Description: This semester, we will continue to focus on learning some of the techniques necessary to do experimental and synthetic organic chemistry. The experiments performed will follow the material we cover in class, when possible.

Goals: 1) To become familiar with and competent in the various laboratory techniques;
2) To understand how the experiments relate to the concepts covered in the lecture.

Laboratory manual: Pavia, Lampman, Kriz, and Engel. Introduction to Organic Laboratory Techniques, A Microscale Approach, 3rd ed. Reference books you may find useful include The Merck Index and The CRC Handbook of Chemistry and Physics (available in the reference section of the library) and an Aldrich catalogue (on reserve in the library). You will also need a laboratory notebook with pre-numbered duplicate white/yellow pages (available in the bookstore).

Evaluation: The final grade will be based on the lab reports. Your laboratory work and reports must be your own and are to be pledged. Note that although the lab reports are short, we expect high-quality work, so do spend some time in getting your report to be as good as possible. Although it’s okay to discuss the concepts covered in the labs with your classmates, you may not show your completed report to another person nor just tell them an answer. Remember, the answers to the questions are the basis for the laboratory evaluation. The grading scale is:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>(100-93%)</td>
</tr>
<tr>
<td>A-</td>
<td>(92-90%)</td>
</tr>
<tr>
<td>B+</td>
<td>(89-87%)</td>
</tr>
<tr>
<td>B</td>
<td>(86-83%)</td>
</tr>
<tr>
<td>B-</td>
<td>(82-80%)</td>
</tr>
<tr>
<td>C+</td>
<td>(79-77%)</td>
</tr>
<tr>
<td>C</td>
<td>(76-73%)</td>
</tr>
<tr>
<td>C-</td>
<td>(72-70%)</td>
</tr>
<tr>
<td>D+</td>
<td>(69-63%)</td>
</tr>
<tr>
<td>D</td>
<td>(62-56%)</td>
</tr>
<tr>
<td>D-</td>
<td>(55-50%)</td>
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</tbody>
</table>

Policies: Lab will begin with a short lecture covering the scope of the experiment. Therefore, you must be prepared when you come to lab. I expect you to have read and understood the material before you get there. The pre-lab report is to be turned in at the very beginning of the lab lecture (1:00 p.m.) on the day that lab is to be done. You will not be admitted to the lab without a completed pre-lab report. The lab write-up is due at the beginning of the lab lecture (1:00 p.m.) in the week following completion of the experiment. Tardiness of either report will result in a lowered grade for the report (10%/week for a maximum penalty of 40%). You must have done the lab to receive credit for a lab report. Please check with an instructor before you
You may NEVER work alone in the lab!!

Lab Reports: In general, your report should be well-written such that another scientist could understand and reproduce what you did. Please write in ink, and put your name on every page. Mistakes are removed by drawing a solid line through them, not by using white-out. The lab report will be graded according to the following outline, with the pre-lab and procedure sections contributing 25 points each and the final write-up accounting for the remaining 50 points. All complete write-ups should include the original data you collected during the lab.

Outline for Lab Reports:

I. Pre-lab (a copy of this will be turned in before the lab begins):
   i. Title of lab.
   ii. Purpose- a brief statement will usually suffice. What technique and/or concept is being studied?
   iii. Reaction to be performed. Include a detailed mechanism.
   iv. Table of Reagents- make a table listing the reagents you'll be using, such as the following:

<table>
<thead>
<tr>
<th>Compound</th>
<th>Mol. Weight</th>
<th>Amount used</th>
<th># mMols</th>
<th>m.p. or b.p.</th>
<th>Density/other data</th>
<th>Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starting material</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>if necess.</td>
<td>if necess.</td>
<td>x</td>
</tr>
<tr>
<td>Reagent</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>if necess.</td>
<td>if necess.</td>
<td>x</td>
</tr>
<tr>
<td>Product</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td>if necess.</td>
<td>x</td>
</tr>
<tr>
<td>Solvent</td>
<td>(expected)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

   An "x" indicates that this column should be filled in; an "if necess." should only be filled in if the data is needed to calculate the amounts you'll need. Note that the table requires that reagents needed for the actual reaction only should be filled in- the data for work-up chemicals (such as sodium bicarbonate, MgSO4, or extraction or recrystallization solvents) is unnecessary.


vi. Anything else specified in the syllabus.

II. Procedure:
   i. Clearly record what you did. Include the time between steps, when necessary.
   ii. Data- Clearly label any collected data to avoid the possibility of confusion later. Make sure to turn in your actual lab data with your lab report. Do not rewrite this section.
III. Final write-up:
i. Products/Unknowns- Identify any unknowns and products, along with proof of its identity.
ii. Conclusions- Analyze the results. Were they what you expected? Why or why not? Rationalize the outcome. *You should always have conclusions!!*
iii. Questions- Answer the assigned questions.

**Schedule of Experiments:**

Week 1 Laboratory check-in.
Jan. 18, 19, 20
Week 2
Jan. 25, 26, 27
Exp. 57: Isolation of Essential Oils (pp. 487-491). (Do not do cinnamon.) Pre-lab: Include i-ii, v. Review Technique 7.4-7.6 (pp. 600-605) and 7.9 (pp. 607-610). Read Technique 11 (pp. 662-668); answer questions 2 and 3. Write-up: Answer questions 1-3 on pp. 548. Conclusions: Identify the compound present in your spice! Fully justify your choice. Also: Remember to wash your NMR tube and cap today if they are dirty.

Week 3
Feb. 1, 2, 3
Spectroscopic Identification of an Unknown. Pre-lab: Read Technique 19.9 (pp. 755-756); nothing will be turned in. Write-up: As your conclusions, identify your compound! Fully justify your identification. (Note the helpful charts on pp. A37 and A52).

Week 4
Feb. 8, 9, 10
Exp. 48: The Diels-Alder Reaction of Cyclopentadiene with Maleic Anhydride (pp. 402-409); special handout. Pre-lab: Include i-v; write a reaction, mechanism, and a reagent table for each of the three reactions that you will do. Write-up: Answer the questions on the handout.

Week 5
Feb. 15, 16, 17
Zinc Allylation of Benzaldehyde (special handout). Pre-lab: Include i-v. Write-up: Answer the questions on the handout.

Weeks 6-8
Feb. 22, 23, 24
Awesome Unknown Lab (special handout). Pre-lab: Write a reagent table for your reaction (i, ii, iv, v). Write-up: 1) Discuss product purity; 2) Interpret each spectrum; 3) Identify your compound; 4) Write a mechanism for the reaction you performed. (200 point lab.)

Week 9
March 21, 22, 23
Exp. 35: The Aldol Condensation Reaction: Preparation of Benzalacetophenones (pp. 316-318). Pre-lab: Include i-v. Write-up: Answer questions 2, 4, 5, and 6. Discuss your percent yield and product purity in the conclusions.

Week 10
March 28, 29, 30
Friedel-Crafts lab (special handout). Pre-lab: Include i-v. Write-up: Answer the questions on the handout.

Week 11
April 4, 5, 6
Exp. 62: Esterification Reactions of Vanillin (pp. 507-509). Pre-lab: Include i-v, mechanisms are not necessary. Write-up: Follow the instructions given for the report preparation on pp. 509. Obtain data but not help from your lab partner. Your final report should include the structures of products A and B and the complete mechanisms for their formation.

Week 12
April 11, 12, 13
Exp. 47: Preparation and Properties of Polymers: Polyester, Nylon, and Polystyrene. Pre-lab: Read pp. 385-401. Include i-iii, v; a reaction and mechanism are necessary for each of the three polymers you will synthesize. Make sure to bring a transparent polymer with you to lab just in case one of your polymers is opaque! Write-up:
Identify the major stretches on the IR spectrum of each polymer. Use the information in the book to identify each polymer.

Week 13
April 25, 26, 27

Check-out.

April 28 is the last day to turn in lab reports.