KUT 204 - Chemistry Practical IV - Physical

Course Objective : To introduce the basic principles and techniques in physical chemistry

Experiment Title	**Content**	**Number of laboratory hours**	**Expected outcome - upon completion of these experiments, the student should be able to:**
1. Primary Salt Effect	• Study on the reaction rate between the dye malachite green and hydroxyl ion	3	• Understand chemical kinetics and reaction rate. • Write the general form of a rate expression. • Understand the various factors that affect the rate of a reaction. • Calculate the first-order and second-order rate constants and the activation energy at different ionic strengths.
2. Determination of The Vapour Pressure and Molar Enthalpy of Vapourization of 2-Propanol	• Measurement of the variation of the vapour pressure of 2-propanol with temperature using an isoteniscope	3	• Use an isoteniscope. • Derive the Clausius-Clayperon equation. • Calculate the molar enthalpy of vapourization of 2-propanol.
3. Determination of The Rate Constant of A Second-Order Reaction Using Electrical Conductance	• Study on the reaction rate of the alkaline hydrolysis of ethyl acetate	3	• Explain what is electrical conductance. • Calculate the rate constant of a reaction using conductance data.

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4. Simultaneous Determination of Chloride-Iodide Mixture: Evaluation of K_{sp} for AgCl and AgI	• Measurement of the change in the emf during the precipitation titration involving Ag^+ with Cl^- and Br^-	3	• Understand the precipitation titration technique. • Use the appropriate equation to determine the percent composition of each substance in a salt mixture. • Determine K_{sp} for AgCl and AgI.
5. Determination of the Heat and Entropy of Solution of Potassium Hydrogen Tartrate ($C_4H_5O_6K$) at 35 ^oC	• Measurement of the solubility of potassium hydrogen tartrate at 35 ^oC in water and in NaCl solution of various concentrations	3	• Understand the acid-base reaction and titration technique. • Determine the concentration of an acid using the titration method. • Determine the heat and entropy of an acid-base reaction. • Explain the effects of temperature and NaCl concentration on the solubility of $C_4H_5O_6K$.
6. Determination of The Dissociation Constant of An Indicator	• Measurement of the visible spectra of bromothymol blue solution under acidic and basic conditions to determine the λ_{max} values • Determination of the absorbance of the indicator at λ_{max} as a function of pH	3	• Recognize the properties of an indicator. • Identify at least three graphical methods to determine the dissociation constant of an indicator.

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7. Thermodynamics of Electrochemical Cells	• Determination of the potential of a H-type cell in the temperature range of 0 to 40 ^{o}C	3	• Understand the fundamental concepts of electrochemistry. • Write half reactions and balance oxidation-reduction reactions. • Determine the thermodynamic quantities (ΔH, ΔS and ΔG) from the measured emf with respect to temperature.
8. Fractional Distillation	• Determination of the temperature-composition phase diagram for the hexane-cyclohexane system	3	• Understand the fractional distillation technique. • Explain the temperature-composition phase diagram. • Calculate the theoretical plates from the temperature-composition phase diagram.
9. Heterogeneous Equilibrium: The Three Component Liquid System with Incomplete Miscibility	• Determination of the phase diagram of the three component liquid of water-chloroform-acetic acid system	3	• Demonstrate the utility of Gibbs phase rule. • Determine the relative concentration of each of the three components. • Draw the phase diagram and tie lines and to determine the plait point.
10. Determination of The Molecular Weight of High Polymers by A Viscosity Method	• Determination of the molecular weights of two high polymers using Ostwald viscometer	3	• Determine the intrinsic viscosity of the polymer. • Calculate the average molecular weight of the polymer using the Mark-Houwink equation.

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11. Hydrogen Bonding Between Phenol Molecules	• Measurement of the infrared (IR) spectra of phenol solutions in hexane in various concentrations	3	• Operate a FT-IR spectrophotometer. • Use the IR technique to determine the degree of dimerization of phenol based on the intensity of O-H absorption.
12. Electrochemistry of solution	• Determination of the standard electrode potential of an electrochemical cell without liquid junction consisting of a Zn amalgam and a Ag/AgCl electrodes in $ZnCl_2$ solution • Determination of the transport number Zn^{2+} using a concentration cell	3	• Distinguish between the electrochemical cell with and without liquid junction. • Determine the cell emf and the mean ionic activity coefficient of electrolyte solutions.
13. UV Spectra of Conjugated Carbonyl Compounds	• Determination of configuration interaction calculations to obtain UV absorption maxima in a series of conjugated carbonyl compound	3	• Perform semi empirical AM1-C1 calculation • Use the single point calculation results to determine the λ_{max} of the carbonyl compounds.
14. Adsorption Photometry: Simultaneous Analysis of a Two-component Mixture of Cr^{3+} and Co^{2+} Spectrophotometrically	• Investigation the nature of the absorption spectra of Co(II) – Cr(III) system.	3	• Demonstrate the utility of Beer-Lambert's Law. • Understand that absorbances are additive. • Determine the absorbances of cobalt and chromium solutions.
15. Kinetics of the Persulfate-iodide Reaction	• Investigation of the kinetics of the reaction between persulfate and iodide ions	3	• Understand the effect of reactant concentration and temperature on the rate of reaction. • Write the rate equation. • Determine the activation energy for the reaction.
TOTAL		**45**	