KUT 308/2 - Chemistry Practical VIII (Physical and Organic Chemistry)

Course Objectives : 1) To introduce the principles and techniques in physical chemistry.
2) To teach students the skills, techniques and philosophy that has been the basis in synthesis, separation, identification and analysis of organic compounds.
3) To show several chemistry concepts, synthetic reactions and the use of synthetic reagents as taught in the chemistry organic lectures.

Experiment Tite	**Content**	**Number of laboratory hours**	**Expected outcome - upon completion of these experiments, the student should be able to:**
Physical			
1. Spectrum of A Particle in A Box	• Determination of bond length for two series of polymethine using particle-in-a-box model	3	• Understand the quantum mechanics of a particle in one dimensional box. • Determine the average bond length of polymethine dye samples using UV-Vis spectrophotometry.
2. Heat of Combustion by Bomb Calorimetry	• Determination of the heat of combustion of a compound at constant volume using a bomb calorimeter	3	• Understand heat capacity and Hess' law. • Calculate the heat of combustion of a compound at constant volume and pressure. • Calculate the enthalpy of formation of a compound using Hess' law.
3. Solid-Liquid Adsorption	• Determination of the adsorption isotherm of acetic acid on charcoal	3	• Distinguish the various types of isotherms. • Apply the Freundlich and Langmuir adsorption models to the adsorption equilibrium data to determine the relevant parameters.

Experiment Tite	Content	Number of laboratory hours	Expected outcome - upon completion of these experiments, the student should be able to:
4. Determination of Surface Areas of Powders by Physical Adsorption of Gases	• Determination of the surface area of an adsorbent by physical adsorption of nitrogen gas using the vacuum line technique	3	• Know the BET theory. • Calculate the specific surface area of an absorbent. • Master the vacuum line technique.
5. Partial Molal Volumes of Water and Methanol Mixtures As A Function of Concentration	• Determination of partial molal volumes of water and methanol as a function of their respective mole fraction	3	• Understand the principle of partial molal properties. • Determine the density of mixtures using pycnometer. • Calculate the molecular weight, molal volume and mole fraction.
6. Amphiphilic molecules	• Determination of surface adsorption for hydrophilic and hydrophobic molecules, and surface tension using Gibbs adsorption equation • Determination of critical micelle concentration for non-polar and polar group	3	• Understand the properties of an amphiphilic substance. • Apply the Gibbs adsorption equation to determine the surface tension. • Understand the mechanism of micellisation. • Determine c.m.c. from conductance measurements of amphiphilic molecules.
7. Acidities and Basicities of Excited- State Molecules	• Molecular modeling study of acidities and basicities of excited state 2-naphthol and 2-naphthoic acid.	3	• Perform semi empirical AM1-C1 calculation. • Model changes in acidity upon photoexcitation.

Experiment Tite	Content	Number of laboratory hours	Expected outcome - upon completion of these experiments, the student should be able to:
8. Enzyme Kinetics: Inversion of Sucrose	• Investigation of the rates of enzyme-catalyzed reactions.	3	• To study the inversion of sucrose catalyzed by the enzyme derived from yeast. • Understand the concept of Michaelis-Menten mechanisme. • To calculate the Michaelis-Menten constant and the activation energy.
9. Vibrational-Rotational Spectra of HCl and DCl	• To study the rotational fine structure of the infrared vibrational spectrum of a linear molecule such as HCl.	3	• To obtain the moment of inertia of the molecule and the internuclear separation from an interpretation of the details of the spectrum. • To determine a force constant, that is a measure of the bond strength, from the pure vibrational frequency. • To observe the isotope effect by the study of DCl.
Organic			
1. Wittig Reaction – Preparation of cis- and trans-Stilbene	• Preparation of benzyltriphenylphosphonium chloride from benzyl chloride and triphenylphosphine • Synthesis of stilbene using benzaldehyde and the prepared benzyltriphenylphosphonium chloride	3	• Carry out the Wittig reaction and relate to their theoretical knowledge of the reaction. • Understand how to use the Wittig synthesis to prepare other types of alkenes. • Know the mechanism of the reaction. • Use IR and NMR spectra to determine the structure of the product.

Experiment Tite	Content	Number of laboratory hours	Expected outcome - upon completion of these experiments, the student should be able to:
2. Claisen-Schmidt Reaction – Preparation of Benzalacetophenone	• Preparation of trans benzalacetophenone from benzaldehyde and acetophenone using Claisen-Schmidt reaction • Preparation of benzylacetophenone dibromide	3	• Find out the major product of the reaction. • Understand the stereochemistry of alkene addition reactions. • Write the mechanism of the reaction.
3. Reactivity Measurement by Competitive Technique	• Synthesis of nitrobenzene and nitrotoluene • Investigation of the competition of the nitration reaction between benzene and toluene	3	• Understand how to interpret the GC spectrum. • Find the major product of the reaction. • Understand why the major product is as such.
4. The Stereochemistry of Nucleophilic Substitution Reaction	• Preparation of bromosuccinic acid	3	• Synthesize bromosuccinic acid. • Know how to use the polarimeter to determine the optical rotation. • Write the mechanism of the reaction.
5. Divalent Carbon Intermediates; Phase Transfer Catalysis	• Preparation of 7,7 dichlorobicyclo[3.2.1]heptane	3	• Synthesise 7-dichlorobicyclo[3.2.1]heptane. • Know the function of carbene as a reaction intermediate. • Understand the concept of phase-transfer catalysis.

Experiment Tite	Content	Number of laboratory hours	Expected outcome - upon completion of these experiments, the student should be able to:
6. Kinetic and Thermodynamic Reaction Conditions	• Preparation of furfural semicarbazone • Preparation of cyclohexanone semicarbazone	3	• Understand what are meant by thermodynamic and kinetic reactions. • Use the IR spectroscopy to determine the reaction products.
7. Selective Reductions of m-Nitroacetophenone With Tin and Sodium Borohydride	• Preparation of *m* aminoacetophenone • Preparation of 1-(*m*-nitrophenyl)ethanol	3	• Understand how important it is to choose the correct reagent so that it can react only with the intended functional group.
TOTAL		**48**	