CHEMISTRY 220
FALL 2014 SYLLABUS

Instructor: Dr. Holly D. Bendorf
Office: 209 Heim Building
Phone: Office: (570) 321-4365
       e-mail: bendorf@lycoming.edu
       Home: (570) 998-8647 (no later than 10:00 pm, please!)

Course Schedule: Class: MWF 9:00 - 10:05, Heim G-09
                 Labs:  T 7:45 - 11:35 am, T 1:00 - 4:50 pm, or Th 7:45 - 11:35 am.
                 Prelab is in Heim 220. Lab meets in Heim 236.

Office Hours: Walk-in or by appointment. If you need to reach me outside of regular work hours, feel free to
call me at home (this is a landline, so no texts please!). I rarely check my work e-mail account from home, so if
you need to reach me on an evening or weekend, please use the home phone number listed above.

Evening Review Session: I will hold an evening review session one night each week. The review session
provides an informal way for us to get together, work problems, talk chemistry and answer questions. While no
one meeting time will work for everyone, I will select a time that works for as many people as possible.

Course Description: CHEM 220, Organic Chemistry I, is an introduction to the study of the chemistry of
carbon compounds. The course covers the chemistry of alkenes and alkynes, the substitution and elimination
chemistry of alkyl halides, the theory and applications of infrared spectroscopy, and the strategies of organic
synthesis. The laboratory portion of the course will introduce the student to a variety of techniques for the
synthesis, purification, and analysis of organic compounds.

Prerequisite: Successful completion of CHEM 111.

Course Objectives: Upon completion of this course, each student should be able to:

1. Discuss bonding in organic compounds in terms of the major theories and the role played by
   hybridization.
2. Identify potential sites of chemical reactivity based on molecular structure.
3. Draw organic molecules and name them according to IUPAC nomenclature rules.
4. Recognize the impact that the 3-dimensional nature of molecules has on chemical behavior and be
   able to identify conformational and stereoisomers.
5. Predict products and propose mechanisms for reactions of alkenes, alkynes, and alkyl halides.
7. Use infrared spectroscopy, polarimetry, and physical properties to characterize molecules of known
   structure and identify molecules of unknown structure.
8. Demonstrate proficiency with standard organic laboratory techniques for the synthesis and
   purification of organic compounds.
This course helps students achieve the following Chemistry Department learning objectives:

1. Exhibit proficiency in the major sub-disciplines of chemistry
2. Perform wet laboratory techniques as appropriate to the major sub-disciplines of chemistry
3. Understand and use modern chemical instrumentation
4. Exhibit integrative, problem-solving skills, such as experimental design, data manipulation, and data interpretation
5. Demonstrate responsible conduct in the laboratory, including laboratory safety and ethical research practices

This course supports the mission of Lycoming College to provide a distinguished baccalaureate education in the liberal arts and sciences.

Required Text and Materials:
- CHEM 220 Course Supplement.
- Model Kit: Organic Chemistry Set 1013A (HGS models / Maruzen)
- Bound laboratory notebook (Freeman).
- Safety glasses or goggles.
- Casio fx-260 calculator (same one used in CHEM 110-111, only needed for the laboratory quizzes)

Optional Materials:
  I'll put a copy of this text on reserve in the library.
  I'll post answer keys for the assigned homework on Moodle, so there is no need to buy this manual unless you REALLY want a copy.
- Study guide for the ACS Exam in Organic Chemistry. Good source of practice problems.
  Available at: http://chemexams.chem.iastate.edu/ 

Grading Criteria: 
- Quizzes 105 points
- Exams 300 points
- Laboratory 110 points
- Final 135 points

650 points

Final grades are assigned as follows:

A 585-650 points (90.0 – 100%)
B 520-584 points (80.0 – 89.9%)
C 455-519 points (70.0 – 79.9%)
D 390-454 points (60.0 – 69.9%)

Plus and minus grades are included in these ranges and correspond to the highest and lowest 2%, respectively.

Please be aware that you must pass both the lecture and laboratory to receive a passing grade for the course. Be sure to keep a record of your quiz, exam, and lab grades. Don’t forget to keep track of your colloquium attendance and any absences, too. You can calculate your average at any time during the semester as follows: 

% = [Total points earned / total points possible] * 100.
Final Grade | Final Average | Interpretation (from the Lycoming College Catalog)
-------------|--------------|------------------------------------------------------------------------------------------------------------------
A            | >90%         | Excellent: Signifies superior achievement through mastery of content or skills and demonstration of creative and independent thinking.  
B            | 80-90%       | Good: Signifies better-than-average achievement wherein the student reveals insight and understanding.               
C            | 70-80%       | Satisfactory: Signifies satisfactory achievement wherein the student’s work has been of average quality and quantity. The student has demonstrated basic competence in the subject area and may enroll in additional coursework. 
D            | 60-70%       | Passing: Signifies unsatisfactory achievement wherein the student met only the minimum requirements for passing the course and should not continue in the subject area without departmental advice. 
F            | <60%         | Failing: Signifies that the student has not met the minimum requirements for passing the course. A failing grade in the course may also result from academic dishonesty or from excessive unexcused absences.

**Exams:** There are three in-class exams on the following dates: **Friday, September 26; Friday, October 24;** and **Friday, November 21.** The final exam is at **8:30 am on Tuesday, December 9.** The final exam is cumulative and is similar in format to the mid-semester exams. Please note that the ACS exam in organic chemistry, given at the end of **CHEM 221,** is cumulative for the entire year.

**Quizzes:** Quizzes are an incentive to stay current with the course. They provide you with a means of evaluating your progress and allow you to identify any potential "trouble spots" before the exam. Quiz questions come from the lecture notes, reading and homework assignments. The lowest quiz grade is dropped.

**A note about exams and quizzes:** While only the final exam is cumulative, you should realize that each topic covered this semester builds upon topics from earlier sections of the course. Therefore, all quizzes and exams are essentially cumulative in nature. Simply cramming the night before a quiz or exam might work early in the semester, but you will pay for it later. **Don’t fall behind in this class or the work will “snowball” on you.** Study every day. Don’t just memorize random facts... instead, work to understand the material. Test your understanding by trying to explain/teach the concepts to a classmate. If you have having trouble with the material, get help (come see me!) right away.

**Reading Assignments from the Text:** Chapter outlines, reading and homework assignments are listed in the course supplement. I suggest you skim the reading assignment before class and read it again more thoroughly afterwards. I strongly recommend taking notes on the reading. Taking notes forces you to summarize the reading in your own words and helps to reinforce the concepts. You will also find these notes to be very helpful as you prepare for exams and quizzes.

**Homework Assignments:** If you want to succeed in this course, it is essential that you complete the homework assignments. Give each problem your best shot before consulting the answer key. If you get a question wrong, make an effort to correct any errors or misconceptions. If you are having trouble with the homework, take time to review your notes, re-read the appropriate section in the text and work the solved problems in the text. Then go back and try the homework again. Of course, you are always welcome to ask me for extra help with the questions on the homework or reading assignments. Lectures and in-class exercises are prepared with the expectation that you have read the assigned material and completed the homework.

**Attendance at class and lab:** Regular attendance at lecture is mandatory. This means that I expect you to arrive on time, remain in class for the entire 65 minutes, and participate in class. Missing part of a class (late arrival, early departure, etc.), sleeping, reading, texting, or engaging in disruptive activities during class is
equivalent to an absence and will be counted as such. Three absences are permitted and each absence beyond that, regardless of the reason, results in a 3-point deduction from the final course grade.

- If you miss a quiz, you will receive a grade of zero on that quiz (remember, you get to drop one quiz).

- If you miss an exam, you will receive a grade of zero on that exam. If you cannot attend class that day due to exceptional circumstances and I approve the absence, you may substitute your grade on the final for the missed exam. You must be able to provide documentation regarding the reason for the absence.

- If you miss a lab, you will receive a grade of zero for that lab. Lab make-ups may be permitted if the absence is due to exceptional circumstances and the missed work can be completed during another regularly scheduled lab period. Note that your lab write-up is still due at your assigned lab meeting time. If necessary, have someone deliver it to the lab for you.

Please keep in mind that absences due to doctor’s appointments, work conflicts, or simply not feeling well (as opposed to being seriously ill) are not exceptional circumstances.

**Additional resources:** You can access course materials, such as answer keys and review session handouts, on the Moodle site for this course. If prompted for a password or key, enter chemical.

Copies of several organic chemistry texts are available in the reading room (217 Heim Bldg.). If you are not satisfied with McMurry’s treatment of a topic, feel free to consult one of the other textbooks— you may just find one you like. These texts are excellent sources of extra practice problems (solutions manuals are available for several of the texts as well). There is an on-line text that some students have found quite useful: [www.cem.msu.edu/~reusch/vtxtindex.htm](http://www.cem.msu.edu/~reusch/vtxtindex.htm).

The “For Current Students” page from the Department of Chemistry web site includes links to syllabi, chemistry curriculum, faculty and student research, colloquium schedule, and other chemistry-related sites. [http://www.lycoming.edu/chemistry/](http://www.lycoming.edu/chemistry/)

The on-line catalogs and databases are good sources of information for your lab reports. We’ll talk more about them at the first lab meeting. You can access the Merck Index online through the ChemBiofinder site (now part of the Perkin Elmer Informatics site). This is more user-friendly than trying to access the Merck Index directly. Additional on-line resources are listed in the lab manual.


**Extra Credit:** You may earn extra credit by attending departmental colloquia (2 points per colloquium). If you cannot attend colloquia due to a class or work conflict, please see me to discuss other options, which are research- and writing-based assignments. Please be aware that all extra credit is due on the last day of class. Extra credit is capped at 10 points and is limited to half a letter grade (for example: from a B+ to an A-).

**Colloquium attendance guidelines:** Colloquium speakers may be your fellow students or visitors from other academic institutions or industry. The speakers have spent a lot of time and effort preparing for colloquium and deserve to be treated with respect. Arrive on time and stay until the end, including the question and answer period (plan on 45 minutes for an internal speaker, 60 minutes for a visitor). Please give the speaker your full attention.

**Cell phones, Laptops, and other electronic devices are not permitted in class, in lab or at colloquium.** If you have one with you, be sure it remains in your purse or backpack and is turned off. The presence and/or use of one of these devices during a quiz or exam will constitute an act of academic dishonesty.
**Academic Integrity:** Be aware that in accordance with the College's policy on academic honesty, any work you submit must be your own. Academic dishonesty includes, but is not limited to, *copying someone else's work on a quiz or an exam or lab write-up or allowing someone else to copy your work*. Any instances of academic dishonesty will be penalized to the fullest extent possible and reported to the Provost and Dean of the College.

**Academic Support:** If you have a learning disability and choose to request academic accommodations, please contact the Coordinator for Services for Students with Disabilities in the Academic Resource Center.

**Course Schedule:** While we may get a little ahead or behind the schedule in terms of the topics covered on any given day, the exam and quiz dates will remain the same. Reading and homework assignments are listed in the course supplement.

<table>
<thead>
<tr>
<th>Date</th>
<th>Subject</th>
<th>Q/E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Week 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aug. 25</td>
<td>Intro. to Organic, Atomic Structure</td>
<td></td>
</tr>
<tr>
<td>Aug. 27</td>
<td>Lewis Structures, Bonding Theory</td>
<td></td>
</tr>
<tr>
<td>Aug. 29</td>
<td>Hybridization</td>
<td></td>
</tr>
<tr>
<td><strong>Week 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept. 1</td>
<td>Drawing Structures, Formal Charge</td>
<td></td>
</tr>
<tr>
<td>Sept. 3</td>
<td>Electronegativity, Polar Bonds, Non-Covalent Interactions</td>
<td></td>
</tr>
<tr>
<td>Sept. 5</td>
<td>Functional Groups, Isomers</td>
<td>quiz (fri)</td>
</tr>
<tr>
<td><strong>Week 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept. 8</td>
<td>Alkanes: Nomenclature, Properties, Conformations</td>
<td></td>
</tr>
<tr>
<td>Sept. 10</td>
<td>Conformations of alkanes</td>
<td></td>
</tr>
<tr>
<td>Sept. 12</td>
<td>Cycloalkanes: Properties, Nomenclature, Conformations</td>
<td>quiz (fri)</td>
</tr>
<tr>
<td><strong>Week 4</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept. 15</td>
<td>Cyclohexane Conformers</td>
<td></td>
</tr>
<tr>
<td>Sept. 17</td>
<td>Organic Reactions and Mechanisms</td>
<td></td>
</tr>
<tr>
<td>Sept. 19</td>
<td>Polar Reactions, Arrow Notation</td>
<td>quiz (fri)</td>
</tr>
<tr>
<td><strong>Week 5</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept. 22</td>
<td>Resonance</td>
<td></td>
</tr>
<tr>
<td>Sept. 24</td>
<td>Resonance; MO theory</td>
<td></td>
</tr>
<tr>
<td>Sept. 26</td>
<td>EXAM 1</td>
<td>EXAM</td>
</tr>
<tr>
<td><strong>Week 6</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sept. 29</td>
<td>Acid-Base Chemistry</td>
<td></td>
</tr>
<tr>
<td>Oct. 1</td>
<td>Acid-Base Chem.; Kinetics and Thermodynamics</td>
<td></td>
</tr>
<tr>
<td>Oct. 3</td>
<td>Alkenes: Structure, DU, and Nomenclature</td>
<td></td>
</tr>
<tr>
<td><strong>Week 7</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oct. 6</td>
<td>Electrophilic Addition: Reaction with HX</td>
<td></td>
</tr>
<tr>
<td>Oct. 8</td>
<td>Carbocation Reactivity and Rearrangements</td>
<td>quiz (wed)</td>
</tr>
<tr>
<td>Oct. 10</td>
<td>Electrophilic Addition of X2 to Alkenes</td>
<td></td>
</tr>
</tbody>
</table>
**Week 8**
Oct. 13  Electrophilic Addition of H2O to Alkenes
Oct. 15  Other Addition Reactions of Alkenes  quiz (wed)
Oct. 17  Long Weekend - No Classes

**Week 9**
Oct. 20  Alkynes: Structure, Properties and Nomenclature
Oct. 22  Addition Reactions of Alkynes
Oct. 24  EXAM 2  EXAM

**Week 10**
Oct. 27  Acid-Base Chemistry of Alkynes  (last day to withdraw from full semester courses)
Oct. 29  Multistep Synthesis
Oct. 31  IR: Theory, Functional Group Absorptions

**Week 11**
Nov. 3  IR: Functional Group Absorptions
Nov. 5  IR Practice
Nov. 7  Stereochemistry: Chirality, Assigning Absolute Configuration  quiz (fri)

**Week 12**
Nov. 10  Enantiomers, Diastereomers & Meso Cmpds
Nov. 12  Stereochem. in Reactions; Atoms Other Than C
Nov. 14  SN2: Kinetics and Mechanism  quiz (fri)

**Week 13**
Nov. 17  SN2: Leaving Group and Nucleophile
Nov. 19  SN1
Nov. 21  EXAM 3  EXAM

**Week 14**
Nov. 24  E1
Nov. 26  No Classes - Thanksgiving
Nov. 28  No Classes - Thanksgiving

**Week 15**
Dec. 1  E2: Kinetics and Mechanism
Dec. 3  E2: Stereochemistry, Bulky Bases  quiz (wed)
Dec. 5  Acid Cat. Subst. & Elim.; Sn1, Sn2, E1 & E2 Summary

**Final Exam:** Tuesday, December 9 at 8:30 am
The intent of the laboratory is to link the theory and practice of chemistry. In this lab, you will gain hands-on experience with many of the laboratory techniques and instruments that are central to the practice of organic chemistry. You will also be encouraged to THINK about what you are doing in the laboratory and how it relates back to the topics studied in class. To encourage this, we will begin most labs with a prelab meeting where we will highlight how the lab experiment connects to the class material. In the lab, I want to encourage you to think about what you are doing and why you are doing it, rather than “just going through the motions.” Many of the questions that you will see as part of your lab write-ups and on lab quizzes will also ask you to make the connection between theory and practice.

It is imperative that you come to the lab fully prepared. Careful preparation and planning before you arrive at the lab will allow you to complete your experiments in an efficient and safe manner. If you have read the lab ahead of time, the prelab discussion will be easier to follow as well.

The laboratory grade is worth a total of 110 points and is comprised of seven lab write-ups (70 points total), three lab quizzes (30 points), and a lab performance evaluation (10 points).

**Lab Outline:**

<table>
<thead>
<tr>
<th>Week</th>
<th>Dates</th>
<th>Lab</th>
<th>Assigned Reading</th>
<th>Report due for:*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aug. 26, 28</td>
<td>Check-in</td>
<td>Chp. 1, 2, 3</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Sep. 2, 4</td>
<td>Synthesis of isobutyl propanoate</td>
<td>Chp. 11, 15, 17</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sep. 9, 11</td>
<td>Purification of isobutyl propanoate</td>
<td>Chp. 5, 14, 17</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Sep. 16, 18</td>
<td>Recrystallization of benzoic Acid and naphthalene</td>
<td>Chp. 8, 9, 10 Isobutyl propanoate</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Sep. 23, 25</td>
<td>Solubility Testing</td>
<td>Chp. 4, 8, 9, 10</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Sep. 30, Oct 2</td>
<td>Extraction: Separation of a mixture</td>
<td>Chp. 11, 13 Quiz 1</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Oct. 7, 9</td>
<td>Extraction: Separation of a mixture</td>
<td>Chp. 11, 13 Recryst. Part I</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Oct. 14, 16</td>
<td>Extraction: Separation of a mixture</td>
<td>Chp. 11, 13 Recryst. Part II</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Oct. 21, 23</td>
<td>Synthesis of benzil</td>
<td>Chp. 15, 18, 20</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Oct. 28, 30</td>
<td>Oxidation puzzle</td>
<td>Chp. 11, 12, 26, 28 Extraction, Quiz 2</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Nov. 4, 6</td>
<td>Oxidation puzzle</td>
<td>Chp. 11, 12, 26, 28 Benziel</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Nov. 11, 13</td>
<td>Limonene</td>
<td>Chp. 25, 27 Oxidation Puzzle</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Nov. 18, 20</td>
<td>Limonene</td>
<td>Chp. 26, 27</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Nov. 25, 27</td>
<td>Thanksgiving--No Labs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Dec. 2, 4</td>
<td>Check-out</td>
<td></td>
<td>Quiz 3</td>
</tr>
</tbody>
</table>

*Late reports will be penalized 5% per day. Lab reports will not be accepted after graded labs are returned.*
**Attendance:** Attendance at lab is mandatory. Lab make-ups are permitted only for excused absences. For safety reasons, labs must be made-up during another regularly scheduled lab period.

**Laboratory Reports:** Lab write-ups are due before the start of prelab. Late write-ups are penalized 5% per day and are not accepted after graded labs have been returned in any lab section. **If you cannot attend your regularly scheduled lab section, be sure to have someone drop-off your lab write-up for you.**

**Lab Safety and Hygiene:** Lab safety is a priority and we will spend a significant portion of our first prelab discussing this topic. If you have questions regarding lab safety at any time throughout the semester, please ask. Because unsafe behavior by one person can jeopardize the safety of another, unsafe behavior is not tolerated and repeated violations may result in dismissal from the lab.

**Laboratory Performance:** One of the goals of this course is to help you develop as a scientist and experimentalist. You will be encouraged to develop the skills needed for success in the lab, such as preparation for lab, laboratory technique, ability to work efficiently, safety and lab hygiene. Assessment of these skills will occur throughout the semester using the matrix below.

### Lab Performance Matrix

<table>
<thead>
<tr>
<th></th>
<th>1 (poor)</th>
<th>2 (fair)</th>
<th>3 (good)</th>
<th>4 (outstanding)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safety – Personal Attire</strong></td>
<td>Must be frequently reminded to wear safety glasses, appropriate clothing or footwear. Brings food, drink, or personal electronic devices into lab.</td>
<td>Need occasional reminding about safety glasses or clothing/footwear. Does not bring food, drink or personal electronic devices into lab.</td>
<td>Consistently wears safety glasses. Wears appropriate clothing and footwear. Does not bring food, drink, or personal electronic devices into lab.</td>
<td>Consistently wears safety glasses and appropriate attire. Does not bring food, drink or personal electronic devices into lab. Never needs to be reminded of policy. Helps others follow safety rules.</td>
</tr>
<tr>
<td><strong>Safety – Work Area and Hygiene</strong></td>
<td>Spills are not cleaned-up right away. Bench or hood is left in poor condition on multiple occasions.</td>
<td>Bench and fume hood are not always left in good condition.</td>
<td>Keeps a clean, uncluttered work area. Bench and fume hood are cleaned at end of lab. Shared space (ie. reagent hood) is clean.</td>
<td>During lab, work area is clean, organized, and without clutter. Bench and fume hood are thoroughly cleaned and organized at end of lab. Checks shared space to ensure it is clean.</td>
</tr>
<tr>
<td><strong>Lab Equipment and Chemicals</strong></td>
<td>Improper disposal of chemicals on multiple occasions. Frequently fails to store equipment properly at end of lab. Leaves lids off reagents bottles.</td>
<td>Improper disposal of chemicals. May occasionally fail to store equipment properly at end of lab. Lids occasionally left off reagent bottles.</td>
<td>Personal and shared equipment stored properly at end of lab. Lids kept on reagent bottles. Chemicals are disposed of properly.</td>
<td>Personal and shared equipment stored properly. Lids kept on reagent bottles. Chemicals are disposed of properly. Helps to ensure that others are handling chemicals, equipment and waste properly.</td>
</tr>
<tr>
<td><strong>Preparation and Efficiency</strong></td>
<td>Misses prelab or is significantly late on multiple occasions. Or, uses lab time poorly.</td>
<td>Is late to prelab on more than one occasion or does not work efficiently in lab.</td>
<td>Arrives on time or has been slightly late on one occasion. Works efficiently in lab.</td>
<td>Arrives on time. Works efficiently in lab. Uses “downtime” effectively (such as to prepare for later parts of the experiment).</td>
</tr>
<tr>
<td><strong>Laboratory Technique</strong></td>
<td>Completes experiments with little attention to technique. Careless or abusive with instruments/ equipment.</td>
<td>Basic proficiency at lab techniques. Or, not careful with equipment and/or instruments.</td>
<td>Careful execution of lab techniques. Handles equipment, instruments and chemicals with care.</td>
<td>Careful and skilled execution of lab techniques. Handles equipment, instruments and chemicals with care.</td>
</tr>
</tbody>
</table>