$, $Co_4(CO)_{12}$ and $Mo_6Cl_{14}^{2-}$).

**UNIT V**

**Bio-inorganic Chemistry**: Role of alkali and alkaline earth metal ions in biology; $Na^+$ -$K^+$ Pump, ionophores and crown ethers. Metal site structure, function. Metal ion transport and storage: Ferritin, Transferrin, Siderophores and metallothionein. Electron Transfer: Cytochromes, Iron-Sulfur Proteins and Copper Proteins. Oxygen transport and storage: Chlorophyll, Hemoglobin, myoglobin, hemerythrin, hemocyanin Oxygen activation: Cytochrome P450, Cytochrome c oxidase.

**Text books:**

1. Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E. A. Keiter and R. L. Keiter, 4th Ed. Harper Collins 1993.
2. Organometallic Chemistry of the Transition Metals by R. H. Crabtree, John Wiley, 1993, 2nd Ed.
3. S. J. Lippard and J. M. Berg, Principle of Bioinorganic Chemistry, University Science Books (1994).

**Reference Books**

1. Concise inorganic chemistry, J. D. Lee, ELBS.
2. Modern Inorganic Chemistry, W. L. Jolly, McGrawHill.
3. Reaction Mechanism in Inorganic Chemistry by R. R. Jordan Oxford Univ. Press, 1998. 2nd Ed.
4. Inorganic Chemistry, K. F. Purcell and J. C. Kotz Holt Saunders international.
5. Concepts and methods of inorganic chemistry, B. E. Douglas and D.H.M.C. Daniel, oxford Press.
6. Inorganic Chemistry, Atkins, ELBS
7. Advanced Inorganic Chemistry, Cotton and Wilkinson, Wiley Eastern.