CHE-203-MJP: Chemistry Practical- III

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

Course Outcomes

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

1. Know the experimental procedures, formulas, and theoretical principles related to kinetics, thermodynamics, conductance, and coordination chemistry.
2. Understand the principles behind rate laws, enthalpy changes, conductometric titrations, colorimetry, and coordination complex formation.
3. Perform laboratory experiments to determine reaction order, heat changes, cell constants, and synthesize coordination compounds.
4. Analyze the reaction rates, calculate thermodynamic parameters, determine ligand ratios, and analyze chromatographic separations.
5. Evaluate the accuracy of results by comparing with theoretical values, validate Beer's Law, and evaluate coordination complex properties like color and magnetism.
6. Design experiments for synthesis, analysis, and characterization of coordination compounds.

Course Contents

Section-I : Physical Chemistry

A. Chemical Kinetics (Any two)

1. To determine the order of reaction between $K_2S_2O_8$ and KI by half-life method.
2. Energy of activation of the reaction between $K_2S_2O_8$ and KI with unequal initial concentration.
3. To study the kinetics of saponification reaction between sodium hydroxide and ethyl acetate
4. To study the effect of concentration of the reactants on the rate of hydrolysis of an ester.
5. To study the kinetics of iodination of acetone.

B. Thermodynamics (Any Two)

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.

C. Electrolytic Conductance (Compulsory)

1. To determine the cell constant of the given cell using 0.01 M KCl solution and hence determine dissociation constant of a given monobasic weak acid.
2. To investigate the conductometric titration of Strong acid against strong base a) Strong acid against strong base b) Strong base against weak acid. (standardization of base must be performed with KHP)

Section-II: Inorganic Chemistry

A. Synthesis of Coordination compounds (Any three)

1. Synthesis of sodium cobaltinitrite (a laboratory chemical) from Co(II) salt and $NaNO_2$ salts. Comment on colour and magnetic properties of the complex.
2. Synthesis of Potassium Tris(oxalato)Fe(III). Comment on colour and magnetic properties of the complex.
3. Synthesis of Tris(acetylacetonato)iron(III) by green chemistry method by reaction between $Fe(OH)_3$ and acetylacetone. Comment on colour and magnetic properties of the complex. (Ref.- 5,6).
4. Synthesis of $[Ni(NH_3)_6]Cl_2$ from $NiCl_2$. Comment on colour and magnetic properties of the complex.
5. Synthesis of $[Cu(NH_3)_4]SO_4$, Comment on colour and magnetic properties of the complex.

B. Inorganic colorimetric investigations (Any two)

1. Estimation of Cu(II) by complexation with R-Nitrso salt/ammonia by colorimetry: Determination of linearity range for Cu^{2+} using different ranges of Cu(II) concentrations and verification Beer's law.
2. Prepare solution of Fe(III) and $SCN^-$of in different molar proportion, record their absorbance and calculate equilibrium constant of $[Fe(SCN)]^{2+}$ complex.
3. Solution state synthesis of $[Ni(en)_3]^{2+}$ complex and determination of i) λmax and calculate 10Dq ii) equilibrium constant of the same complex.

C. Determination Metal ligand ratio (any one)

1. Potassium Tris(oxalate)Fe(III) complex (From synthesized complex by volumetric method).
2. Fe(III) or Cu(II)–Salicylic acid complex by colorimetric method.

D. Determination of transition metal ions by paper chromatography using colour forming ligands.

References

Section-I : Physical Chemistry

1. Systematic experimental physical chemistry, S. W. Rajbhoj, T. K. Chondekar, Anjali publication.
2. Practical Physical Chemistry, Vishwanathan and Raghwan , Viva book.
3. Practical Chemistry, O. P. Pandey, D. N. Bajpai Dr. S. Giri, S Chand Publication
4. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publication.
5. Practical Physical Chemistry, 3rd Edn. A. M. James and F. E. Prichard, Longman publication.
6. Experiments in Physical Chemistry, R. C. Das and B. Behra, Tata McGraw Hill.
7. Advanced Practical Physical Chemistry, J. B. Yadav, Goel Publishing House.
8. Advanced Experimental Chemistry, Vol-I, J. N. Gurtu and R. Kapoor, S. Chand and Company.
9. Physical Chemistry Experiments, Raghvan and Vishwanathan.

Section-II : Inorganic chemistry

1. Advanced Practical Chemistry, Jagdamba Sing et al, Pragati Prakashan, Merrut.
2. Practical Chemistry, Panday, Bajpai, Giri, S.Chand and Co.
3. Handbook of Preparative Inorganic Chemistry, Volume 2, Second Edition, Edited By Georg Braue R, Academic Press, New York, London, 1965. (Page-1541)
4. Inorganic Syntheses Vol -1 by H S Booth. First Ed, 1939. (page-36).
5. Novel Synthesis of Tris(acetylacetonato)-iron(III), Journal of Chem. Soc. Dalton Trans. 1983
6. Metal Acetylacetonate Synthesis Experiments: Which Is Greener?, Journal of Chemical Education, 2011, 88, 947–953, dx.doi.org/10.1021/ed100174f
7. Experimental Inorganic/Physical Chemistry: An Investigative, Integrated Approach to Practical Project Work, MounirA. Malati, Woodhead Publishing Limited, 1999.
8. Colorimetric Determination of the Iron(III)-Thiocyanate Reaction Equilibrium Constant with Calibration and Equilibrium Solutions Prepared in a Cuvette by Sequential Additions of One Reagent to the Other, Journal of Chemical Education, Vol.88 No.3 March 2011.
9. Experiments in chemistry, D. V. Jahagirdar, Himalaya publication.

10. A spectrophotometric study of complex formation between Fe(III) and salicylic acid, Kinya Ogawa, Nobuko Tobe, Bulletin of chemical society of Japan, 39, 227-232, 1966.
11. Salicylate determination by complexation with Fe(III) and optical absorbance spectroscopy
12. Determination of Equilibrium Constants of Metal Complexes from Spectrophotometric Measurements: An Undergraduate Laboratory Experiment, Journal of Chemical Education, Vol. 76, No. 9, September 1999.