CHE-356-MJP: ORGANIC CHEMISTRY PRACTICAL II

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

A. Course Objectives:

1. To introduce students to the principles and techniques of organic chemistry practical work.
2. To provide understanding of spectroscopic methods for structural analysis.
3. To familiarize students with quantitative estimation methods in organic chemistry.
4. To impart knowledge of isolation and extraction techniques of natural products.
5. To develop awareness of chromatographic separation methods.
6. To inculcate laboratory discipline, safety, and scientific approach.

B. Course Outcomes (COs):

CO No.	Course Outcome Statement (COs) *After learning the course, the students are able to -*
CO-1	Recall laboratory techniques, safety rules, and instrumentation.
CO-2	Explain principles of spectroscopy, estimation, extraction, and chromatography.
CO-3	Perform experiments for spectral interpretation, estimation, and separation.
CO-4	Analyze spectral data and experimental observations.
CO-5	Evaluate accuracy of results and justify procedures used.
CO-6	Design and execute experiments following proper methodology and safety.

C. Contents:

Prerequisites
Students should have a basic understanding of organic chemistry, including functional groups and molecular structure, along with fundamental knowledge of chemical bonding. They should be familiar with basic laboratory techniques, safety practices, and simple titration methods. An introductory understanding of spectroscopic techniques is also desirable to effectively perform and interpret practical experiments.
A minimum of 12 experiments are to be completed.
A) Spectral Interpretation **a) IR Spectral Interpretation (Any Two)** 1. Identification of functional groups in unknown organic compounds using IR spectra. 2. Comparative IR spectral study of aldehydes and ketones.

3. Comparative IR spectral study of carboxylic acids and esters.
4. Comparative IR spectral study of aliphatic and aromatic compounds containing the same functional group.

Note: In each experiment, two IR spectra should be provided.

b) ^{1}H NMR Spectral Interpretation (Any Two)

1. Interpretation of ^{1}H NMR spectra of simple aliphatic organic compounds.
2. Interpretation of ^{1}H NMR spectra of simple aromatic organic compounds.
3. Analysis of spin–spin splitting patterns using the (n + 1) rule in ^{1}H NMR spectra of simple aliphatic compounds.
4. Structural elucidation of simple straight-chain aliphatic compounds (containing 3–4 carbon atoms) using IR and ^{1}H NMR spectra.

Note: Provide the spectra of two compounds for each of the first three experiments and the spectrum of one compound for the fourth experiment.

Note: For Spectral Interpretation experiments, students should identify and assign characteristic peaks in IR spectra and interpret chemical shift, integration, multiplicity, and coupling patterns in ^{1}H NMR spectra. Proper peak assignments with justification must be provided in tabular form. In comparative studies, key differences between functional groups should be clearly discussed. For structural elucidation, students should correlate IR and ^{1}H NMR data logically to deduce the structure with proper reasoning. A brief note on the principles involved and clear presentation of spectral interpretation steps should be included.

B) Organic Estimations (Any Three)

1. Estimation of ascorbic acid (Vitamin C).
2. Estimation of glucose.
3. Estimation of glycine.
4. Determination of the saponification value of oil.
5. Estimation of alkali content in an antacid using standard HCl solution.

Note: For Organic Estimations, students should clearly state the principle of the method (titrimetric or volumetric analysis), write the balanced reaction involved, and standardize the solution where required. Proper observations and titration readings must be recorded systematically, followed by calculations with formulae and units. The final result should be expressed with appropriate significant figures.

C) Natural Product Extractions (Any Four)

1. Extraction of anthocyanin from flower petals of *Hibiscus (Hibiscus rosa-sinensis)*.

2. Isolation of casein from milk.
3. Extraction of essential oil from orange peel by solvent extraction.
4. Isolation of trimyristin from nutmeg.
5. Extraction of caffeine from tea leaves.
6. Extraction of eugenol from cloves.
7. Isolation of cinnamic acid from cinnamon.

Note: For Natural Product Extractions, students should state the principle of extraction (such as solvent extraction, acid–base extraction, or precipitation) and justify the choice of solvent based on solubility and polarity. Observations during extraction, separation, and purification should be recorded carefully. Percentage yield must be calculated, and product identification may be supported by melting point or characteristic tests where applicable. A brief note on the chemical nature, source, and applications of the isolated compound, along with safety precautions, should also be included.

D) Chromatography (Any One)

1. Qualitative identification of functional groups by TLC using suitable chemical staining reagents (acids, amino acids, aldehydes, ketones, phenols, etc.).
2. Separation of naphthalene and acetanilide by column chromatography.

Note: TLC (Functional Group Identification)

State the principle of adsorption chromatography and justify the solvent system and staining reagent based on polarity and functional group. Record Rf values, spot colors, and observations clearly. Include brief interpretation, applications, and safety precautions.

Note: Column Chromatography (Separation)

State the principle of differential adsorption and justify the choice of adsorbent and eluent based on polarity. Record order of elution, TLC monitoring, and solvent volume. Calculate percentage recovery and confirm identity where possible. Include brief notes and safety precautions.

Important Note: At the time of the practical examination, the candidate shall perform:

- Spectral interpretation and one experiment from extraction/chromatography

OR

- Any one experiments from estimation

Reference Books

1. Spectrometric Identification of Organic Compounds, Robert M. Silverstein, Francis X. Webster, David J. Kiemle, John Wiley & Sons, 7th Edition, 2005.

2. Introduction to Spectroscopy, Donald L. Pavia, Gary M. Lampman, George S. Kriz, James R. Vyvyan, Cengage Learning, 5th Edition, 2015.
3. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis, V. K. Ahluwalia, Renu Agarwal, Universities Press / Orient Blackswan Pvt. Ltd., Illustrated Edition, 2000.
4. A Text-Book of Practical Organic Chemistry, A. I. Vogel, Pearson Education / Longman, 5th Edition, 1989.
5. Practical Organic Chemistry, F. G. Mann, B. C. Saunders, Pearson Education, 4th Edition, 2009.