**Organic Chemistry II Laboratory - Chem 2325 Syllabus – Spring 2013**

INSTRUCTOR: Holly Sebahar, Ph.D. Room: 1340 HEB Email: holly.sebahar@utah.edu

COURSE DESCRIPTION: The purpose of the laboratory is to give students hands on experience with the scientific method, teach critical thinking and writing skill as well as important techniques to prepare students for advanced work in chemistry and related science and engineering fields, review concepts learned in lecture, and to *introduce* certain concepts that are well-suited to hands-on discovery.

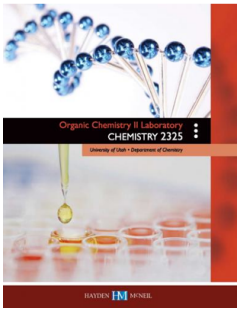
EXPECTED LEARNING OUTCOMES: Students that successfully complete this course should be able to:

- Calculate limiting reagent, theoretical yield, and percent yield.
- Engage in safe laboratory practices by handling laboratory glassware, equipment, and chemical reagents appropriately.
- Dispose of chemicals in a safe and responsible manner.
- Work effectively as a member of a team. Communicate productively with lab mates, teaching assistant and instructor.
- Maintain a detailed scientific notebook.
- Use the scientific method to create, test, and evaluate a hypothesis.
- Characterize products by physical and spectroscopic means including mp, IR, NMR, GC, and MS.
- Consult the scientific literature for physical data and experimental procedures.
- Perform common laboratory techniques including reflux, distillation, recrystallization, vacuum filtration, and thin-layer chromatography. Create and carry out work up and separation procedures.
- Critically evaluate data collected to determine the identity, purity, and percent yield of products and to summarize findings in writing in a clear and concise manner.
- Predict the outcome of several common organic reactions using a basic understanding of the general reactivity of functional groups and mechanism.

LECTURES: Thursdays 9:40-10:30am and 12:55 pm-1:45 pm, HEB 2008. You may attend either lecture.

PRE, CO-REQUISITES: Chem 2315 must be taken before Chem 2325. Chem 2315 and 2325 may not be taken simultaneously. Chem 2325 **cannot** be taken before Chem 2320.

REQUIRED TEXTS: ***Organic Chemistry II Laboratory, Chemistry 2325***
Authors: W.W. Epstein; Jimmy Lee Seidel; Craig S. Young
Published by Hayden-McNeil, ISBN: 978-0-7380-5330-1




***Customized Lab Record,*** or similar bound notebook with carbon copies
Published by Hayden-McNeil
You may use the end of your lab notebook from Chem 2315. Notebooks will be sold after lectures the first two weeks of class for $12 by the ACS Student Chapter.

OPTIONAL TEXT: ***The Organic Chem Lab Survival Manual (any edition)***
Author: James W. Zubrick

COURSE WEBSITES: **CHEM 2325-001 Spring 2013** This general site is maintained by the instructor. Look here to find the lab syllabus, announcements from the instructor, and experiments not found in the text.

**CHEM 2325-00X Spring 2013** where X is your section number. This site is maintained by your teaching assistant. Look here to find announcements from your TA and to view your lab grades. You may also email your lab-mates, your teaching assistant, or the instructor from this website.

TEACHING ASSISTANTS: The laboratory teaching assistants have full responsibility and authority in the laboratory. Please respect their authority by being responsible individuals when a request is made. **The TA's mailboxes are located in HEB 1504.** Be sure to put your TA's name on anything you put in the mailbox because many TAs share mailboxes. Always keep a computer copy of your write-ups in case they are lost (and occasionally they are when they are not turned in directly to your TA). You can also e-mail your write-up to your TA, but get a confirmation they received it.

STOCKROOM ATTENDANTS: The stockroom personnel have full responsibility and authority over laboratory and stockroom policies and procedures. Please respect their authority by being responsible individuals when a request is made.

CHECK-IN: Check-in will occur in the first laboratory period. You are required to bring a combination (not key) lock to share with your lab partner (one lock for 2 people), goggles, and one roll of paper towels/group. Your lock combination number will be left with the attendant for emergencies. Failing to bring a lock after the second lab will automatically prevent you from doing any further lab work.

***YOU MUST REGISTER FOR THE LAB SECTION THAT YOU PLAN ON ATTENDING*. NO EXCEPTIONS. As part of the check-in you must be sure to sign the locker assignment sheet in the lab (with the correct number**

**for the lab bench you have selected). <u>If you do not sign the locker assignment sheet, then you are not registered for your lab bench and it may be given to other students registering late.</u>**

LAB ATTIRE: *IMPORTANT!!* For your own safety, the following are required AT ALL TIMES in lab: Goggles, shoes that cover the entire foot, short- or long-sleeved shirt, and pants/shorts/skirt that extend beyond your knee. Please tie back long hair. This means NO sandals, shorts or short skirts, bare midriffs, or open backs. If you come to lab wearing inappropriate clothing you will be sent home. You should change clothes and return as quickly as possible. If a large amount of the lab is missed you will be required to come back at a different time to make it up. We recommend that you keep extra shoes and long pants in your locker.

GLOVE POLICY: Gloves will be required for a select number of experiments this semester. Each student will be provided with one pair of gloves for these experiments. Additional gloves will cost $0.50/pair. Free gloves will be available 15 minutes before class until 30 minutes after class begins in the 4$^{th}$ floor stockroom. You are welcome to buy and bring your own gloves to lab.

RESPONSIBILITY: You are responsible for all information and announcements given **in class**. Announcements will be made at the beginning of lecture. You are also responsible for all information on the **course website** and sent by **email**. Please check the site regularly for updates and important safety information.

GROUP WORK: In lab and in life group work will be required. Learning to work efficiently and amicably is extremely important. In this course you will work closely with a lab partner. It is *imperative* that you treat your lab partner with respect and common courtesy at all times. Personality and scheduling conflicts may arise. However, it is *your* responsibility to maintain open communication with your lab partner so that you can work through potential problems. If your efforts to resolve the issues on your own are unsuccessful, please notify your TA or the lab instructor so that we may help. It is recommended you switch lab partners frequently.

POINT BREAKDOWN:

| | | |
|---|---|---|
| 1) Prelab | 10 x 5 | 50 |
| 2) Observations | 10 x 5 | 50 |
| 2) Lab work | 2 x 50 | 100 |
| 3) Conclusions | (3 x 50) + (1 x 100) | 250 |
| 4) Worksheets | 6 x 50 | 300 |
| 5) Quizzes | 9 x 20 | 180 |
| 6) Clicker points | | 50 |
| TOTAL POINTS POSSIBLE | | 980 |

GRADING: You are expected to complete ten labs. **IF YOU DO NOT COMPLETE AT LEAST EIGHT LABS YOU WILL AUTOMATICALLY FAIL THE COURSE**.

Everyone who conscientiously does all labs with complete write-ups and earns a minimum of 50% of total possible quiz points will receive a passing grade. Failing to complete three or more labs will result in a fail. A missing write-up will be considered equivalent to missing half a lab. Five missing quizzes will also be considered equivalent to missing one lab. Persons who do not take all quizzes, do not have a minimum of 50% of total possible quiz points, do not write full and conscientious conclusions, and do not turn in conclusions on time will receive a C or lower. **TA's may vary slightly in their grading on quizzes and write-ups, so you will be graded only in comparison to other students in your TA's sections, not in any other TA's section.**

Your grades will be available approximately one week after an assignment has been turned in on *your section's* website. Please check your grades early and often to ensure that everything has been entered accurately. IMPORTANT: Please inform the instructor of concerns regarding the grading of lab assignments early in the semester so that the problem can be addressed.

I will determine a grade with and without the clicker points and you will earn the higher of the two grades.

QUIZZES: Quizzes will be given at the <u>beginning of every experiment</u>. The ONE lowest quiz score will be dropped. The quizzes will cover techniques, chemical concepts, mechanisms, safety, common calculations like percent and theoretical yield, and your ability to draw conclusions from data from the previous experiment. Approximately one third to one half of the quiz will cover the pre-lab reading from the current experiment.

Your TA should return your quizzes and conclusions by the following week so that you can learn from your mistakes. *If your work is not returned within two weeks, notify your instructor*.

LAB WORK:

Your lab work will be graded at mid-semester and at the end of the term. At each time you may earn a maximum of 50 points for a total of 100 points. You will earn full credit if you arrive to lab on time, keep your work station clean and containers labeled, come to lab prepared and as a result work efficiently, handle the waste and equipment properly, wear your lab goggles and appropriate lab attire at all times, write observations directly into your notebook as the lab proceeds, work safely, demonstrate high quality lab technique that results in high yields of high purity products. **IMPORTANT: half of your labwork points will be deducted if you dispose of glass, solid or liquid waste**

**improperly. NO CHEMICALS SHOULD BE POURED DOWN THE DRAIN – INCLUDING ACETONE.** The Environmental Protection Agency (EPA) defines acetone as a volatile organic compound which exhibits the flammability characteristic of flash point < 140° F and must therefore be treated as hazardous waste. Rinse your glassware with acetone into a beaker – then dispose of it in the appropriate waste container.

STUDENT RESPONSE SYSTEM:

I highly recommend that you purchase a **Turning Point Response Card XR remote**. This is a response system that allows you to respond to questions I pose during class. You will be graded on your answer and your in-class participation. You will receive 3 points for incorrect answers and 4 points for each correct answer. After dropping your lowest 2 scores, your percentage of points earned versus points possible will be calculated then multiplied by 50 points. Your Response Card Remote will be used every day in class, often within the first two minutes of class, and you are responsible for bringing your remote daily. Register your remote online asap or prior to class 1/17 **at the latest**. If you have not registered by this time you will lose the opportunity to earn clicker points available during class on 1/17.

To register for your remote follow these steps:

- To register your clicker please go to: http://webreg.turningtechnologies.com
- You will need to enter your first and last name, your uNID (IMPORTANT: in the format uXXXXXXX), and your device ID number. This is found on the back of your clicker*, is 6 or 8 characters and contains only numbers 0-9 and letters A-F.* Your email address is optional.
- If you have already registered your clicker for another class successfully you should not need to register again.

You must respond with your own clicker only. Anyone caught inputting answers on another student's clicker will be charged with academic dishonesty. If found guilty all parties involved you will automatically forfeit the full 50 points for the semester may face much more serious consequences. There is no penalty for a few absences during the semester.

MAKE-UP LABS:

Make-up labs are permitted in certain circumstances. **The make-up lab should preferably be done that same week, or at the very latest the following week. No make-up labs can be done later than one week after the normally scheduled time.** Please email your TA if miss lab. If you cannot attend your regular laboratory section for a legitimate reason, please follow the instructions below:

1) First, choose a day and time that you are able to make up the lab. See the lab schedule posted on Canvas for sections times/locations.

2) Download the "Lab Make-up Form" from the general lab website and fill it out.

3) Please ask the stockroom attendant to sign the form upon arrival to lab. They will keep a record of students making up labs during the semester. Recall you are allowed only two make up labs/semester.

4) Report to the lab room at the beginning of lab. Introduce yourself to the TA and join a lab group. **The TA should grade your pre-lab and quiz and sign your notebook pages and the make-up form before your leave the lab.**

5) No later than one week after making up the experiment staple your quiz, lab notebook pages, the conclusion, and the make-up form together and turn the packet into your TA. You may give your assignment to the TA directly or drop it off in their mailbox (HEB 1504). If the assignment is turned in late, penalties will apply.

**You are limited to 2 make-up labs per semester unless you have extraordinary circumstances.**

EQUIPMENT:

You are accountable for the equipment in your organic chemistry locker. On the first day of lab, your teaching assistant will assign a locker to you. Make sure to put a combination lock on the locker as you may be penalized for the replacement of missing items later during the semester. Located inside your equipment locker is a breakage card listing the entire contents of the drawer. At check in, verify all items against the list. If anything is missing, the stockroom attendant will replace the item. During the semester, when you lose or break an item, the stockroom attendant will punch the card next to the item name to indicate that they have replaced the item. At the end of the semester, you may be assessed a grade point penalty based upon any breakage or loss in excess of that amount covered by your special course fee. Be careful with your equipment and do not lose the breakage card.

EXCESSIVE BREAKAGE:

Your laboratory fee is used primarily to cover the cost of chemicals and materials you use during the semester. It also includes a small component for small items in your drawer that are occasionally broken or lost. It does not cover breakage of special, major equipment that is not part of your equipment locker. When doing the experiments part of your assignment is to work carefully without breaking equipment, particularly special equipment. If you do break a major piece of equipment during an experiment, you may lose all 50 labwork points for that period of the semester. Please be extremely careful with the equipment.

CHECK-OUT:

Check-out will occur at the end of the last lab. You are required to clean all your glassware and review the glassware with your TA. The section will also be responsible for cleaning the common areas of the lab. Failure to check out will result in your grade being lowered one level (e.g., an A- to a B+).

NOTEBOOK:

Accurate record keeping is essential to many fields including chemistry. Doctors are required to take accurate, meticulous notes when speaking with patients to guarantee proper medical care; an accountant must keep a carefully detailed record of each transaction to avoid hassle with the IRS; a lawyer's notes must be thorough and complete to avoid misinformation being presented at a trial. Likewise, the lab notebook is a permanent record of a chemist's laboratory activities. Chemists often refer to their notebooks when applying for patents and writing scientific papers, and when formulating conclusions before moving forward with a research project. Additionally, the lab notebook is used as evidence when a company is taken to court. Because of these significant implications it is important to learn data collection techniques that prepare you for your future, regardless of your specific field of study. In chemistry 2325 careful record-keeping will be encouraged and enforced.

The goal when writing in your laboratory notebook should be to write clear enough and with sufficient organization and detail such that someone unfamiliar with the subject would be able to repeat your experiment *exactly* and obtain the same results using only your notebook. The following general guidelines should be followed:

**You are required to purchase the "Customized Lab Record" from the bookstore. This is a carbonless duplicate set laboratory notebook that will allow you to give one copy of your notebook entry to the teaching assistant. **Leave the first two pages of your notebook blank and make a table of contents. **Items A – E constitute the prelab. **The pre-lab must be done before you come to the lab and will be graded by the T.A.** Item F is to be done during the lab and G and H are to be done at home following the lab. ***You will submit your notebook pages and a conclusion one week after performing the experiment*. **Write directly into your notebook – NOT on a separate sheet of paper. Inevitably, the paper will be lost or misplaced. To encourage formation of good habits your TA will sign your notebook pages before you leave lab each day. All procedural information and observations must be recorded at this time. **Write in pen only, NOT pencil. Do not erase or use whiteout. Make corrections by drawing a single line through the mistake. **Write neatly and leave a lot white space! If someone is to repeat your work they have to be able to read it and follow your organization. The use of tables is highly recommended. **Permanently attach any graphs/spectra that are generated to the notebook with staples or tape.

You must follow the format presented below for your notebook entry. It is recommended you use the left side of the page for outlining procedures and the right side for observations. Read section 1.2 in your Techniques manual (the second half of the lab manual) for more information, including guidance in common calculations.

A. **Title**
B. **Reaction (*draw out structures)*.**
**C. Mechanism.** Include the mechanism for each reaction, unless otherwise instructed. Your effort, not accuracy, will be considered as part of the pre-lab points.
D. **Physical data for all reactants used and products produced and solvents** (with literature reference cited) with appropriate precautions (when using dangerous chemicals such as sulfuric acid). Do NOT fill in the amounts used. These should be the actual amounts measured out in lab.
E. **Brief procedure outline** The procedure is usually given in detail in the lab manual. Therefore the procedural *details* can be referenced. For example: See *Organic Chemistry Laboratory Experiments and Techniques* – Experiment Name, page XX for a detailed procedure. **You should still include an outline of the important main points of the procedure in your notebook and be sure to note any changes to the procedure written in the manual.** Rewriting the main steps of the procedure will help you to more fully understand the experiment and what is expected of you. Avoid copying the text of the manual word for word. Write this outline on the left side of your notebook page.
F. **Actual procedure and observations.** Include comments about what occurs during the experiment, like color changes, gas evolution, precipitates, etc. Make sure to write in such a manner that a person attempting to reproduce your experiment can do so without getting verbal instructions from you and can then get identical results to yours. Be sure to write during the lab as you perform the experiment. Also include things that occurred that were not planned and which may or may not influence your results. Note that authentic description of the actual procedure sometimes demands recording the time. Write these observations on the right side of your notebook page.
G. **Calculations**- include important calculations (percent yield, etc).
H. **Discussion and Conclusion.** Summarize briefly your findings (see below for more details).

PRE-LAB:

It is important that you have read the laboratory experiment in advance and are prepared to begin work. It is your responsibility to read the experimental procedure and background information until you understand the details of the experiment. **To assure your advance preparation you are required to submit a pre-lab sheet within the first five minutes of lab, otherwise no credit will be given for the prelab.** This prelab will include sections A-E of the notebook record (see above). You may start work only after your TA has signed the prelab. No work is permitted without writing a prelab.

PHYSICAL CONSTANTS:

Physical constants can be found in the chemical catalogs available in HEB 3102, online at chemfinder.com and in hard copies of the *Merck Index* and the Chemical Rubber Company *Handbook of Chemistry and Physics* in the Science Reserve desk on the fourth floor of the Marriott Library. To find the electronic edition of the *CRC* go to http://www.lib.utah.edu → research tools→ article databases → C (or same route for the electronic edition of the Merck).

CONCLUSIONS:

Your conclusions will be collected at the beginning of the next scheduled lab period. Conclusions 1 - 7 days overdue will be lowered 7 points for each business day they are late. **Conclusions more than 7 business days overdue will not be accepted.** Conclusions for the make-up lab will be due in your TA's mailbox (HEB 1504) one week after you complete the make-up lab.

Conclusions must be written individually, even if the experiment is done with a lab partner. A sample write-up is found on the web page.

**The conclusion should be sufficiently concise so as to not exceed two pages of *text* (reactions, mechanisms and tables are not included in this limit), but it is doubtful you can do an adequate job in much less than two pages. It should be written on a computer, double-spaced.**

In Chem 2325 you will be conducting chemical reactions. It is important that your conclusions **not** include procedural details. **The conclusion should concentrate on "why" and not "what",** should be scientific and objective, and should not include any personal pronouns (I, we). You should begin the write-up by stating the chemical reaction and its mechanism. You may draw these by hand or use the wonderful chemical drawing software, ChemDraw, available to you in HEB 1000. You will be graded on the accuracy and completeness of your mechanism in the final write-up therefore it is important to ask questions during lab if necessary. Explain **why** you did certain important things in the reaction procedure (why was a catalyst or a reflux necessary, why was it necessary to have anhydrous conditions, why was an extraction or recrystallization or cooling necessary, etc). What did some of your observations indicate about the reactions that were occurring? How were impurities, by-products, and unreacted starting materials removed during the work-up?

*Use your results as evidence to tell a story that culminates in your major conclusions. Be sure to evaluate your confidence in the results.* Important note here: any organic chemist can tell you that following a written, published procedure is no guarantee that you will actually get the product you set out to make. **Therefore, treat all products isolated or synthesized as unknowns.** Prove to your TA the true identity of the product(s). Give your percent yield and show how you did your calculation (indicating limiting reagent). Does your data (mp, optical activity, IR, NMR) agree with the accepted (literature) values? Always be sure to include the literature value and reference the source. Discuss the quantity and purity of your product, and do an error analysis on your results if you had problems. Explain the possible sources of a low yield or impurities and what you would do differently if you were to repeat the experiment. You should emphasize concepts in your write-up that were emphasized in the lab lecture. Your TA will also give you an indication each week of important concepts that you should include in your write-up.

If you use a reference for your conclusion, be sure to indicate it. Plagiarism in the conclusion is unethical and will result in a failure on the entire write-up.

For best results on quizzes it is recommended you always do your write-up (or at least a draft of your write-up) before the quiz. Flow sheets will be particularly helpful in your write-ups.

If you have difficulty writing coherent conclusions, ask your TA, the instructor or the University Writing Center for help. The Writing Center is located on the third floor of the Marriott Library. Their phone number is 587-9122 and their website is www.writingcenter.utah.edu/.

ACADEMIC HONESTY:

**All students are expected to act honestly in the course.** By submitting an assignment you are representing that it is your own work and that you have followed the rules associated with the assignment. Any and all cases of suspected academic dishonesty such as cheating, plagiarizing, or misrepresenting one's work will be dealt with severely, in accordance with the Student Code: http://www.admin.utah.edu/ppmanual/8/8-10.html. A few specific guidelines are given below. If you have questions about what is acceptable *please ask!*

- ⇒ All work in the lab notebook must belong to the student alone. It should be completed by the individual and *everything should be in the student's own words*. Each student should record his/her own data *as the experiment progresses* and must complete any analysis individually.
- ⇒ Students are encouraged to discuss results and conclusions to more fully understand the experiment, however all written work (recording of data, observations, etc. in the lab notebook, and all work on reports, etc.) should be done individually, even when working in groups. This means that reports may contain similar ideas, but *everything* should be presented in your own words and formatting.

SYNTHESIS REPORT:

A synthesis report on the two-week Sulfanilamide Experiment will replace the two conclusions for these labs and will be worth 100 points. It should be four pages in length and double-spaced typed. It is necessary to cover both parts of the Sulfanilamide Experiment together because this allows consideration of the entire strategy of the multistep synthesis and the use of protecting groups. It is recommended a draft of the first half of the report be written before the quiz over Sulfanilamide I.

WASH HANDS:

All students are REQUIRED to wash their hands as a safety precaution before leaving the laboratory in case they have accidentally encountered any chemicals.

DISABILITIES:

Any student needing special consideration because of a disability should contact the Center for Disability Services, 162 Union. It is recommended that any student who is pregnant delay taking organic laboratory courses until the pregnancy is complete.

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations.

All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.