

CHE-313-MJP: ORGANIC CHEMISTRY PRACTICAL I

Course Type: Major Elective Practical

Credits: 2

A. Course Objectives:

1. To provide training in separation and qualitative analysis of organic compounds.
2. To familiarize students with organic synthesis and green chemistry techniques.
3. To develop understanding of reaction mechanisms and laboratory procedures.
4. To introduce methods for derivative preparation and compound identification.
5. To inculcate skills in safe laboratory practices and scientific reporting.

B. Course Outcomes (COs):

CO No.	Course Outcome Statement (COs) <i>After learning the course, the students are able to -</i>
CO-1	Recall principles of separation, organic reactions, and derivative formation.
CO-2	Explain experimental procedures, mechanisms, and qualitative analysis methods.
CO-3	Apply techniques for separation, synthesis, and identification of organic compounds.
CO-4	Analyze observations, reaction outcomes, and purity of products.
CO-5	Evaluate efficiency, yield, and environmental aspects of organic reactions.
CO-6	Prepare laboratory reports with mechanisms and results.

C. Contents:

Prerequisites

Students should have basic knowledge of organic chemistry, functional groups, and reaction mechanisms. Familiarity with laboratory techniques, purification methods, and safety procedures is required.

A minimum of 12 experiments are to be completed.

A. Separation of Binary Mixtures and Qualitative Analysis (Any Six)

- a) Solid–Solid Mixtures (Any Two)
- b) Solid–Liquid Mixtures (Any Two)
- c) Liquid–Liquid Mixtures (Any Two)

At least one mixture from each of the following categories should be included:

- Acid–Base
- Acid–Phenol

- Acid–Neutral
- Phenol–Base
- Phenol–Neutral
- Base–Neutral
- Neutral–Neutral

Note: Solid–solid mixtures must be insoluble in water.

For Separation of Binary Mixtures and Qualitative Analysis, students should clearly describe the principle of separation based on solubility and acid–base behavior. A systematic separation scheme with proper flow chart should be included, along with observations for each test performed. Confirmatory tests, derivative preparation (if required), and melting point determination must be reported for identification of each component. A brief explanation of the chemical basis of each step and necessary safety precautions should also be included.

B. Organic Preparations

a) Green Chemistry Preparations (Any Two)

1. Solvent-free aldol reaction between acetophenone and *p*-tolualdehyde.
2. Preparation of benzoic acid under solvent-free (solid-state) conditions.
3. Preparation of *p*-bromoacetanilide from acetanilide using potassium bromide and ceric ammonium nitrate.
4. Preparation of 5-nitrosalicylic acid from salicylic acid using calcium nitrate.

Note: For Green Chemistry preparations, students should include a brief note on the green principles involved (such as solvent-free conditions, reduced waste, safer reagents, and energy efficiency), along with a short comparison to the conventional method. Where applicable, they may calculate atom economy and comment on environmental impact and safety. In addition to yield and melting point, a concise mechanistic explanation and product confirmation should also be included.

b) Organic Preparations (Any Three)

1. Preparation of *p*-iodonitrobenzene from *p*-nitroaniline by the Sandmeyer reaction.
2. Preparation of methyl orange by diazotization of sulfanilic acid followed by azo coupling with N,N-Dimethylaniline.
3. Preparation of *p*-chlorobenzoic acid and *p*-chlorobenzyl alcohol from *p*-chlorobenzaldehyde.
4. Preparation of anthracene–maleic anhydride adduct via the Diels–Alder reaction.

5. Preparation of acetylsalicylic acid (aspirin) from salicylic acid by acetylation using acetic anhydride.
6. Preparation of 2-amino-4-(4-chlorophenyl)thiazole from 4-chlorophenacyl bromide and thiourea
7. Preparation of 1,4-dihydropyrimidinone from ethyl acetoacetate, benzaldehyde, and urea using oxalic acid as a catalyst.

Note: For Organic Preparations, students should include the balanced reaction, reaction mechanism, and the role of reagents or catalysts. Percentage yield, purification method, and melting point for product confirmation must be reported. A brief note on the reaction type and its significance, along with necessary safety precautions, should also be included.

C) Preparation of Organic Derivatives (Any Two)

1. Oxime derivative of benzophenone
2. Acid derivative of benzamide
3. Hydrazone derivative of acetophenone and phenylhydrazine
4. 2,4-Dinitrophenylhydrazone (2,4-DNP) derivative of benzaldehyde

Note: Select any one experiment from (1) and (2), and any one from (3) and (4).

For Preparation of Organic Derivatives, students should include the balanced reaction and a brief reaction mechanism explaining derivative formation. They must report the purpose of derivative preparation (confirmation of functional group and characterization), along with observations, percentage yield, recrystallization method, and melting point determination for identification. A short note on the significance of derivative formation in qualitative analysis and necessary safety precautions should also be included.

Important Note

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

- Complete analysis of one binary mixture,

OR

- One organic preparation and one preparation of an organic derivative.

References:

1. Comprehensive Practical Organic Chemistry: Preparations and Quantitative Analysis, V. K. Ahluwalia, Renu Aggarwal, Universities Press / Orient Blackswan Pvt. Ltd., Illustrated Edition, 2000.
2. Green Chemistry Experiments: A Monograph, R. K. Sharma, Indu Tucker Sidhwani, M. K. Chaudhuri, I. K. International Pvt. Ltd., 1st Edition, 2009.

3. Green Chemistry Experiments in Undergraduate Laboratories, Jodie T. Fahey, Lynn E. Maelia, American Chemical Society / Oxford University Press, 1st Edition, 2013.
4. A Textbook of Practical Organic Chemistry, A. I. Vogel, Pearson / Longman, 5th Edition, 1989.
5. Practical Organic Chemistry: Qualitative Analysis Manual, Various Authors, S. Chand / New Age International Publishers, Latest Edition.
6. Advanced Practical Organic Chemistry, O. P. Agarwal, S. Chand / New Age International Publishers, Latest Edition.