Course Description:
A strong foundation in organic laboratory skills is provided in this course. Laboratory work includes learning the basic techniques including recrystallization, melting point determination, distillation, liquid/liquid extraction, thin-layer and column chromatography. Mastery of these basic techniques lays the foundation for carrying out a number of organic syntheses or natural product isolations. Students will have access to modern instrumentation for the characterization of synthetic products or organic unknowns. Standard analysis methods include IR, NMR, UV/Vis spectroscopy, mass spectrometry, polarimetry and GC. CHEM 210 is a prerequisite and CHEM 212 a corequisite for this course.

Required Instructional Materials:
- **Lab Notebook:** Bound carbonless carbon copy notebook (100 pages)
- **Goggles:** Goggles or safety glasses with side-shields are acceptable. Protective clothing is strongly recommended. Disposable gloves are provided in lab.
- **Combination Lock:** Bring your own or purchase from the chemistry club.

Grading & Course Policies:

Lab Courtesy:
Failure to abide by safety rules will result in automatic deduction of courtesy points. Point deductions can also result from being chronically late, leaving early, disrupting or distracting other students. Courtesy points will also, to some degree, be a judge of your preparedness for lab (i.e. do you know what you are doing when you come to lab) and how you use your time in lab (i.e. do you work efficiently.)
Attendance:
It is very important that you attend lab. A grade of W is awarded to students who withdraw prior to Late Drop (Friday, April 6th). Students are advised to discuss attendance irregularities or poor class performance with the instructors. Do not simply stop your attendance. This will result in a failing grade for the course.

Point distribution:  
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<thead>
<tr>
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<tbody>
<tr>
<td>Mini Lab Reports (8 x 25)</td>
<td>200 pts</td>
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<tr>
<td>Lab Reports (8 x 50)</td>
<td>400 pts</td>
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<tr>
<td>Lab Courtesy:</td>
<td>50 pts</td>
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<tr>
<td>Total</td>
<td>650 pts</td>
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</tbody>
</table>

Final Grade Scale:  
A  94-100%
A-  90-93%
B+  87-89%
B   83-86%
B-  80-82%
C+  75-79%
C   70-74%
D   60-69%
F   < 60%

Late Reports:
A 5-point per day deduction is assessed on all late reports.

Check-Out:
Failure to check-out of a CHEM 213 laboratory drawer will be penalized with 50-point deduction and a $25 check-out lab fee. You will also be responsible for the cost of any broken or missing items. This fee will be charged on your student account even if you drop or withdraw from the course.

Academic Integrity:
Academic integrity is a basic guiding principle for all academic activity at the University, and all members of the community are expected to adhere to this principle. Specifically, academic integrity is the pursuit of scholarly activity in an open, honest, and responsible manner. It includes a commitment not to engage in or tolerate acts of falsification, misrepresentation, or deception. Such acts violate the fundamental ethical principles of the University community and undermine the efforts of others.

Succeeding in CHEM 213 is dependent upon students learning from the textbook, the instructor, but also from each other. Working individually, with a partner or in groups may be required throughout the semester. Working in groups and helping each other is strongly encouraged; however, we strongly believe that students understand the fine line between collaborating and plagiarism. Please do not cheat. This means students should not share data and/or final reports. Penn State Behrend puts a very high value on academic integrity, and violations are not tolerated. Violators will receive academic sanctions and may receive disciplinary sanctions, including the awarding of an XF grade. In cases such as these, an XF grade is recorded on the transcript and states that failure of the course was due to an act of academic dishonesty. All acts of academic dishonesty are recorded so those repeat offenders can be sanctioned accordingly.

For more information: http://behrend.psu.edu/for-faculty-staff/faculty-resources/academic-integrity

Learning Resource Center:
The Learning Resource Center promotes the academic success of Penn State Erie students through peer tutoring and study skills advising. Tutoring is free and available in most subject areas.

For more information: http://psbehrend.psu.edu/Academics/academic-services/lrc.
Disabilities and Learning Differences:
Penn State is strongly committed to providing full access to its programs and services for all individuals. The University encourages academically qualified students with disabilities to take advantage of the educational programs and accommodations offered at Penn State Behrend.

For more information: http://behrend.psu.edu/student-life/educational-equity-and-diversity/student-resources/students-with-disabilities-and-learning-differences

Educational Equity Concerns:
Penn State takes great pride to foster a diverse and inclusive environment for students, faculty, and staff. Acts of intolerance, discrimination, harassment, and/or incivility due to age, ancestry, color, disability, gender, national origin, race, religious belief, sexual orientation, or veteran status are not tolerated.

Any act of intolerance can be reported through Educational Equity at the Report Bias site: http://equity.psu.edu/reportbias/statement

Counseling and Psychological Services:
Students with academic concerns related to this course should contact the instructor in person or via email. Students also may occasionally have personal issues that arise in the course of pursuing higher education that may interfere with their academic performance. If you find yourself facing problems affecting your coursework, you are encouraged to talk with an instructor and to seek confidential assistance at the Penn State Behrend Personal Counseling Services at (814) 898-6504.

For more information: http://psbehrend.psu.edu/student-life/student-services/personal-counseling

Title IX:
Penn State is committed to fostering an environment free from sexual or gender-based harassment or misconduct. The Office of Sexual Misconduct Prevention and Response ensures compliance with Title IX, a federal law that prohibits discrimination based on the sex or gender of employees and students. Behaviors including sexual harassment, sexual misconduct, dating violence, domestic violence, and stalking, as well as retaliation for reporting any of these acts violate Title IX and are not tolerated. The University is also committed to providing support to those who may have been impacted by incidents of sexual or gender-based harassment or misconduct and may provide various resources and support services to individuals who have experienced one of these incidents.

For more information: http://titleix.psu.edu/ or http://titleix.psu.edu/resources-penn-state-erie-the-behrend-college/

Copyright of Class Materials:
You may not share any information from this course (including notes and assignments) with others who are not currently registered for the course, nor post such information electronically without the permission of the instructor--this includes online note-taking/note-sharing services (See Penn State Administrative Policy AD-40). Unless you have my permission, you risk disciplinary sanctions.
<table>
<thead>
<tr>
<th>Date</th>
<th>Experiment</th>
<th>PreLab Due</th>
<th>Report Due</th>
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<tbody>
<tr>
<td>January 8/9</td>
<td>Check-in &amp; Safety</td>
<td>Read pgs 13 - 30</td>
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<tr>
<td>January 10/11</td>
<td>Experiment 1 (part A only)</td>
<td>PreLab 1</td>
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<tr>
<td>January 15/16</td>
<td><strong>MLK Day</strong></td>
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<tr>
<td>January 17/18</td>
<td>Experiment 2</td>
<td>PreLab 2</td>
<td>Experiment 1 (25 pts)</td>
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<tr>
<td>January 22/23</td>
<td>Experiment 3</td>
<td>PreLab 3</td>
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<tr>
<td>January 24/25</td>
<td>Experiment 4</td>
<td>PreLab 4</td>
<td>Experiment 2 (25 pts)</td>
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<tr>
<td>January 29/30</td>
<td>Experiment 5</td>
<td>PreLab 5</td>
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<tr>
<td>Jan 31/Feb 1</td>
<td>Experiment 5 (continued)</td>
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<td>Experiment 3 (25 pts)</td>
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<tr>
<td>February 5/6</td>
<td>Experiment 10</td>
<td>PreLab 10</td>
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<tr>
<td>February 7/8</td>
<td>Experiment 10 (continued)</td>
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<td>Experiment 4 (25 pts)</td>
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<tr>
<td>February 12/13</td>
<td>Experiment 15</td>
<td>PreLab 15</td>
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<tr>
<td>February 14/15</td>
<td>Experiment 9 (adapted)</td>
<td>PreLab 9</td>
<td>Experiment 5 (25 pts)</td>
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<tr>
<td>February 19/20</td>
<td>Experiment 22</td>
<td>PreLab 22</td>
<td>Experiment 10 (25 pts)</td>
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<tr>
<td>February 21/22</td>
<td>Experiment 22 (continued)</td>
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<td>Experiment 15 (25 pts)</td>
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<tr>
<td>February 26/27</td>
<td>Experiment 23</td>
<td>PreLab 23</td>
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<tr>
<td>Feb 28/Mar 1</td>
<td>Experiment 23 (continued)</td>
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<td>Experiment 9 (25 pts)</td>
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<tr>
<td>March 5/6</td>
<td><strong>Spring Break</strong></td>
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<tr>
<td>March 7/8</td>
<td><strong>Spring Break</strong></td>
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<tr>
<td>March 12/13</td>
<td>Experiment 30</td>
<td>PreLab 30</td>
<td>Experiment 22 (50 pts)</td>
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<tr>
<td>March 14/15</td>
<td>Experiment 30 (continued)</td>
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<td>Experiment 23 (50 pts)</td>
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<tr>
<td>March 19/20</td>
<td>Experiment catch-up</td>
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<tr>
<td>March 21/22</td>
<td>Experiment 42</td>
<td>PreLab 42</td>
<td>Experiment 30 (50 pts)</td>
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<tr>
<td>March 26/27</td>
<td>Experiment 42 (continued) &amp; Expt’ 56 (prep)</td>
<td>PreLab 56</td>
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<tr>
<td>March 28/29</td>
<td>Experiment 56 (part A &amp; part B adapted)</td>
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<td>Experiment 42 (50 pts)</td>
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<tr>
<td>April 2/3</td>
<td>Experiment 56 (continued)</td>
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<td>April 4/5</td>
<td>Experiment 37</td>
<td>PreLab 37</td>
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<tr>
<td>April 9/10</td>
<td>Experiment 37 (continued)</td>
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<td>Experiment 56 (50 pts)</td>
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<tr>
<td>April 11/12</td>
<td>Experiment 35</td>
<td>PreLab 35</td>
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<tr>
<td>April 16/17</td>
<td>Experiment 35 (continued)</td>
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<td>Experiment 37 (50 pts)</td>
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<tr>
<td>April 18/19</td>
<td>Experiment 32</td>
<td>PreLab 32</td>
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<tr>
<td>April 23/24</td>
<td>Experiment 32 (continued)</td>
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<td>Experiment 35 (50 pts)</td>
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<tr>
<td>April 25/26</td>
<td>Check-Out</td>
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<td>Experiment 32 (50 pts)</td>
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* subject to change
Experiments

PreLab Assignments

• Before the laboratory, prepare a written PreLab assignment in your lab notebook according to the instructions in the text page 912. There is also an example in the report guidelines section of the syllabus. An experimental outline is sufficient; the list of equipment and a flow chart may be included but are not required. Please use the text and the report guidelines to prepare your PreLab.

• Perform all “Before You Begin” exercises for that experiment.

• Read all the “Operations” sections in text associated with experiment (i.e. OP-10 Mixing.)

• Assume all experiments are performed “Standard Scale” unless otherwise indicated.

• Be aware of what you need to do to start an experiment before you arrive in lab. If indicated in the “before you begin” section, calculate the amount of chemicals you are required to measure out and become familiar with the type of glassware you will be asked to use. A helpful guide to identifying laboratory glassware is in the textbook (pg. 908-911.)

• If the pre-lab is missing or incomplete you will not be permitted to start the experiment.

During the Experiment

• Remember a laboratory notebook is just that, a notebook. You wouldn’t take detailed lecture notes after leaving the lecture hall, do not do so in lab. It is a ‘habit’ that you need to form. You need to tell yourself consistently through the first few experiments to take notes after every step is accomplished. Do not write data on backs of handouts, post-it notes or any other secondary means ~ all original data goes directly into the notebook!

• Avoid using personal pronouns such as “I”, “my”, etc.

• All calculations must be in the notebook! The textbook has a detailed reminder (from general chemistry) on how to do the stoichiometry calculations required for most organic experiments (Appendix IV, pg. 918-922.)

• Honesty is required in the notebooks and data keeping. We are preparing you for a career as a professional in the sciences. This is one reason why notes must be directly written in a notebook and all errors crossed out with a single line. In academia or in industry laboratory notebooks are legal documents and are often audited for accuracy and completeness. For safety reasons they are used to trace where accidents occurred and what the individual was doing at the time of the incident. This information can be vital in assisting the individual (if they are not conscious) and in preventing a repeat of the accident.

• Neatness is required in the notebooks. As stated above the notebooks purpose is to communicate what you have done, more often than not, to someone else. Points will be deducted from your notebooks if they are not organized and legible. Writing in the margins or not leaving “white” space for instructor comments is highly discouraged.

• Safety is required in the lab. Failure to follow safety rules will result in point deductions or immediate expulsion from lab.
During the Experiment (continued)

- Cleanliness is required in the laboratory. Respect for the shared common areas (mp/IR) is expected.
- You are responsible for keeping glassware clean and drawer free of loose solids and liquid stains.
- Your hood location must be clean and wiped down after every experiment. All hoses, bowls, and clamps must be put back when you are finished. Hotplates may be left out at the instructors’ discretion if they need to cool. The thick vacuum hose on the aspirator may be left in place.
- All waste must be disposed of per the instructions from your instructor. Do not let old products and unknowns collect in your drawer! Please do not leave behind waste of any type for future classes.
- You will be assigned cleaning duties in the lab. Failure to keep the lab as you found it will result in point deductions.

After the Experiment

- Complete the Calculations, Raw Data, Results, Discussion, Conclusions, References and Exercises sections of the “Writing A Laboratory Report” in your notebook. See Appendix III, pg. 913-914, #4-8 and the example outline provided in the report guidelines. Exercises will be given out in class and are required in a separate section at the end of each report.
- Tear out the original perforated pages of your notebook for turn-in on the specified due date. Late reports will receive a 5-point deduction per day.
- Any raw data (IR spectra, GC chromatograms, etc.) should be attached to the back of the report.
Reports Guidelines

PreLab

Title Info: Include your name, section number, date and title of the experiment (brief).

Introduction: Include goal(s) and/or objective(s) of experiment, name/type of reaction(s), pertinent background information, experimental outline, chemical reaction(s) and any “before you begin” exercises.

Physical Data: Relevant physical data (chemical structure, melting/boiling point, density, hazards and/or concerns) associated with each laboratory should be listed in a table format. Page 57, Figure 3.1 in your text provides a good model to follow.

Inlab Observations

Procedure: The procedure is a detailed account of everything you accomplished during the lab. This portion of the report does not need to be in complete sentences but must contain enough information that a classmate could repeat your procedure exactly.

Raw Data: All raw data should be included in this section, i.e. mp, weights, spectra, etc. The information should be in a summary table or graph when appropriate. Include simple analysis, e.g. IR table with peak assignments or other relevant spectra analysis.

Final Report

Calculations: Any calculations (detailed % yield, corrections, etc.) must be detailed here.

Results: Summary and discussion of results

• create and insert all physical/spectral data into tables/charts
• address the identity of your products based on the data (include and analyze IR, NMR, etc. and compare your spectra to that of the any known compounds)
• address the purity of your products based on melting point and/or spectral data; repeat literature values were applicable
• address the percent yield of your product(s) & briefly discuss any problems

Discussion: Discussion of the chemistry based on the results

• discuss what type of reaction you are doing/purpose of the experiment
• include chemical equations for your reaction to show the transformation
• discuss any potential stereoselectivity or regioselectivity in the reaction
• discuss any side reactions that occur or side products that could form
• include a mechanism, where applicable

Conclusion: Statement with final conclusion; state your final results. (brief)

References: Include source(s); text, handout, and/or reference books, spectra catalogs, etc.

Exercises: Each experiment will include questions as assigned in class. These exercises are required in a separate section at the end of each report.
Other criteria for Final Reports

1. All reports must be completed in the carbonless duplicate notebook. The original will be collected.
2. Use passive voice and past tense. Do not use the first or second person singular or plural.
3. The report should be concise.
4. Do not muddle procedure, calculations, results and discussion together. Each section should be complete before you start the next.
5. The data should dominate the report, being clearly tabulated for maximum visibility.
6. Literature values for physical constants should be reported and correctly referenced.
7. Do not write a detailed account of standard procedures, m.p. needs no further explanation.
8. Do not dispose of your products until your report is returned and graded.
9. An equation for every reaction that occurred during the experiment should be included.
10. All raw spectra and chromatograms should be included as a figure or appendix to your report with the operating conditions.
11. Peak assignments should be written directly on the spectrum. These assignments must also be tabulated in the results section.

Tips for Keeping a Good Notebook

1. Leave two pages at the front of your notebook for a title page and a table of contents.
2. The first entry in your notebook for each particular experiment must be a PreLab.
3. Include the date each time you continue the same experiment on a different day.
4. Always write in blue or black permanent ink.
5. It is helpful to have an appendix on the back pages of your notebook with common information. This may include boiling points, melting points, molecular weights, abbreviations, etc.
6. Always record weights, measurements, colors, smells, unusual events, spills, and any other observations.

For example:

- added 0.263 g of NaCl to 20 mL of distilled H₂O
- beaker became very warm and the water began to boil, then smoke appeared
- after containing the smoking beaker in the hood, the NaCl container was examined
- the container was not NaCl, it was Na (sodium metal)
- disposed of hazardous Na/H₂O with a slow addition isopropyl alcohol
- started experiment again

7. Use as many standard abbreviations and chemical formulas as possible. It will help you practice for lecture and save you time in the lab.
8. Record your data as it occurs. If you wait until the end of the class period you will not remember that actual steps you took. Very often it will deviate from the text, so the text is no longer a reliable source. You will need this detailed information for the procedure section of your final report. You do not have to write in complete sentences in your notebook.
9. At the end of the class period, it is essential that you have the instructor sign-off on your data. This ensures academic honesty, but more importantly it helps me give time to provide each student with information for the next class period.