Organic Chemistry II Laboratory
The University of Toledo
College of Natural Sciences and Mathematics
CHEM 2470 – All Sections

Instructor: Dr. John Payton
Office Hours: T & Th 1-3pm & W 2-3pm
or by appointment
Office Location: BO 2034
Office Phone: (419) 530-4591
Email: john.payton@utoledo.edu

Term: Spring 2018
Lab Location/Times: Multiple areas/times
Course Website: http://dl.utoledo.edu
Instructor’s Website: N/A
Credit Hours: 1

COURSE/CATALOG DESCRIPTION
Practice of organic laboratory techniques. Four hours of laboratory per 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 (CHEM 2470 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 Rf values

COURSE OBJECTIVES & 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), $^1$H- 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.

TEACHING STRATEGIES
This face-to-face course is designed to stimulate student learning though the delivery of readings, in-course lectures, and performance of experiments.

PREREQUISITES
Students must have completed Organic Chemistry I (2410) and its lab course (2460 or 2480) and either be enrolled (or have finished) CHEM 2420: Organic Chemistry II. Please note that withdrawal from CHEM 2420 during the semester will necessitate withdrawal from CHEM 2470.

REQUIRED TEXTS AND MATERIALS
The following materials are required for this course:
  ISBN: 9781337458214
- A laboratory notebook with carbon(less) pages
- Approved safety goggles (can be purchased from the UT bookstore or from the UT-ACS group).

TECHNOLOGY REQUIREMENTS
Most activities in this course will be done through your lab manual and your lab notebook. There may be a few times in the semester where the lab coordinator will send materials to you, either through Blackboard or via your Rockets email address. It is your responsibility to check both places on a regular basis.
GRADING POLICIES
The grade for this course is based upon the following components:

- Laboratory reports: 9 @ 50 pts each 450 points
- Spectroscopy problems: 4 @ 20 points each 80 points
- Combined Spectroscopy problems 60 points
- Quizzes 2 @ 100 points each 200 points
- Safety Quiz/Video 15 points
- Samples 9 @ 5 points each 45 points
- Technique points 9 @ 5 points each 45 points
- Final Examination 150 points

Total Points 1045 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.

Notebook: The most important part of a chemistry laboratory is the notebook, and this is reflected in the points assigned to the notebook. A handout entailing what is expected in the laboratory notebook will be available on Blackboard. In general, lab reports will be due one week after performing the lab. Late assignments will receive a 5 point grade deduction for each day late. Any assignment over 1 week late will receive a zero (0) grade.

Spectroscopy Problems: Spectroscopy problems can be found in the back of your manual. The page numbers are stated in the schedule. You will turn in the assignments about a week after they are assigned according to the syllabus (See Class Schedule at the end). Late assignments will receive a 2 point grade deduction for each day late. Any assignment over 1 week late will receive a zero (0) grade.

Quizzes and Final Examination: Two quizzes and a final examination will be given in class. The dates are as follows (please note that these dates correspond to the Monday of the week of labs, you will take the quiz in your normal lab period that same week):

<table>
<thead>
<tr>
<th>Quiz</th>
<th>Date and Week</th>
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<tbody>
<tr>
<td>Quiz 1</td>
<td>Feb. 12th – 16th (Week 5)</td>
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<tr>
<td>Quiz 2</td>
<td>Apr. 9th – 13th (Week 13)</td>
</tr>
<tr>
<td>Final Examination</td>
<td>Apr. 23rd – 27th (Week 15)</td>
</tr>
</tbody>
</table>

The quizzes will be brief and will consist primarily of short answer/essay questions. The final exam will have both a standardized (multiple choice) and subjective (essay, short answer) sections (however, this is subject to change). Safety procedures, techniques, historical background of experiments, overall concepts, calculations, and any spectral methods are potential quiz and final material.
If you miss a quiz or the final exam, and have an excused absence with documentation notify the Dr. Beres as soon as possible so that possible alternative arrangements can be made. The final examination will be cumulative over all labs and readings.

**Samples:** All samples must be shown to the teaching assistant and signed off on. The TA will also record the following data on a product sheet; please make sure you have this information ready for them: percent yield and/or recovery, physical description, and purity. The melting point range or boiling point range listed on the product sheet should be the value you measured, not the value listed in the textbook or any other reference book.

**Technique:** Technique points are determined by the TA and laboratory coordinator. Components of the technique score include laboratory safety, attitude, demonstration of competent lab techniques, ability to perform routine tasks in a timely manner, and neatness of lab drawer, work area, shared equipment, and chemicals. If the lab is found to be messy at the end of the lab period, either by the laboratory coordinator, TA, or the chemistry stockroom, the entire class will lose technique points.

**COURSE POLICIES**

**Laboratory Attendance Policy:** Attendance is MANDATORY. Due to the sheer number of students and sections, no make-up laboratory experiments will be permitted except under extreme circumstances as determined by the laboratory coordinator (Dr. Payton).

If you know *in advance* that you will miss a lab session, you must let the laboratory coordinator know before the absence, every effort will be made to find an alternative lab for you to complete. You must fill out the excused absence form on Blackboard and submit it to the laboratory coordinator with documentation. Any kind of absence requires a valid excuse (i.e., written medical documentation). Any unexcused absence will result in a score of zero for all assignments for that day (including samples, lab report(s), and/or quiz). All documentation for excused absences must be presented to the laboratory coordinator within 7 days of missing the lab. Consult the 2016-2017 UT Catalogue for the definitions of what an excused and unexcused absence is.

If you are more than 20 minutes late for a laboratory session, you will not be permitted to attend that session. During the first 20 minutes, your TA (and/or I) will cover the basic information necessary to complete that day’s experiment, safety issues, precautions, and locations of chemicals and other materials. After the experiment has begun, for safety purposes, your TA needs to be working with all students, not covering the information for those students who are late. Therefore, if you are more than 20 minutes late, you will not be permitted to attend the laboratory and it will be counted as an unexcused absence. In this event, you are encouraged to obtain the missed information from other students in the laboratory, but you will not be permitted to submit laboratory reports for sessions in which you were counted absent.

**Safety Requirements:** There will be another document (provided by the Chemistry Stockroom) 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.). If students are wearing inappropriate clothing, they will be asked to leave class in order to change their clothes.
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 handout from the UT Chemistry Stockroom 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 “Student Evaluation” 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.

**Student Responsibilities:** The following are items that I ask of all students who take any of my lab courses to do:
1. Read the laboratory assignment and appropriate lecture material prior to each laboratory session. It is required that a laboratory notebook be kept to record observations and experimental results.
2. Be on time and use the full laboratory period.
3. Ask questions and participate in each activity.
4. Turn in all work as assigned.
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 to the proper areas. Check the sink to be sure that it is clear of all glassware and trash.

**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 and I will re-grade the assignment – not your TA. Please remember that there is a two-week window (after you have received your graded assignment back from your TA) in which you can contest the grading of an assignment, lab report, or quiz.

**Academic Dishonesty:** The academic honesty policies, as stated in the 2016-2017 UT Catalogue will be STRICTLY ENFORCED. Any student found violating the UT academic honesty policies – including (but not limited to) copying from someone else’s laboratory notebook, falsifying documents, plagiarism, will be penalized in accordance with these policies.

**Drop, Withdrawal, and Incomplete Grades:** Course drop and withdrawal procedures have been set by the University faculty. Pay attention to those add/drop dates as they pass very quickly during the semester! For both dropping the course or withdrawing you should go to Rocket Solution Central 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. 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. Remember that if you drop CHEM 2420, you must drop CHEM 2470.

**Special Needs:** The University is an equal opportunity educational institution. If you have special needs with respect to your participation in this course, please make an appointment to discuss this matter with the laboratory coordinator. The lab coordinator will work with you and the Office of Accessibility to make appropriate accommodations for your needs.

**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 hours for a reply from Dr. Payton or your TA. Do not anticipate a response over weekends or holidays. We want you to be successful in this course so let’s work together!
# CHEM 2470 – Organic Chemistry Laboratory II
## Class Schedule

**Schedule for All Lab.** Please note that this schedule is tentative and may change.

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Activities</th>
<th>Reading Assignment</th>
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<tbody>
<tr>
<td>1</td>
<td>1/16-1/19</td>
<td>Introduction/Safety; check-in; NMR lecture</td>
<td>Blackboard</td>
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<tr>
<td></td>
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<td><strong>Assign:</strong> $^1$H-NMR Spectroscopy</td>
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<tr>
<td>2</td>
<td>1/22-1/26</td>
<td>Lab 1 – “An Oxidation Puzzle”</td>
<td>1-4</td>
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<td><strong>Assign:</strong> <em>Molecular Formulae</em></td>
<td>Blackboard</td>
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<td></td>
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<td><strong>DUE:</strong> $^1$H-NMR Spectroscopy</td>
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<tr>
<td>3</td>
<td>1/29-2/2</td>
<td>Lab 2 &amp; 3 – “Preparation and Properties of Polymers”</td>
<td>5-22</td>
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<td><strong>DUE:</strong> <em>Molecular Formulae</em></td>
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<tr>
<td>4</td>
<td>2/5-2/9</td>
<td>Lab 4 – “Preparation of a C-4 or C-5 Acetate Ester”</td>
<td>23-26</td>
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<tr>
<td>5</td>
<td>2/12-2/16</td>
<td><strong>QUIZ I</strong> &amp; Workday: Spectroscopy</td>
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<td><strong>Assign:</strong> $^{13}$C-NMR Spectroscopy</td>
<td>Blackboard</td>
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<td><strong>Assign:</strong> Mass Spectrometry</td>
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<td><strong>Assign:</strong> Combined Spectra Problems</td>
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<tr>
<td>6</td>
<td>2/19-2/23</td>
<td>Lab 5 B – Benzoic Acid (&amp; Ph-MgBr)</td>
<td>27-38</td>
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<td><strong>DUE:</strong> $^{13}$C-NMR Spectroscopy</td>
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<tr>
<td>7</td>
<td>2/26-3/2</td>
<td>Lab 5 B – Benzoic Acid (con’t)</td>
<td>27-38</td>
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<td><strong>DUE:</strong> Mass Spectrometry</td>
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<td>8</td>
<td>3/5-3/9</td>
<td><strong>NO CLASSES – Spring Break!</strong></td>
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<tr>
<td>9</td>
<td>3/12-3/16</td>
<td>Lab 6 – The Investigation of the Mechanism</td>
<td>39-42</td>
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<td><strong>DUE:</strong> Combined Spectra Problems</td>
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<tr>
<td>11</td>
<td>3/26-3/30</td>
<td>Lab 7 – “Preparation of an α,β-Unsaturated Ketone”</td>
<td>49-54</td>
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<tr>
<td>12</td>
<td>4/2-4/6</td>
<td>Lab 7 – (con’t)</td>
<td>49-54</td>
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<td><strong>QUIZ II</strong></td>
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<tr>
<td>14</td>
<td>4/16-4/20</td>
<td>Lab 8 A – “Biodiesel”; <strong>Check-out</strong></td>
<td>59-70</td>
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<tr>
<td>15</td>
<td>4/23-4/27</td>
<td><strong>FINAL EXAMINATION</strong></td>
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