CHE-202-MJ-T: Inorganic Chemistry-I

Course Type: Major (Theory) **No. of Credits: 2**

Course Outcomes

The end of the course, student will be able to

1. Learn key terms and concepts such as types of ligands, isomerism, hybridization, d-orbital shapes, and theories like VBT and CFT.
2. Explain the principles of coordination bonding, types of isomerism, and the structural implications of VBT and CFT in coordination compounds
3. Apply VBT and CFT to predict geometry, magnetic properties, and hybridization of coordination complexes
4. Compare types of isomerism and interpret orbital splitting patterns in octahedral, tetrahedral, and square planar complexes.
5. Determine the magnetic moment, ligand field strength and geometry of complexes.
6. Summarize the coordination compounds according to their geometry, spin state, and ligand environment using CFT and VBT concepts.

Course Contents

Chapter 1 : Introduction to Coordination Compounds **[6 Hours]**

Double salt and coordination compound, basic definitions: coordinate bond, ligand, types of ligands, chelate, central metal ion, charge on complex ion, calculation of oxidation state of central metal ion, metal ligand ratio; Werner's work and theory, Effective atomic number, equilibrium constant (**Ref-6: 138-140**), chelate effect, IUPAC nomenclature. (**Ref.-1:** 194-200, 222-224; **Ref-4:** 483-492)

Chapter 2 : Isomerism in coordination complexes **[3 Hours]**

Introduction, polymerization isomerism, ionization isomerism, hydrates isomerism, linkage isomerism, coordination isomerism, coordination position isomerism, geometric isomerism, optical isomerism. ***(Ref-1:** 232-236)*

Chapter 3 : Valance Bond Theory of Coordination Compounds **[6 Hours]**

Paramagnetic and diamagnetic nature coordination complexes, calculation of magnetic moment from number of unpaired electrons, Aspects and assumptions of VBT, applications of VBT on the basis of hybridization to explain the structure and bonding in $[Ag(NH_3)^{2+}]$, $[Ni(Cl_4)]^{2-}$, $[MnCl_4]^{2-}$, $[Ni(CN)_4]^{2-}$, $[PtCl_4]^{2-}$, $[Cr(H_2O_6)]^{3+}$, $[Co(NH_3)_6]^{3+}$, $[Fe(CN)_6]^{3-}$ (Inner orbital complex) and

$[FeF_6]^{3-}$(outer orbital complex). Use of observed magnetic moment in deciding the geometry in complexes with C.N.4, limitations of VBT. (**Ref-2:** 592-597, **Ref-3:**350-351).

Chapter 4 : Crystal Field Theory **[15 Hours]**

Shapes of d-orbitals, **Crystal field Theory** (CFT): Assumptions, Application of CFT to **- i) Octahedral complexes**: splitting of 'd' orbitals in Oh ligand field, effect of weak and strong ligand fields, low spin and high spin complexes, spin only magnetic moment of low spin and high spin complexes, colour absorbed and spectrochemical series, crystal splitting energy, Crystal field stabilization energy and factors affecting it, tetragonal distortion in Cu(II) complexes; **ii) Square planar complexes –** Formation of Sq. Pl. complexes from distorted Oh complex, examples and spin only magnetic moments of Cu(II), Ni(II), Pt(II) square planar complexes; **iii) Tetrahedral complexes**: Splitting of d orbitals in tetrahedral ligand field, Crystal field splitting parameter (Δt), spin only magnetic moment, CFSE in Td complexes, Comparison of Δt and Δo, **(Ref-1:**194-225).

References

1. Concise inorganic chemistry, J. D. Lee, 5th Ed (1996), Blackwell Science
2. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
3. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson.