**SYLLABUS**[1]

# CHEM 2123 – ORGANIC CHEMISTRY LABORATORY I

Fall 2021


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**PREREQUISITES**: CHEM 1312 (General Chemistry II) or equivalent.
**COREQUISITES**: CHEM 2323 (Organic Chemistry I) or equivalent.

**DESCRIPTION:** Introduction to basic experimental technique and information sources. Major topics include safety, record keeping, written communication, information sources, physical separations, determination of physical constants, purification and characterization techniques, and simple organic reactions.

## LEARNING OBJECTIVES AND OUTCOMES

- Describe and utilize safety protocols associated with basic organic chemistry laboratory operations.
- Know how to keep experiment records, produce reports, interpret data, and draw conclusions.
- Prepare, purify, and characterize simple organic compounds.
- Know how to work and communicate effectively in small groups and teams.

**TEXTBOOK** (CHEM 2123 & 2125): ***A Microscale Approach to Organic Laboratory Techniques***, **6th ed**.
By Pavia/Kriz/Lampman/Engel

**a) Direct purchase through eLearning** – Click on the "eBook" link on the left panel. Follow the prompts to register or sign in with Cengage. You will be able to purchase and access the eBook directly from eLearning. Additional benefits are:

- Offline access through the Cengage Mobile App, free from the App Store & Google Play.
- Free 7-day trial through *Cengage Unlimited*. You can access the eBook immediately.
- If you have a *Cengage Unlimited* subscription, you can access the eBook at no cost.

**b) Purchase through Bookstore** – ISBN 9781305968349. Students can also purchase and access their eBooks through the **Follett Discover link** on eLearning.

**ORGANIC CHEMISTRY LAB NOTEBOOK** – Must have numbered duplicate sheets (carbon copies) for prelabs. We recommend the ***Hayden-McNeil Organic Chemistry Lab Notebook***, ISBN 978-1-930882-46-1.

## SUPPLIES REQUIRED FOR FIRST MEETING

- **COMBINATION PADLOCK** (Only one per group is needed).
- **APPROVED SAFETY GLASSES**: Must have the **Z87 code** engraved on them. The **spectacle type** is recommended over the goggle type. They are more comfortable and can be worn over prescription glasses. They can also be made to prescription at certain retail outlets.

## SUPPLIES REQUIRED FOR SECOND MEETING AND THROUGH THE REST OF THE TERM

- **GLOVES**: Disposable gloves are available in the lab, but they are not chemical resistant and can cause allergic reactions. If you prefer to bring your own, dishwashing gloves are adequate.
- **ITEMS OF PERSONAL USE** (for cleaning, labeling, etc.): Towel, Sharpie marker or pen, and masking tape.

[1] *The descriptions and timelines presented in this syllabus are subject to change.*

**CLASS SCHEDULE – Org. Lab I – Fall 2021**

*There are no labs the first week of class. Lab operations begin on the second week.*

| DATE | TOPIC / EXPERIMENT |
|---|---|
| Aug. 30 – Sept. 4 | • Organic Lab Procedures & Safety Protocols<br>• SDS assignment<br>• Check-in |
| Sept. 6 – 11 | **NO LABS** |
| Sept. 13 – 18 | **Exp. 3A: Crystallization & Melting Points**<br>NOTE: Acetanilide is substituted for sulfanilamide in this experiment<br>(See class notes for details). |
| Sept. 20 – 25 | **Acid-Base Extraction of Active Ingredients in Excedrin**<br>(Not in textbook - Posted in eLearning) |
| Sept. 27 – Oct. 2 | **Thin Layer Chromatography: Analysis of Analgesic Drugs**<br>(Not in textbook - Posted in eLearning) |
| Oct. 4 – 9 | **Column Chromatography: Separation of Lycopene from Tomato Paste**<br>(Not in textbook - Posted in eLearning) |
| Oct. 11 – 16 | **Exp. 14A: Synthesis of isopentyl acetate (banana oil)**<br>Part 1: Reflux & Workup |
| Oct. 18 – 23 | **Exp. 14A – Part 2: Distillation and Infrared analysis**<br>Technique 25: Infrared Spectroscopy |
| Oct. 25 – 30 | **MID-TERM EXAM & CHECKOUT** |
| Nov. 1 – 6 | **Proton NMR Spectroscopy – Part 1**<br>Technique 26 |
| Nov. 8 – 13 | **Proton NMR Spectroscopy – Parts 2 & 3**<br>Technique 26 |
| Nov. 15 – 20 | **Mass Spectrometry**<br>Technique 28 |
| Nov. 22 – 28 | **FALL / THANKSGIVING BREAK** |

**SEE DETAILED DESCRIPTIONS BELOW**

## DETAILED DESCRIPTIONS, READINGS, & ASSIGNMENTS

### INTRODUCTORY MEETING

**1. Organic Lab Procedures & Safety Protocols**

ASSIGNED READINGS:

- *Syllabus & Introductory Items* folder in eLearning – **Please read the items in this folder carefully**.
- Technique 1 in the textbook (Laboratory safety).

ASSIGNMENT: Safety Data Sheets (due next period) – Download from eLearning (100 pts).

**2. Overview of Prelabs and Lab Reports**

ASSIGNED READINGS: Guide to Prelabs and Post-labs (posted in *eLearning*)

**3. Check-in Procedure**

Students will form groups of two. **Each group must provide a combination padlock**. No drawers can be assigned without combination padlocks.

*For all experiments, you are encouraged to bring the class notes to the lab. They contain useful tips to save time and avoid common mistakes. They also point to possible modifications to the experimental procedure.*

**EXP # 3A: CRYSTALLIZATION AND MELTING POINTS**.
**Note: Acetanilide is substituted for sulfanilamide in this exp. See the class notes for details**.

ASSIGNED READINGS

- Exp. 3 (Introduction, part A, and posted notes)
- Technique 8: Filtration – Sections 3, 4, and 8
- Technique 9: Physical Constants of Solids: The Melting Point – Sections 1-5, and 7
- Technique 10: Solubility – All sections
- Technique 11: Crystallization – Parts A and B.

*NOTE: The "Pre-Lab Calculations" section of some experiments in the textbook (such as exp. 3A, p. 22) is not required for your prelab.*

**ACID-BASE EXTRACTION OF ACTIVE INGREDIENTS IN EXCEDRIN**. Liquid-liquid extraction, miscibility & solubility, distribution coefficient.

ASSIGNED READINGS & EXERCISES:

- Posted class notes
- Technique 12: Extractions – Sections 1-11

**THIN LAYER CHROMATOGRAPHY: ANALYSIS of ANALGESIC DRUGS**. Introduction to theory and practice of chromatography.

ASSIGNED READINGS & EXERCISES:

- Posted class notes

- Technique 20: Thin-Layer Chromatography - Sections 1, 2, 4 – 7, 9, 10.
- Suggested study questions from Technique 20: # 1 – 5

**COLUMN CHROMATOGRAPHY: SEPARATION OF LYCOPENE FROM TOMATO PASTE**. Use of column chromatography to separate and identify naturally occurring pigments.

**NOTE**: For the prelab, do not include the pigments present in tomato paste in your table of physical constants. Include only the solvents used.

ASSIGNED READINGS & EXERCISES:

- Posted class notes
- Technique 19: Column Chromatography
    - Sections 1-6
    - Sections 8-9

**EXP # 14A: CHEMICAL SYNTHESIS: PREPARATION OF ISOPENTYL ACETATE & INTRODUCTION TO INFRARED SPECTROSCOPY**. Esterification, reflux, simple distillation, boiling point determination, driving equilibrium reactions, infrared spectroscopy.

ASSIGNED READINGS & EXERCISES <u>FOR PART 1</u> (first week):

- Exp. 14 (introduction, part A, and posted notes)
- Technique 7 (Reaction Methods): Sections 1 – 3
- Technique 13 (Physical Constants of Liquids): Sections 1 & 2 (up to p. 747 only)
- Technique 14 (Simple Distillation): Sections 1 – 3, but only up to p. 761 (Fig. 14.6)
- Suggested study questions from the textbook: # 3-7 on p. 114 - 115

ASSIGNED READINGS & EXERCISES <u>FOR PART 2</u> (second week):

- Class notes on *Infrared Spectroscopy* (PowerPoint presentation) posted in eLearning
- Technique 25 (Infrared Spectroscopy): Part B only (p. 893 – 913)
- Try problem 2 at the end of this section. Some related problems will appear in the post-lab.

**PROTON NMR SPECTROSCOPY** – Introduction to Nuclear Magnetic Resonance spectroscopy (NMR).

ASSIGNED READINGS & EXERCISES:

- Posted class notes
- Technique 26: Nuclear Magnetic Resonance Spectroscopy
    - Read introduction (first two pages), and Part B, sections 26.4 – 26.11
- Recommended exercises from Technique 26: # 5-9

**MASS SPECTROMETRY**

ASSIGNED READINGS:

- Technique 28 (Mass Spectrometry): Read all sections

**CHECKOUT**

- ALL students must be present for checkout. Those missing will continue to be responsible for the equipment in their drawer.
- No checkout is allowed prior to this date unless you drop the course.

**GRADING POLICY**

The final grade for this course is calculated as follows. All work is graded on a 100-point scale.

- Prelabs 40%
- Post-labs/Assignments 40%
- Mid-term exam 20%

**INDIVIDUAL PRELABS** are required to perform every experiment. Students must turn their prelabs before beginning the lab session. Please refer to the guidelines for writing prelabs posted in *eLearning*.

**POST-LABS are associated with wet labs**. They are a group effort and consist of a form to be filled out and turned in following completion of the experiment. The grade obtained applies to all members of the group. However, the following behaviors can result in loss of points for students who:

- Show a lack of preparation or knowledge of basic procedures.
- Disregard safety rules (for instance not wearing eye protection).
- Do not carry their fair share of the group's work or are consistently distracted.
- Leave the lab for long periods of time, except for bathroom breaks and emergencies.
- Leave the lab for good before the group concludes the experiment (this earns a grade of zero for the experiment).
- Any other types of unprofessional or unsafe behavior.

**ASSIGNMENTS are associated with dry labs** and are to be completed individually by each student.

**MID-TERM EXAM**. The mid-term will be administered **in person**. The exam will consist of approximately 30 multiple-choice questions, based on the theory and technique of the experiments performed prior to the exam. **Calculations will be an important part of the exam. Make sure to bring a basic calculator**.

LETTER GRADE ASSIGNMENT TABLE (based on final percent grade after round off)

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|---|---|---|---|
| 95 - 100 = **A**+ | 80 – 84 = **B**+ | 65 – 69 = **C**+ | 50 – 54 = **D**+ |
| 90 – 94 = **A** | 75 – 79 = **B** | 60 – 64 = **C** | 45 – 49 = **D** |
| 85 – 89 = **A**- | 70 – 74 = **B**- | 55 – 59 = **C**- | 40 – 44 = **D**- |

**DROPPED GRADE POLICY**

1. One prelab and one post-lab OR assignment will be dropped at the end of the course (they don't have to be for the same experiment).

2. For two-period experiments, the first period is usually the most important. Therefore:
   - Students who miss the first period will get no credit for the experiment.
   - Students who miss only the second period will get a 50% deduction from the report grade. For example if the group's post-lab grade is 80 pts., students who missed the first half will get 40 pts. as their post-lab grade.

**3.** The mid-term exam cannot be dropped.

**MAKUP POLICY**

1. Makeups are only allowed when university policy provides for accommodations. Documentation is required in all cases. Common examples are:
    - Military or jury duty.
    - Major medical events such as illness, hospitalization, or quarantining.
    - Participation in university-sponsored events.
    - Accommodations recommended by a qualified professional such as a doctor or counselor, or a university official.

2. NOT INCLUDED IN THE ABOVE CATEGORY ARE: minor emergencies, participation in events not sponsored by the university, and personal engagements like travel, social events, family affairs, and funerals.

3. **Experiment makeups are only allowed during the period allocated to the experiment in the syllabus**. Instructors may suggest alternative arrangements for students that cannot meet this requirement.

**UTD SYLLABUS POLICIES AND PROCEDURES** – Refer to the *Provost Webpage* for a complete list of university syllabus policies and procedures, including Incomplete health guidelines, grade policy, academic integrity, student conduct and discipline, grievance procedures, student resources, etc.