



Organic Chemistry I Laboratory

The University of Toledo
Department of Chemistry and Biochemistry
College of Natural Sciences and Mathematics
CHEM 2460 – All Sections

Instructor:	Dr. Zin-Min Tun	Offered:	Spring 2021
Email:	zinmin.tun@utoledo.edu	Course Website:	Blackboard Learn
Office Hours:	by appointment	Lab Location:	Multiple Locations
Office Location:	BO 2034	Lab Day/Time:	Multiple Times
Instructor Phone:	(419) 530-4591	Credit Hours:	1

CATALOG/COURSE DESCRIPTION

Practice of organic laboratory techniques. Four hours of laboratory per lab session. Approved chemical safety goggles meeting the American National Standard Z87.1-1968 must be worn by every student during every laboratory class meeting.

COURSE OVERVIEW/ TEACHING METHODOLOGY

Welcome to Organic Chemistry! The purpose of this laboratory course is to introduce students to the techniques that organic chemists (as well as biochemists, physical chemists, etc.) use in their daily routines. After learning and understanding those techniques, students will apply their knowledge to new situations to understand synthesis reactions, molecular structure determination, and analysis of (un)known compounds.

Organic chemistry laboratory is important for several reasons. It introduces students to many different laboratory practices and concepts that will be used in subsequent chemistry laboratory classes (CHEM 2460 and beyond) and in other laboratory situations in biology, pharmacy, and chemical engineering (just to name a few!). It is anticipated that by the completion of this course, students will be familiar with all of the following topics and techniques:

- Safety in the laboratory
- Interpreting and following scientific directions
- Keeping a proper lab notebook
- Names and proper usage of lab instruments
- Understanding of general properties of compounds (including solubility, miscibility, acid/base chemistry, etc.)
- Proper usage of glassware
- Isolation and purification techniques (including filtration, solvent removal, drying solutions, distillations, chromatography (thin-layer, column, and gas) and crystallization/recrystallization)
- Characterization techniques including spectroscopy and melting point determination
- Interpretation of scientific results including percent yield and recovery, melting point, boiling point, IR and NMR spectra, and R_f values



STUDENT LEARNING OUTCOMES

Upon completion of this course, the student will be able to:

1. Demonstrate their knowledge of departmental safety rules through their laboratory practice, including the ability to dispose of waste properly.
2. Apply basic stoichiometric algorithms (calculating limiting reagents, theoretical yield, mole ratios) in the context of organic chemistry.
3. Demonstrate a command of the rules for assigning significant figures in their work, specifically in calculations and laboratory measurements and calculations.
4. Understand and be able to use the basic operations of an organic chemistry laboratory including gravity and vacuum filtration, liquid-liquid extraction, simple and fractional distillation, reflux, recrystallization, thin-layer chromatography, gas chromatography, column chromatography, drying of solids and solutions, and the theories behind these techniques.
5. Know the significance of pK_a values in experimental steps.
6. Identify and assess the purity of organic compounds using analytical techniques, including melting point, thin-layer chromatography, IR, and gas chromatography.
7. Deduce organic structures using spectroscopic methods, including infrared (IR), 1H - and ^{13}C -nuclear magnetic resonance spectroscopy, and mass spectrometry
8. Determine molecular formulas from a mass spectrum by using the Rule of 13 and other techniques
9. Deduce hydrogen deficiency from a molecular formula and use this information to help deduce a structure
10. Be able to follow a detailed experimental procedure and construct a flow diagram to illustrate it.
11. Depict and explain detailed chemical mechanisms for all laboratory reactions (and their related reactions)
12. Demonstrate the ability to maintain a properly laboratory notebook
13. Construct a lab report that includes an analysis of the data collected, and discussion of the outcomes and answers to open questions associated with the experiment.

PREREQUISITES AND COREQUISITES

Students must have completed the General Chemistry sequence before enrolling in this course (CHEM 1230/1240, 1280/1290) with a grade of D- or better. Students also are required to be concurrently enrolled in (or have successfully passed) Organic Chemistry I lecture (CHEM 2410). Please note that *withdrawal from CHEM 2410 during the semester will necessitate withdrawal from CHEM 2460.*

TEXTS AND ANCILLARY MATERIALS

The following materials are **required** for this course:

- **CHEM 2460: Organic Chemistry Lab I** by D. L. Pavia, UT Custom Edition, published by Cengage
ISBN: 978-1-337-92830-4
- A laboratory notebook with carbon(less) pages (can be purchased from the UT bookstore)
- Approved safety goggles (can be purchased from the UT bookstore or from the UT-ACS group).



GENERAL TECHNOLOGY REQUIREMENTS

Browser Check Page: Students need to have access to a properly functioning computer throughout the semester. The Browser Check Page (<http://www.utoledo.edu/dl/helpdesk/browser-check.html>) will enable you to perform a systems check on your browser, and to ensure that your browser settings are compatible with Blackboard (<https://blackboard.utdl.edu/webapps/login/>), the learning management system that hosts this course.

Software: Student computers need to be capable of running the latest versions of plug-ins, recent software and have the necessary tools to be kept free of viruses and spyware. The computer needs to run the following software, available in the UT Online Download Center (<https://www.utoledo.edu/dl/main/downloads.html>). • Word Processing Software • Adobe Acrobat Reader • Java Plugin Console • Adobe Flash Player • Adobe Shockwave Player • Google Chrome Browser – Recommended

Internet Service: High-speed Internet access is recommended, as dial-up may be slow and limited in downloading information and completing online tests. This course does contain streaming audio and video content.

Use of Public Computers: If using a public library or other public access computer, please check to ensure that you will have access for the length of time required to complete tasks and tests. A list and schedule for on-campus computer labs is available on the Open Lab for Students webpage.

UT Virtual Labs: Traditionally, on-campus labs have offered students the use of computer hardware and software they might not otherwise have access to. With UT's Virtual Lab, students can now access virtual machines loaded with all of the software they need to be successful using nothing more than a broadband Internet connection and a web browser. The virtual lab is open 24/7 and 365 days a year at VLAB: The University of Toledo's Virtual Labs.

Learner Technical Support can be found here <http://www.utoledo.edu/dl/students/learnersupport.html>

TECHNOLOGY REQUIREMENTS FOR QUIZZES AND EXAMS

LockDown Browser + Webcam Requirement

This course requires the use of LockDown Browser and a webcam for online quizzes and exams. The webcam can be the type that's built into your computer or one that plugs in with a USB cable. Watch this brief video to get a basic understanding of LockDown Browser and the webcam feature. (<https://www.respondus.com/products/lockdown-browser/student-movie.shtml>)

Download Instructions

Download and install LockDown Browser from this link:

(<https://download.respondus.com/lockdown/download.php?id=213815819>)

If you have any issues with the Webcam requirement, please contact Dr. Tun asap to arrange for alternate proctoring arrangements for the exams.



ACADEMIC POLICIES

All students at the University of Toledo are expected to read, understand, and follow the academic policies that govern their attendance at the University. These policies include, but are not limited to, academic dishonesty, academic forgiveness, adding and dropping a course, grades and grading, and the missed class policy. Please use the following URL to read a comprehensive list of academic policies that pertain to you in this class and throughout your academic journey:

<http://www.utoledo.edu/policies/academic/undergraduate/>. If you have any questions after reading through the policies, please let me know.

COURSE EXPECTATIONS

Subject to Change: Any changes to the Syllabus will be announced in class, through Blackboard or your rockets email.

Communication: You are urged to communicate with me about any aspect of the course with concerns you or which might limit your success. Please allow for 24-48 hours, not including weekends or holidays, for a reply from Dr. Tun or your TA. Please also make sure that you include your course number and section number (e.g. CHEM2460-001) either in the subject line or in the body of the email to facilitate the communication. We want you to be successful in this course so let's work together!

Student Responsibilities:

1. Be on time and be prepared. ***If you are more than 20 minutes late for a laboratory session, you will not be permitted to attend that session.***
2. Read the laboratory assignment and appropriate lecture material prior to each laboratory session. It is required that a laboratory notebook be kept to record pre-lab, notes and observations, experimental results and discussions.
3. Follow lab safety rules and COVID-19 specific rules.
4. Turn in all work as assigned.
 - Pre-labs are due at 11:59 pm of the day **before** your lab experiment. ***You will not be allowed to perform the experiment without completing the pre-lab for it.***
 - Lab reports and worksheets are due at 11:59 pm on the day that they are due. Due dates are listed in the course schedule.
5. **Clean up:** Be certain that your area of the laboratory table is properly cleaned after use. Wash and return all glassware and other instruments and equipment to their proper areas. Check the sink to be sure that it is clear of all glassware and trash.

Safety Requirements: There will be another document that will go over specific safety policies and procedures, but here are the basic rules of the lab:

1. Eating, drinking, and smoking are NOT PERMITTED in the laboratory.
2. Non-registered persons are not permitted in the laboratory.
3. Appropriate laboratory apparel including footwear is required (i.e.: jeans, cotton shirts, no loose clothing, etc.). Students who are wearing clothing inappropriate for lab will be asked to leave the lab. The students may be allowed to come back in the lab (a) if they changed into clothing appropriate for lab and (b) if they are back no later than 20 minutes from the beginning of the lab period.
4. Safety goggles **MUST BE WORN BY EVERYONE** while experiments are being conducted. Your TA will determine and announce when goggles may be removed. The appropriate eyewear must be splash goggles, which are available for purchase from the UT bookstore.



Students should consult the safety handout concerning additional rules and guidelines for laboratory work. ANY violation of the safety rules/guidelines will result in a loss of technique points (see the “Grading Policies” section below for more information). **If a student repeatedly violates these safety rules, the laboratory coordinator has the right to remove the student from the laboratory room.**

IMPORTANT COVID-19 SPECIFIC RULES

Due to the current additional requirements implemented to prevent the spread of Covid-19, the following summary outlines some important changes to this semester’s lab course.

- Due to COVID-19, the maximum number of students that can safely work in each lab at a given time is 12.
- There will be **no loaner goggles** supplied by the Chemistry Stockroom. You must own your own goggles. You must arrive appropriately dressed (no exposed skin except for arms shoulders down, closed toe shoes that will not be penetrated by a simple spill) and with approved goggles.
- NO students will be permitted in the lab without a face covering. **We recommend that you bring a spare mask to lab in case the mask you are wearing gets exposed to chemicals by accidental touching etc.** If you have a medical reason that prevents you from wearing a face covering due to a health condition deemed high-risk for COVID-19 by the Centers for Disease Control and Prevention (CDC), please contact the Student Disability Services Office (SDS).
- The lab doors will be a “one-way”, where one door serves as entrance and the other serves as exit.
- Backpack storage cubicles and hoods are numbered, and you will be assigned a specific set of hood and cubicle that you must use every time you are in the lab.
- When you arrive at the lab, wash your hands with water and soap, and put on gloves. Wipe your cubicle and your work area with paper towels sprayed with ethanol.
- When you are finished for the day, you should wipe your work area(s) and cubicle again. Whenever you use a shared instrument or piece of equipment, wipe it off with a paper towel/ethanol as soon as you are finished.
- Be conscientious of the distance between yourself and others. If you need somebody to briefly step aside so that you can pass through while **maintaining a 6-foot distance**, please ask them to do so.
- **If you show any kinds of COVID symptoms – do not attend lab**, and inform Dr. Tun and your TA before your lab time. Virtual materials will be made available to you, and you will be able to finish your work and earn your grade this way.
- Some experiments will be carried out as “virtual experiments” to accommodate the reduced number of students in the lab. These experiments were chosen as experiments that do not teach new hands-on techniques, but rather as experiments where techniques learned during earlier experiments are applied, and critical thinking skills are developed by analyzing the results. This ensures that we still meet the learning outcomes, as critical thinking skills can be trained using virtual materials.



OVERVIEW OF COURSE GRADE ASSIGNMENT

GRADING POLICIES

The grade for this course is based upon the following components:

Safety Quiz	10 points
Safety Discussion	5 points
Pre-Labs (5 @ 12 pts each)	60 points
Lab Reports (5 @ 38 pts each)	190 points
Samples points (5 @ 10 points each)	50 points
Technique points (5 @ 5 points each)	25 points
Lab Cleanliness (5 @ 5 points each)	25 points
Virtual Lab Report (1 @ 50 points each)	50 points
Spectroscopy Worksheets (6 @ 20 points each)	120 points
Quizzes (2 @ 20 points each)	40 points
Final Examination	<u>100 points</u>
Total Points	675 points

The grading scale for this class is:

A	=	100 – 92%	A-	=	91 - 89%	B+	=	88 -86%
B	=	85 – 81%	B-	=	80 - 78%	C+	=	77 - 75%
C	=	74 - 70%	C-	=	69 - 67%	D+	=	65 - 63%
D	=	62 - 58%	D-	=	57 - 55%	F	=	54 - 0%

In order to complete this course with a grade of C+ or higher, you will need to:

- Achieve a score of 50% or higher on the comprehensive lab final examination.
- Achieve at least 75% of the total points for the course.

Please note that *extra credit* will **NOT** be given in this class. In order to compensate for differences in grading among TAs, different grading scales or grading adjustments may be used in order to ensure that fair grade assignments are made for each lab section.

Re-grading: If you have any questions or concerns about your grade or want to contest a grade for a certain assignment, you need to present the assignment directly to the laboratory coordinator, Dr. Tun, and she will re-grade the assignment – not your TA. There is only a one-week window (one week after your assignment was graded by the TA) in which you can contest the grading of an assignment, lab report, or quiz, so please check your graded assignments as soon as the assignment grades are posted in the grace center by your TA.

Lab Report: The lab report consists of the information you will be normally including in your lab notebook. The report can be typed up or you can simply scan in your lab notebook pages. The purpose of the lab reports following the lab notebook format is to teach you good notebook keeping skills. A handout entailing what is expected in the laboratory notebook will be available on Blackboard. Lab reports' due dates are listed in the course schedule. Late assignments will receive a 5 point grade deduction for each day late. Any assignment 1 week late or later will receive a zero (0) grade.



Worksheets: Spectroscopy worksheet can be found on Blackboard. Worksheets' due dates are listed in the course schedule. Late assignments will receive a 2 point grade deduction for each day late. Any assignment 1 week late or later will receive a zero (0) grade.

Quizzes and Final Examination: There will be two quizzes and one final examination, and the dates are as follows:

Quiz 1	March 3 rd (Wednesday)
Quiz 2	April 7 th (Wednesday)
Final Examination	April 28 th (Wednesday)

Quizzes and the final exam are timed and they will be available from 6:00 am to 11:59 pm on the scheduled date, and you can take it at a time that works best for you during that window. **You are required to use of LockDown Browser and a webcam to take the quizzes and the final exam. Questions will be displayed one at a time, and back-tracking will not be allowed.**

Quizzes and the final exam will consist primarily of multiple choice, true/false, matching, or fill in the blank questions. Safety procedures, techniques, historical background and overall concepts of experiments, mechanisms, yield calculations, and any spectral methods are potential quiz and final exam material. The final examination will be *cumulative*. In order to complete this course with a grade of C+ or higher, you will need to achieve a score of 50% or higher on the comprehensive lab final examination.

Midterm Grading

Midterm grades are assigned the 8th week of class and are used to assist students with determining their academic standing. Attendance is also recorded during the 8th week to meet state and federal laws regarding financial aid disbursement. Please note, if you are not attending class it could affect your financial aid (scholarships, grants, loans or Federal Work Study). If you decide you are not going to attend this class (or any other class you have registered for), you must formally withdraw(drop) from the course. You can do this by logging on to the myUT portal, clicking on the "Student" tab, and then under "My Toolkit" click on Register/Drop/Withdraw.

Final Grading

Your final grades will be calculated based on a total of 835 points.

UNIVERSITY POLICIES

Your safety and well-being as a University of Toledo student is important to the faculty, staff, and administration; as such please take a minute to review the following university policies that apply to you as a student of the University:

- <https://www.utoledo.edu/title-ix/policies.html>
- The University of Toledo's Title IX (Sexual Misconduct) Policy - 3364-50-01
- Nondiscrimination 3364-50-02
- Nondiscrimination on the basis of disability - Americans with Disability Act compliance 3354-50- 03
- Consensual romantic and/or sexual relationships - Policy 3364-25-65
- Student Code of Conduct 3364-30-04



Please use this URL to view a more comprehensive list of student policies:

<https://www.utoledo.edu/policies/audience.html/#students>

Academic Accommodations The University of Toledo embraces the inclusion of students with disabilities. We are committed to ensuring equal opportunity and seamless access for full participation in all courses. For students who have an accommodations memo from Student Disability Services, I invite you to correspond with me as soon as possible so that we can communicate confidentially about implementing accommodations in this course. For students who have not established affiliation with Student Disability Services and are experiencing disability access barriers or are interested in a referral to healthcare resources for a potential disability or would like information regarding eligibility for academic accommodations, please contact the [Student Disability Services Office](http://www.utoledo.edu/offices/student-disability-services/) (<http://www.utoledo.edu/offices/student-disability-services/>) by phone: 419.530.4981 or email at StudentDisability@utoledo.edu.

ACADEMIC AND SUPPORT SERVICES

Please follow this link to view a comprehensive list of [Student Academic and Support Services](http://www.utoledo.edu/studentaffairs/departments.html) (<http://www.utoledo.edu/studentaffairs/departments.html>) available to you as a student

SAFETY AND HEALTH SERVICES FOR UT STUDENTS

Please use the following link to view a comprehensive list [Campus Health and Safety Services](#) available to you as a student.

STUDENT SUPPORT SERVICES

Course scheduling assistance: Chemistry Department Secretary, Ms. Samples, is in Room BO 2022, telephone 419-530-2698. She takes care of all scheduling changes.

Chemistry Help Center, Virtual/Online, is where the teaching assistants hold their office hours so it is a great place to receive assistance. The spring semester virtual help center link is <https://us.bbcollab.com/guest/80670d8c3ff9469dbb520091a0612503>. The Help Center hours are MW 9-12, 1-4, 5-8; TR 9-8 and F 9-4, from January 25 until the end of classes. No appointment is necessary.

Tutoring support. Virtual/Online for all UT students is available through the **Learning Enhancement Center** located in the Carlson Library.

INCLUSIVE CLASSROOM STATEMENT

In this class, we will work together to develop a learning community that is inclusive and respectful. Our diversity may be reflected by differences in race, culture, age, religion, sexual orientation, gender identity/expression, socioeconomic background, and a myriad of other social identities and life experiences. We will encourage and appreciate expressions of different ideas, opinions, and beliefs so that conversations and interactions that could potentially be divisive turn, instead, into opportunities for intellectual and personal development.

OTHER SPECIAL NOTES

It is important to note that, based on the unpredictability of the COVID-19 virus, things can change at any time so please be patient and understanding as we move through the semester.



CHEM 2460 – Organic Chemistry Laboratory I

Group A Lab Schedule

Please note that this schedule is tentative, and the lab coordinator may adjust it as needed.

<u>Week</u>	<u>Dates</u>	<u>Activities</u>	<u>Techniques</u> <u>(Assigned Reading)</u>	<u>Assignment</u> <u>Due Date</u>
1	1/20	Check-in		
		Policies and Procedures		1/26
		Safety Quiz and Discussion (Blackboard)	1	1/26
2	1/27	UV-Vis Worksheet (Blackboard)		2/2
3	2/3	Exp. 1A: "Intro. To Microscale Lab" & Exp. 2A-D: "Solubility" (Pages: 1-21)	3, 4, 5 10	2/9
4	2/10	GC worksheet (Blackboard)	22	2/16
5	2/17	Exp. 3A, 3C, 3D: "Crystallization" (Pages: 22-33)	6, 8, 9, 11	2/23
6	2/24	IR worksheet (Blackboard)	25	3/2
7	3/3	<u>Quiz 1 (Available from 6:00 AM to 11:59 PM)</u> Essay: "Identification of Drugs" and Exp. 12: "TLC Analysis of Analgesic Drugs" (Pages: 57-64)	19, 20	3/9
8	3/10	No Lab - Instructional Break		
9	3/17	Proton NMR worksheet (Blackboard)	26	3/23
10	3/24	Exp. 4A, 4C, 4D: "Extraction" (Pages: 34-43)	12	3/30
11	3/31	C-13 NMR worksheet (Blackboard)	27	4/6
12	4/7	<u>Quiz 2 (Available from 6:00 AM to 11:59 PM)</u> Exp. 8B: "Simple and Fractional Distillation" (Pages: 48-55) Check-out	7, 14, 15	4/13
13	4/14	Mass Spectrometry Worksheet (Blackboard)	28	4/20
14	4/21	S _N 2 Reactions of Alkyl Halides (Virtual Lab on Blackboard)		4/27
15	4/28	<u>FINAL EXAMINATION (Available from 6:00 AM to 11:59 PM)</u>		



CHEM 2460 – Organic Chemistry Laboratory I

Group B Lab Schedule

Please note that this schedule is tentative, and the lab coordinator may adjust it as needed.

<u>Week</u>	<u>Dates</u>	<u>Activities</u>	<u>Techniques</u> <u>(Assigned Reading)</u>	<u>Assignment</u> <u>Due Date</u>
1	1/20	UV-Vis Worksheet (Blackboard)		1/26
2	1/27	Check-in Policies and Procedures Safety Quiz and Discussion (Blackboard)	1	2/2 2/2
3	2/3	GC worksheet (Blackboard)	22	2/9
4	2/10	Exp. 1A: "Intro. To Microscale Lab" & Exp. 2A-D: "Solubility" (Pages: 1-21)	3, 4, 5 10	2/16
5	2/17	IR worksheet (Blackboard)	25	2/23
6	2/24	Exp. 3A, 3C, 3D: "Crystallization" (Pages: 22-33)	6, 8, 9, 11	3/2
7	3/3	<u>Quiz 1 (Available from 6:00 AM to 11:59 PM)</u> Proton NMR worksheet (Blackboard)	26	3/9
8	3/10	No Lab - Instructional Break		
9	3/17	Essay: "Identification of Drugs" and Exp. 12: "TLC Analysis of Analgesic Drugs" (Pages: 57-64)	19, 20	3/23
10	3/24	C-13 NMR worksheet (Blackboard)	27	3/30
11	3/31	Exp. 4A, 4C, 4D: "Extraction" (Pages: 34-43)	12	4/6
12	4/7	<u>Quiz 2 (Available from 6:00 AM to 11:59 PM)</u> Mass Spectrometry Worksheet (Blackboard)	28	4/13
13	4/14	Exp. 8B: "Simple and Fractional Distillation" (Pages: 48-55) Check-out	7, 14, 15	4/20
14	4/21	S _N 2 Reactions of Alkyl Halides (Virtual Lab on Blackboard)		4/27
15	4/28	<u>FINAL EXAMINATION (Available from 6:00 AM to 11:59 PM)</u>		