CHE-355-MJP: PHYSICAL CHEMISTRY PRACTICAL II

Course Type: Major Practical **Credits: 2**

A. Course Objectives:

1. To provide hands-on exposure to physicochemical measurement techniques.
2. To familiarize students with the use of analytical instruments and experimental setups.
3. To develop understanding of experimental design and methodology in physical chemistry.
4. To inculcate skills in systematic data recording and scientific observation.

B. Course Outcomes (COs):

CO No.	Course Outcome Statement (COs) *After learning the course, the students are able to -*
CO-1	Recall principles of refractometry, spectrophotometry, conductometry, and viscosity.
CO-2	Explain experimental techniques and physicochemical concepts.
CO-3	Apply calculations to determine physical parameters.
CO-4	Analyze experimental data and observations.
CO-5	Evaluate accuracy and errors in results.
CO-6	Prepare laboratory reports.

C. Contents:

Prerequisites
Students should have basic knowledge of physical chemistry concepts such as solutions, kinetics, and equilibrium. Familiarity with laboratory techniques, handling of instruments and basic calculations is required.
A minimum of 12 experiments are to be completed.
A. Refractometry (any two) 1. To determine the specific refractivity's of the given liquids A and B and their mixture and hence determine the percentage composition their mixture C. 2. To determine the molecular refractivity of the given liquids A, B, C and D. 3. To determine the molar refraction of homologues methyl, ethyl and propyl alcohol and show the constancy contribution to the molar refraction by -CH_2 group. 4. Determine the refractive index of a series of salt solutions and determine the concentration of a salt of unknown solution.

B. Spectrophotometry and Colorimetry (any three)

1. To determine the indicator constant of methyl red indicator
2. To estimate the Fe^{3+} ions by the thiocyanate method.
3. Cobalt by using the R-nitroso salt method.
4. To determine the order of reaction for the oxidation of alcohol by potassium dichromate and potassium permanganate in an acidic medium calorimetrically.
5. Simultaneous determination of Cu^{2+} and Ni^{2+} ions by colorimetry/spectrophotometry method

C. Conductometry (any four)

1. To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conduct metric method.
2. To determine the normality of citric acid in given fruit by titrating it against standard NaOH solution by conductometric method.
3. To determine $\lambda\infty$ of strong electrolyte (NaCl or KCl) and to verify Onsager equation.
4. To estimate the amount of lead present in given solution of lead nitrate by conductometric titration with sodium sulphate.
5. To determine the relative strength of monochloro acetic acid and acetic acid conductometrically

D. Viscosity: (any one)

1. To determine the molecular weight of a high polymer by using solutions of different concentrations.
2. Determine the radius of the glycerol molecule from the viscosity measurement.

E. Solid State Chemistry (Any one)

1. Experimental Determination of Atomic Radii of Metal Atoms Using Bulk Density
2. Measurements of Metallic lumps.
3. Analysis of crystal structure from X-ray diffraction spectra of any two compounds (Calculation d, lattice constant, crystal volume and density, and assigning planes to peaks using JCPDS data).
4. Analysis of Intermolecular Interactions in Molecular Crystals using CrystalExplorer Software

F. Table work (Any one)

1. Analysis of the given vibration-rotation spectrum of HCl(g)
2. Analysis of crystal structure from X-ray diffraction spectra of any two compounds

(Calculation d, lattice constant, crystal volume and density, and assigning planes to peaks using JCPDS data)

References:

1. Practical Physical Chemistry, A. Findlay, T. A. Kitchener, Longmans, Green and Co., 9th Edition, 1973.
2. Experiments in Physical Chemistry, J. M. Wilson, K. J. Newcombe, A. R. Denko, R. M. W. Richett, Pergamon Press, Edition not specified.
3. Senior Practical Physical Chemistry, B. D. Khosla, V. S. Garg, R. Chand & Company, Delhi, 2019 Edition.
4. Experimental Physical Chemistry, D. P. Shoemaker, McGraw-Hill, 7th Edition, 2003.
5. Physical Chemistry, W. J. Moore, Prentice Hall, 5th Edition, 2001.
6. Advanced Physical Chemistry Experiments, R. C. Gurtu, S. Gurtu, Pragati Prakashan, Meerut, Edition not specified.
7. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House, Edition not specified.
8. Practical Physical Chemistry, B. Vishwanathan, P. S. Raghavan, Viva Books Pvt. Ltd., 2014 Edition.
9. Vogel's Qualitative Inorganic Analysis, G. Svehla, Longman, 5th Edition, 1979.
10. Vogel's Textbook of Quantitative Inorganic Analysis, A. I. Vogel, ELBS, 5th Edition, 1989.
11. Experimental Physical Chemistry, A. M. Halpern, G. C. McBane, W. H. Freeman & Co., 3rd Edition, 2003.
12. Exploring Chemistry with Electronic Structure Methods, J. B. Foresman, A. Frisch, Gaussian Inc., 2000 Edition.
13. Computational Chemistry: A Practical Guide for Applying Techniques to Real World Problems, D. C. Young, John Wiley & Sons, 2001 Edition.
14. Computational Chemistry Using the PC, D. Rogers, John Wiley & Sons, 3rd Edition, 2003.
15. Molecular Modelling: Principles and Applications, A. R. Leach, Longman, 2nd Edition, 2001.
16. CrystalExplorer Software, CrystalExplorer Team, Official Website, Latest Version.
17. Cambridge Structural Database (CSD Teaching Subset), Cambridge Crystallographic Data Centre (CCDC), Latest Version.