SYLLABUS[1]

CHEM 2233 – ORGANIC CHEMISTRY LABORATORY
SPRING 2024

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COURSE COREQUISITES: CHEM 2325 (Organic Chemistry II lecture)

COURSE DESCRIPTION: This course provides the basic skills necessary to conceptualize, design, and execute organic experiments. Topics include safety, purification and characterization techniques, reaction methods, representative types of organic reactions, and instrumental methods of structure determination.

LEARNING OBJECTIVES AND OUTCOMES

- Utilize safety protocols associated with basic laboratory operations.
- Keep experiment records, produce reports, interpret data, and draw conclusions.
- Understand and implement basic physical operations such as separations and purifications.
- Understand and implement common reaction methods and techniques.
- Perform representative reaction types, either in isolation or as part of a synthesis.
- Use instrumental methods of structure determination such as Infrared and NMR spectroscopies.

TEXTBOOK: *A Microscale Approach to Organic Laboratory Techniques*, 6th ed.
By Pavia/Kriz/Lampman/Engel

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

b) 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.

ORGANIC CHEMISTRY LAB NOTEBOOK – Must have numbered duplicate sheets (carbon copies) for prelabs. It can be obtained from the campus or the off-campus bookstores.

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.


SPECTACLE TYPE


GOGGLE TYPE

You may also want to bring your own marker and tape for labeling containers during experiments.

CLASS SCHEDULE – CHEM 2233 – SPRING 2024
NOTE: Recitation lectures are a week ahead of the corresponding experiments, as shown below.

[1] *The descriptions and timelines presented in this syllabus are subject to change at the discretion of the Professor.*

RECITATION LECTURE DATES	EXPERIMENT DATES	EXPERIMENTS
Jan. 16 – 19	Jan. 22 – 26	**Introduction & Check-in**
Jan. 22 – 26	Jan. 29 – Feb. 2	**Exp. 3A: Crystallization & Melting Points** NOTE: Acetanilide will be substituted for sulfanilamide
Jan. 29 – Feb. 2	Feb. 5 – 9	**Acid-Base Extraction of Active Ingredients in Excedrin** (Not in textbook - Posted in eLearning)
Feb. 5 – 9	Feb. 12 – 16	**Identification of the $C_4H_8O_2$ isomers by ^1H NMR Spectroscopy**
Feb. 12 – 16	Feb. 19 – 23	**TLC Analysis of Analgesic Drugs** (Not in textbook - Posted in eLearning)
Feb. 19 – 23	Feb. 26 – Mar. 1	**Column Chrom. of Lycopene from Tomato Paste** (Not in textbook - Posted in eLearning)
Feb. 26 – Mar. 1	Mar. 4 – 8	**Exp. 14A: Synthesis of isopentyl acetate – Part 1** Reflux & workup
Mar. 11 – 17: ***SPRING BREAK***		
NO RECITATION (Mar. 4 – 8)	Mar. 18 – 22	**Exp. 14A: Synthesis of isopentyl acetate – Part 2** Distillation & infrared analysis
Mar. 18 – 22	Mar. 25 – 29	**Exp. 49: Preparation of Benzocaine**
Mar. 25 – 29	Apr. 1 – 5	**An oxidation puzzle** (Not in textbook - Posted in eLearning)
Apr. 1 – 5	Apr. 8 – 12	**Exp. 69: Esterification of Vanillin** Introduction to Microwave Chemistry
Apr. 8 – 12	Apr. 15 – 19	**Exp. 43C: Preparation of diene by Wittig Reaction** (Green Chemistry Method)
Apr. 15 – 19	Apr. 22 – 26	**Exp. 39: Aldol Condensation Reaction** / *Check-out*

EYE PROTECTION, LONG PANTS OR DRESS, AND CLOSED SHOES ARE REQUIRED TO WORK IN THE LAB AT ALL TIMES, INCLUDING CHECK-IN.

DETAILED DESCRIPTIONS, READINGS, & ASSIGNMENTS

INTRODUCTORY MEETING & CHECK-IN

- Organic Lab Procedures & Safety Protocols
- Overview of Prelabs and Lab Reports
- Check-in Procedure

ASSIGNED READINGS (posted in *eLearning*)

- *Syllabus & Introductory Items*
- *Guide to Prelabs and Post-labs*

CHECK-IN

- Students will form groups of two and will be assigned a drawer.
- Each group must provide a combination padlock. No drawers can be assigned without one.

NOTE: *During experiments make sure to have access to the class notes and experimental procedures as posted in eLearning. We will follow these procedures rather than those in the textbook, even if sometimes they may be similar.*

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 this experiment (p. 22 of the textbook) 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

IDENTIFICATION OF THE ISOMERS OF $C_4H_8O_2$ by ^1H NMR SPECTROSCOPY. Introduction to practical ^1H NMR spectroscopy to identify the structures of isomeric compounds.

ASSIGNED READINGS & EXERCISES:

- Posted class notes
- Technique 26: Nuclear Magnetic Resonance Spectroscopy
  - Part A
  - Part B, sections 26.4 – 26.11
- Recommended exercises from Technique 26: # 5-9

THIN LAYER CHROMATOGRAPHY: ANALYSIS of ANALGESIC DRUGS. Introduction to 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 and 8-9)

EXP # 14A: PREPARATION OF ISOPENTYL ACETATE. Simple chemical reactions, esterification, reflux, simple distillation, chemical equilibrium, use of infrared spectroscopy in product characterization.

ASSIGNED READINGS & EXERCISES FOR PART 1 (first week):

- Exp. 14 (introduction, part A, and posted notes)
- Technique 7 (Reaction Methods): Sections 7.1 - 7.3
- Technique 13 (Physical Constants of Liquids): Sections 13.1 and 13.2 (up to p. 747 only)
- Technique 14 (Simple Distillation): Sections 14.1 – 14.3, but only up to p. 761 (Fig. 14.6)
- Suggested study questions from the textbook: # 3-7 on p. 114 - 115

ASSIGNED READINGS & EXERCISES FOR PART 2 (second week):

- Class notes (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.

EXP. 49: PREPARATION OF BENZOCAINE. Local anesthetics, microwave synthesis versus conventional reaction methods, use of ^{1}H NMR for product characterization.

- Readings: p. 402 – 409, including the introductory essay (*Local Anesthetics*)
- Posted notes
- Suggested study questions from the textbook: # 1 – 4

OXIDATION PUZZLE. Selective oxidation of alcohols. Use of infrared and NMR spectroscopy for product characterization.

- This experiment is not in the textbook. Refer to the class notes posted in eLearning.

EXP. 69: ACID & BASE CATALYZED VANILLIN ESTERIFICATION. Selective reactivity of functional groups under different conditions, microwave synthesis versus conventional reaction methods, use of ^{1}H NMR to solve a structure problem.

- Readings: p. 586 – 587 and posted notes.

EXP 43C: PREPARATION OF CONJUGATED DIENE. Use of the Wittig reaction in alkene synthesis, organic mechanisms involving phosphorus, green chemistry methods in synthesis.

- Readings: p. 369 – 371 and 374 – 375, and posted notes. Note: The TLC part of this experiment will not be performed.
- Suggested study questions from the textbook: # 1, 2 (p. 376).

EXP. 39: ALDOL CONDENSATION. Use of crossed aldol condensation reactions in the preparation of benzalacetophenones.

- Readings: p. 349 – 351 and posted notes.
- Note: Only 3-nitrobenzaldehyde will be used. No other aldehydes will be available.
- Suggested study questions from the textbook: # 1, 2, 4(a, b, c) on p. 352-3.

CHECKOUT

- PROPER ATTIRE IS REQUIRED: Eye protection, long pants or dress, closed shoes.
- All glassware must be clean and dry. The best way to do this is to wash it first with soap and water, followed by an acetone rinse. For stubborn stains please consult your instructor.

GRADING POLICY

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

- Quizzes 30%
- Prelabs 30%
- Post-labs/assignments 40%

One quiz, 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). Students are advised to reserve this option for emergencies.

QUIZZES will be given during the first 10 min. of the lab session. Students arriving late will be deducted 10 points per minute late.

INDIVIDUAL PRELABS are due at the beginning of the lab period, and are required to perform every experiment. NO LATE PRELABS ARE ACCEPTED. Refer to the guidelines for writing prelabs.

POST-LAB REPORTS consist of a form to be filled out with experimental data and turned in following completion of the lab. Although there is a grading rubric for post-labs, students can lose points if they show a lack of preparation, do not carry their share of the group's work, are constantly distracted, or disregard safety rules.

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

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-

PUNCTUALITY POLICY

Students are expected to arrive at the lab within the first 15 min. of the lab session. Students are also expected to be prepared, which means:

- Wearing eye protection, long pants or dress, and closed shoes.
- Having the prelab ready to turn in.

MISSED EXPERIMENTS and MAKEUP POLICY

1. STUDENTS WHO MISS THREE OR MORE EXPERIMENTS WILL AUTOMATICALLY FAIL THE COURSE.
2. Late prelabs are not accepted.
3. Makeups are only allowed when university policy provides for accommodation. 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.
    - Directives issued by a professional such as a doctor, counselor, or university official.
4. NOT INCLUDED IN THE ABOVE CATEGORY ARE: minor emergencies, participation in non-university events, and personal engagements such as travel, social events, family affairs, and funerals.
5. Makeup experiments are only allowed during the period allocated to the experiment in the syllabus.

SAFETY POLICY

Safety policy is important in the organic chemistry lab due to the presence of fumes, solvents, flammables, and toxic materials that can be absorbed through the skin. The following regulations are in place.

1. Eye protection is required for everyone while inside the labs, regardless of the type of activity. Safety eyewear must have the Z87 code engraved on the frame.

2. Lab coats must be worn while inside the lab. Conversely, lab coats should not be worn outside the chemistry labs, except to drop them in the collection bins.

3. Proper attire is required. This means long pants and closed shoes. No one wearing shorts or sandals is allowed to work in the chemistry labs, even if wearing a lab coat.

4. Gloves must be worn whenever handling chemicals. Dishwashing gloves are adequate for most purposes. Disposable gloves are available in the lab, but are not chemical or tear proof.

    - If you choose to wear disposable gloves discard them as soon as they get damaged.
    - If you have or develop an allergy to lab gloves, we recommend you bring your own, based on medical recommendation.

5. Pregnant students must obtain medical approval and present it to the section instructor.

6. Contact lenses are not allowed. Many contact lenses are made of synthetic materials that are susceptible to the action of organic chemicals and vapors. If you have a medical condition that requires continuous use of contact lenses, obtain medical advice and inform your instructor.

7. Allergies or other medical conditions that may adversely affect your safety in the chemistry labs must be discussed with your instructor prior to handling chemicals.

8. Use of drugs or medications that may impair normal mental or physical functioning must be discussed with the instructor so that proper measures can be implemented.

9. All accidents, however minor, must be reported immediately. Failure to do so prevents proper action and can further aggravate the situation.

10. Disruptive behavior may result in serious accidents. Please refrain from engaging in such behaviors.

ACADEMIC SUPPORT RESOURCES

Chemistry Clinic Tutoring Center – Help with General and Organic Chemistry during the semester.

Also visit the Academic Support Resources website for information on, and a list of, the university's academic support resources and policies for all students.

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