CHE-241-MN-T: Physical and Inorganic Chemistry

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

Course Outcomes

At the end of the course, student will be able to

1. Learn key concepts such as the laws of thermodynamics, electrolytic conductance, and definitions related to coordination chemistry.
2. Know thermodynamic processes, conductivity variations, and bonding theories in coordination compounds.
3. Use formulas and concepts to calculate entropy changes, conductance values, and oxidation states in complexes.
4. Differentiate between various chemical processes like isothermal vs. adiabatic expansion, strong vs. weak electrolytes, and inner vs. outer orbital complexes.
5. Examine the effectiveness of theoretical models such as VBT and determine the feasibility of chemical processes based on thermodynamic and conductivity data.
6. To investigate conductance behavior or predict geometry and magnetism in coordination complexes.

Course Content

Chapter 1: Chemical Thermodynamics **[8 hours]**

(Recapitulation: Introduction, terminology of thermodynamics, thermodynamic equilibrium, properties, thermodynamic processes)

First law of thermodynamics, Enthalpy, Heat capacity, Relation between Cp and Cv, Expansion of ideal gas and changes in thermodynamic properties: Isothermal process, Adiabatic process, Limitations of the first law: Need for the second law, Cyclic process, Carnot cycle, Second law of thermodynamics. Concept of entropy, Entropy change in isothermal expansion, Reversible and irreversible processes, Phase change and entropy of mixing of ideal gases, Work and free energy function. **Numericals** [Ref. 1: Pages- 236-237, 303-327, Ref. 2: Pages-528-535, 571-582, Ref. 3: Pages-134-140, 175-189]

Chapter 2: Electrolytic Conductance **[8 hours]**

(*Recapitulation: Electrolytes, Ohm's law and Electrical units, electrolytic conductance, resistance and specific resistance*) Electrolytic Conductance, Specific and equivalent conductance, Variation of equivalent conductance with concentration. Kohlrausch's law and

its applications to determine: Equivalent conductance at infinite dilution of a weak electrolyte, The ionic product of water & Solubility of sparingly soluble salts, Migration of ions, ionic mobilities & Absolute velocity of ions. Transport number determination by: – Hittorf's method & – Moving boundary method. **Numericals** [Ref. 1: Pages- 860-861, 865-868, 883-896, Ref. 2: Pages- 801-815, Ref. 3: Pages- 303-306, 318-326]

Chapter 3 : Chemistry of Coordination Compounds [6 Hours]

Definition and difference between 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, chelate effect, IUPAC nomenclature. (**Ref.-4:** 194-200, 222-224)

Chapter 4 : Valance Bond Theory of Coordination Compounds [8 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-5:** 592-597, **Ref-6:**350-351).

References

1. Essentials of Physical Chemistry by Arun Bahl, B.S. Bahl and G.D.Tuli –Multicolor Ed.
2. Principles of Physical Chemistry by B. R. Puri, L. R. Sharma, M. S. Pathania (46th Ed.)
3. Physical Chemistry, G. M. Barrow (5th Ed.)
4. Concise inorganic chemistry, J. D. Lee, 5th Ed (1996), Blackwell Science, Wiley
5. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
6. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson.