



CHEM2490 Synthesis and Identification of Organic Compounds

Spring 2021

The University of Toledo

Department of Chemistry & Biochemistry

College of Natural Sciences & Mathematics

CRN: 24295 (Sec. 1) and 24296 (Sec. 2) or 24301 (Sec. 4), or 24298 (Sec. 91) and 24299 (Sec. 92) or 24303 (Sec. 94)

Name:	Dr. Joseph Schmidt	Class Location:	SM 2100
Email:	joseph.schmidt@utoledo.edu	Class Day/Time:	T 11:30-12:25
Office Hours:	Online only (by appointment)	Lab Location:	BO 3097
Office Location:	WO 3277	Lab Day/Time:	TR 1:00-3:50PM or MW 1:00-3:50PM
Office Phone:	419-530-1512	Credit Hours:	2

CATALOG/COURSE DESCRIPTION

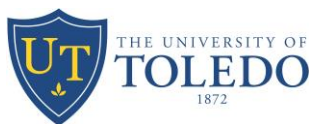
Practice of organic laboratory techniques. Three hours of laboratory per lab session, twice a week. Approved chemical safety goggles meeting the American National Standard Z87.1-1968 must be worn by every student during every laboratory class meeting.

COURSE OVERVIEW

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 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:

- *Demonstrate their knowledge of departmental safety rules through their laboratory practice, including the ability to dispose of waste properly.*
- *Apply basic stoichiometric algorithms (calculating limiting reagents, theoretical yield, mole ratios) in the context of organic chemistry.*
- *Demonstrate a command of the rules for assigning significant figures in their work, specifically in calculations and laboratory measurements and calculations.*
- *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.*
- *Know the significance of pK_a values in experimental steps.*
- *Identify and assess the purity of organic compounds using analytical techniques, including melting point, thin-layer chromatography, IR, and gas chromatography.*
- *Deduce organic structures using spectroscopic methods, including infrared (IR), ^1H - and ^{13}C -nuclear magnetic resonance spectroscopy, and mass spectrometry.*
- *Determine molecular formulas from a mass spectrum by using the Rule of 13 and other techniques.*
- *Deduce hydrogen deficiency from a molecular formula and use this information to help deduce a structure.*
- *Be able to follow a detailed experimental procedure and construct a flow diagram to illustrate it.*
- *Depict and explain detailed chemical mechanisms for all laboratory reactions (and their related reactions).*
- *Demonstrate the ability to maintain a properly laboratory notebook.*
- *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) as well as Organic Chemistry I (CHEM 2410/2480) with a grade of C- or better, as well as having declared chemistry or biochemistry as a major. Students also are required to be concurrently enrolled in (or have successfully passed) Organic Chemistry II lecture (CHEM 2420). A student, registered for both CHEM 2420 and 2490 concurrently, who is intending to drop/withdrawal from the lecture course by mid-semester (in first 8 weeks) must also drop the associated lab course. A student withdrawing from the lecture during the last weeks of allowed withdrawal (weeks 9-10) may be allowed to finish the lab course if they have a grade of C or better in the lab and permission of the lab instructor.

REQUIRED INSTRUCTIONAL MATERIALS (TEXTS AND ANCILLARY MATERIALS)

A. Required Materials:

- 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)
- Lab manual will be posted through Blackboard – courtesy of Prof. Michael Young!!



UNIVERSITY POLICIES

Policy Statement on Non-Discrimination on the basis of Disability (ADA): The University is an equal opportunity educational institution. Please read [The University's Policy Statement on Nondiscrimination on the Basis of Disability Americans with Disability Act Compliance](#).

ACADEMIC ACCOMODATIONS

The University of Toledo is committed to providing equal access to education for all students. If you have a documented disability or you believe you have a disability and would like information regarding academic accommodations/adjustments in this course please contact the [Student Disability Services Office](#).

COURSE EXPECTATIONS

You are expected to come to both the lectures and labs on time. Failure to attend the prelab lecture will lead to your being excluded from the lab for that particular day. You are expected to come to each lab, and there will be pre-lab assignments which must be complete before you will be allowed to participate in the lab.

COURSE STRUCTURE

Lecture

- *Lecture sessions are designed to clarify the concepts covered in the lab, as well as give an overview of techniques that will be used in the lab.*
- *Attendance is expected: The labs are only 3 hours in duration, so these lectures will be where you learn everything that you'll need.*
- *Lab exercises will be available on Blackboard for each week.*
- *Please be considerate of your fellow students during the lecture period. Disruptions of any kind will not be tolerated and may result in expulsion from the classroom.*

Laboratory

- *Labs will be principally conducted by your TA, with assistance from myself (Prof. Schmidt), as well as Dr. Yong-Wah Kim or the NMR TA (Vinod Gattoji), although you should be relatively independent with NMR usage this semester.*
- *You will be required to have appropriate clothing before being allowed to enter the lab.*
- *Prelabs are due prior to the beginning of the lab, and results and postlabs are due approximately 1 week after completion of the experiment! All deadlines will be noted on the Blackboard site for this course.*
- *You will be expected to adhere to all of the lab safety rules.*
- *You are all expected to do your part to maintain a clean lab environment as part of GLP (Good Lab Practices):*
 - *All reagent and solvent bottles should be completely closed immediately after use;*
 - *All spills and dribbles should be cleaned immediately;*
 - *All glassware should be put away at the end of the lab, and walkways should be kept free of debris.*
 - *Failure to adhere to these rules will lead to punitive measures in the form of lost points as decided by your TA!*



- Your TA will regularly ensure that you know what you're doing – Failure to adequately comprehend the lab may also lead to punitive measures in the form of lost points, so pay attention during pre-lab lectures!

Blackboard

- Blackboard is a course management system provided by the University of Toledo and can be accessed at <https://blackboard.utdl.edu/> . Your access code is your UTAD user name and password.
- You should consult the site regularly for news and announcements. Handouts, lecture notes, and lab experiments will be posted. The system also permits you to check your grades at any time and to email your instructor or other students in the class.

Inclement Weather Policy

If classes are cancelled on a lab day, lab will proceed at the next scheduled meeting. We will adjust the experiments to adjust for the reduced availability of lab time. If both portions of a lab are cancelled, your grade will be determined based on the labs we have been able to complete.

Lab Absence Policies

Refer to UT Missed Class Policy

(<https://www.utoledo.edu/policies/academic/undergraduate/pdfs/3364-71-14%20Missed%20class%20policy.pdf>).

Communication

You are urged to communicate with Prof. Schmidt or the Teaching Assistant (Pratibha or Leart) about any aspect of the course which concerns you or which might limit your success. We want you to be successful in this course, so let's work together!

Chemistry Help Center

The Chemistry Help Center is where the teaching assistants hold their office hours so it is a great place to receive assistance. Due to Covid-19 restrictions, the Help Center will be virtual this semester. The Help Center will be staffed starting January 25, MW 9-12, 1-4, 5-8; TR 9-8; and F 9-4; until the end of classes. No appointment is necessary.

<https://us.bbcollab.com/guest/80670d8c3ff9469dbb520091a0612503>



OVERVIEW OF COURSE GRADE ASSIGNMENT

Course Points:

The following is the distribution of possible points in the course:

Lab Notebook and Reports (50 pts/lab)	500 pts 58.8 %
CURE Lab	200 pts 23.5 %
Lab Final (April 27 th , Lecture Time, SM 2100)	100 pts 11.8 %
Lab Cleanliness	<u>50 pts 5.9 %</u>

Total: 850 pts

FORMAT FOR LABORATORY NOTEBOOK REPORTS

Keeping an accurate laboratory notebook is essential to your success in this class. Some guidelines are given below:

- The laboratory notebook **must not** be loose leaf or spiral bound. Lab notebooks are available from the campus bookstore and are designed so that they permanently contain the original pages of your Prelab and Postlab reports.
- Use permanent blue or black ink only (ballpoint pen, NO red ink!).
- Other textbooks, lab manuals, loose sheets of paper, iPads or cellphones are not allowed in the laboratory. The complete outline of procedures must be written in your laboratory notebook prior to performing the experiment.
- **Copies** of your lab notebook pages are required for grading. The assigned notebooks are designed so that the carbon copies can be removed and handed in to your TA.
- Your TA may periodically inspect your notebook.

YOUR LAB REPORT CONSISTS OF THREE (3) PARTS

Part I - Prelab Report. A copy of your lab notebook pages containing the lab write-up and answers to any prelab questions. This is due in advance of each experiment.

Part II - Results. A copy of your notebook pages containing observations noted during the lab experiment. Is due with **Part III** one week from the conclusion of the experiment.

Part III - Postlab Report. A summary of results and answers to postlab questions. This can be written on separate loose-leaf paper. Is due with **Part II** one week from the conclusion of the experiment.

I. PRELAB REPORT (30% of the report grade)

The initial part of your lab report must be written in your laboratory notebook. A copy of the original pages of this report will be collected prior to the experiment and will be returned to you after the whole lab is graded. It will consist of:

- Your name, lab section and the name of your TA (on each page) (-1 pt if it isn't done).
- The title and number of the experiment (-1 pt if it isn't done).
- Objectives. This should include hypotheses about the outcome of the lab, which you will test by experiment. ***It is your responsibility to propose what you expect to determine from each experiment.*** (2 pts).
- Prelab question answers. These will always require an analysis of the hazards and risks associated with the experiment. It will also include the list of chemicals: masses or volumes, structures, and amounts. Look up molecular masses and calculate the material amount in moles (if appropriate), boiling/melting points (bp/mp, if appropriate) and density (if appropriate). Your prelab will suggest what is needed in the *Reagent Table*. (11 pts)
- List of equipment (sketch complex apparatus). (1 pt)



- Outline of procedure. This must be sufficiently detailed to allow you to perform the experiment. Make sure you note any necessary safety precautions. (1 pt).

The copy pages of this report must be handed in BEFORE you begin the experiment.

II. RESULTS (10% of the report grade)

This section should be started on a fresh page of your notebook, after the prelab report. A combined copy of the Results/Postlab report will be stapled and turned in to your TA after the experiment is complete.

This section should be completed **during** the lab session and consists of:

- a) Your name, lab section and the name of your TA (on each page). (-1 pt if it isn't done)
- b) The title and number of the experiment. (-1 pt if it isn't done)
- c) Results: Date, times, measured masses and volumes used in the experiment (if you use different amounts from the procedure, note this), measured mp/bp of your products and any other observations (color changes, etc) recorded during the lab session. (1-2 pts, as appropriate)
- d) Characterization materials: include copies of *labeled* spectra, etc., recorded during the lab session. (0-4 pts, as appropriate)

III. POSTLAB REPORT (60% of the report grade)

This section does not need to be written in your lab notebook - it can be written on separate loose leaf sheets and stapled to your results copy pages. It is to be completed **after** the lab period at home, and consists of:

- Your name, lab section and the name of your TA (on each page). (-1 pt if it isn't done)
- The title and number of the experiment. (-1 pt if it isn't done)
- Analysis of results: In 5-15 sentences, comment on the outcome of your experiment, notably the quality of your results. Describe problems that may have occurred and possible solutions. If there was any deviation from what you expected, explain how and why did the outcome differ from that predicted in your prelab report? What was learned from the experiment? (5-20 pts, as appropriate)
- Answers to postlab questions, including labelling of spectral characterization. (5-20 pts, as appropriate)

Staple Parts II and III together and turn into your TA at the beginning of the next week's lab session. You should keep a copy of Part III for yourself.

Midterm Grading

Midterm grading serves as a point in the term where the instructor of record may provide a midterm grade assessment and may identify any student who has never attended, has stopped attending, or who is not actively participating in the course. In addition, students may use midterm grade to help make a decision in regards to withdrawing from the course.

The U.S. Department of Education requires the University to document both active participation and satisfactory academic progress as part of the compliance with federal financial aid regulations. Students receiving Title IV Federal Aid funds are required to have regular attendance and satisfactory academic progress in their courses to receive federal aid.

Final Grading

Your final grades will be calculated based on a total of 850 points.



Grade Scale These are the minimum percentages (points) needed to receive the indicated grade:

A	90% (765)	A–	87% (739.5)	B+	84% (714)	B	81% (688.5)
B–	78% (663)	C+	75% (637.5)	C	72% (612)	C–	69% (586.5)
D+	66% (561)	D	63% (535.5)	D–	60% (510)		

Drop, Withdrawal and Incomplete Grades

- *Course drop and withdrawal procedures have been set by the University faculty. Dropped courses do not appear on your transcript. If you are in a course after that date, there will be a grade on your transcript (A-F, W, or Incomplete). The deadline for dropping is **Feb. 2nd**.*
- *You may withdraw from the course and receive a grade of **W**. W's do not affect your GPA. For both dropping the course or withdrawing you should go to the Registrar's Office in Rocket Hall. You do not need your instructor's permission for either process. Please note that course registration changes might change your **financial aid**. The deadline for withdrawal is the end of the 10th week, **March 26th**.*
- *A student, registered for both CHEM 2420 and 2490 concurrently, who is intending to drop/withdrawal from the lecture course by mid-semester (in first 8 weeks) must also drop the associated lab course. A student withdrawing from the lecture during the last weeks of allowed withdrawal (weeks 9-10) may be allowed to finish the lab course if they have a grade of C or better in the lab and permission of the lab instructor.*
- *A course grade of **Incomplete** is given only to those who have completed all but a small percentage of course requirements for an acceptable reason.*

Attendance/Class Participation

On two occasions during the term, instructors are asked to report student attendance. However, you will remain enrolled in the class independent of these reports. That is, you remain registered for the class and will receive a final grade unless you take the action of dropping or withdrawing.



SPECIAL COURSE EXPECTATIONS DURING COVID-19

ATTENDANCE

The University of Toledo has a missed class policy. It is important that students and instructors discuss attendance requirements for the course. Students must perform a daily health assessment, based on [CDC guidelines](#), before coming to campus each day, which includes taking their temperature. Students who are symptomatic/sick should not come to class and should contact the Main Campus Health Center at 419-530-3451. Absences due to COVID-19 quarantine or isolation requirements are considered excused absences. Students should notify their instructors and these absences may not require written notice.

FACE COVERINGS

All students must wear face coverings while on campus, except while eating, alone in an enclosed space, or outdoors practicing social distancing. NO students will be permitted in class without a face covering. 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), you should submit a request for an accommodation through the Student Disability Services Office (SDS) by completing the [online application](#). Students will need to provide documentation that verifies their health condition or disability and supports the need for accommodations. If a student is already affiliated with SDS and would like to request additional accommodations due to the impact of COVID-19, they should contact their accessibility specialist to discuss their specific needs.

SOCIAL DISTANCING

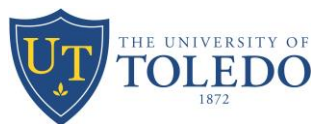
Students should practice social distancing inside and outside the classroom. Please follow signage and pay attention to the seating arrangements. Do not remove stickers or tape from seats and/or tables; this is there to provide guidance on the appropriate classroom capacity based on the recommended 6 feet of social distancing between individuals. Please be conscious of your personal space and respectful of others. Also be cognizant of how you enter and exit the room; always try to maintain at least 6 feet of distance between yourself and others.

DESKS AND WORK SPACES

Students will need to sanitize their desks and/or work space before class with the University provided sanitizing spray and paper towels.

SPECIAL NOTES

It's 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. I also ask that you keep me informed of concerns you may have about class, completing course work/assignments timely, and/or health concerns related to COVID.



IMPORTANT COVID-19 SPECIFIC RULES FOR OUR CLASS

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.

- For the lecture portion, seats in SM 2100 will be clearly marked as seats to be used or not. Please choose a seat that is marked to be used. We will create a seating chart, and you are asked to sit in the same seat every week. This is important in case anyone in our class should be exposed to a Covid-infected person, as it will determine exposure for contact tracing.
- 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.
- We recommend that you bring a spare mask to lab in case yours gets exposed to chemicals by accidental touching etc.
- Backpack storage cubicles will be marked with hood and group numbers. You will be assigned a specific cubicle that you must use every time you are in the lab.
- The maximum number of students that can work in BO 3097 at a given time is 8, as we need to limit the lab to 1 student per hood. Each section will be split into groups A and B.
- When you arrive at the lab, wash your hands with water and soap, and put on gloves. There will be paper towels sprayed with ethanol that you should use to wipe your cubicle and your work area. 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.
- The lab doors will be a "one-way", where one door serves as entrance and the other serves as exit.
- 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 symptoms – do not attend lecture or lab. Virtual materials will be made available, 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.