

# CHEMISTRY 220

## FALL 2011 SYLLABUS

**Instructor:** Dr. Holly D. Bendorf **Office:** 209 Heim Building  
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Home: 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, Th 7:45 - 11:35 am.  
Prelab in Heim 220. Lab in Heim 236.

**Office Hours:** By appointment or just drop by.

**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 and answer questions. I'll try to find times/dates that fit our schedules.

**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.
6. Propose multi-step syntheses of small molecules.
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.

### Required Text and Materials:

- "Organic Chemistry" 8<sup>th</sup> Edition, John McMurry, Brooks Cole Publishers.
- CHEM 220 Course Materials Booklet.
- CHEM 220-221 Lab Manual.
- Model Kit: Organic Chemistry Set 1013A (HGS models / Maruzen)
- Bound laboratory notebook (Freeman).
- Safety glasses or goggles.
- Non-programmable calculator with logarithmic and exponential functions.

**Optional Materials:** Copies of the last two optional texts are on reserve at the library.

- "Study Guide and Solutions Manual for Organic Chemistry" John McMurry.
- "Organic Chemistry as a Second Language" 2<sup>nd</sup> Edition, David Klein.
- Study guide for the ACS Exam in Organic Chemistry  
Available at: <http://chemexams.chem.iastate.edu/>

<b>Grading Criteria:</b>	Quizzes	105 points
	Exams	300 points
	Laboratory	120 points
	Final	<u>150 points</u>
		675 points

**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 grade at any time during the semester as follows:  $\% = [\text{Total points earned} / \text{total points possible}] * 100$ .

<u>Final Grade</u>	<u>Final Average</u>	<u>Interpretation</u>
A	>90%	Student has demonstrated mastery of the concepts and the application of the concepts to new problems. Exceptional work.
B	80-90%	Student has demonstrated mastery of the concepts at a high level. Above average work.
C	70-80%	Student has demonstrated satisfactory knowledge of the material. Average work.
D	60-70%	Student has demonstrated rudimentary knowledge of the course material.
F	<60%	Unsatisfactory performance in course. A failing grade in the course may also result from academic dishonesty or from excessive unexcused absences.

“Plus” and “minus” grades are assigned as follows: the lowest 2% of a range corresponds to the “-” grade and the highest 2% corresponds to the “+” grade. For example, 80.0 – 81.9% equates to a B- and 88.0 – 89.9% equates to a B+. Grades are calculated to the tenths position.

**Exams:** There are three in-class exams on the following dates: **Friday, September 30; Wednesday, October 26; and Monday, November 21.** The final exam is at **1:00 pm** on **Wednesday, December 14.** 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 technically "cumulative," you should realize that each topic covered this semester builds upon previous topics. Therefore, all quizzes and exams are essentially cumulative. 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 facts...instead, work to understand the material. Test your understanding by trying to explain/teach the concepts to a classmate.

**Reading Assignments from the Text:** Chapter outlines, reading assignments and homework assignments are listed in the course materials booklet. I suggest you skim the reading assignment before class and read it again more thoroughly afterwards. I highly 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 on Moodle or the solutions manual. 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 questions on the homework or reading assignments.

I do not collect homework because I think it is better for you to be able to check your answers *as you complete the assignment*. Immediate feedback is preferable to waiting several days for me to correct a set of homework problems. Although the problems are not collected, you should complete them before the next class period to ensure that you are fluent with the material. Lectures and in-class exercises are prepared with the expectation that you have read the assigned material and completed the homework. I am here to help you learn chemistry and will gladly help you in any way I can, but I also expect you to be responsible for your own learning.

**Attendance at class and lab:** Regular attendance at lecture is mandatory. Attendance at class means arriving on time, remaining in class for the entire 65 minutes, and participating 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.

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 considered 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 chem220.

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/>

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. This is more user-friendly than trying to access the Merck Index directly. Additional on-line resources are listed in the lab manual.

Aldrich Catalog    [www.sigmaaldrich.com](http://www.sigmaaldrich.com)    ChemBiofinder    [chemfinder.cambridgesoft.com](http://chemfinder.cambridgesoft.com)

**Extra Credit:** You may earn extra credit which can "bump up" your final course grade by half of a letter grade (i.e.; from a B+ to an A-). Extra credit may be earned by attending departmental colloquia (3 per colloquium). If you cannot attend colloquium 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 15 points.

**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, PDAs and Laptops 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. Any instances of plagiarism, whether on a quiz, exam or lab report (including copying answers from a classmate), will be penalized to the fullest extent possible and reported to the Provost and Dean of the College.

**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.

Date	Subject	Text	Q/E
<b>Week 1</b>			
Aug. 29	Intro. to Organic, Atomic Structure	1.1-3	
Aug. 31	Lewis Structures, Bonding Theory	1.4-5	
Sept. 2	Hybridization	1.6-11	
<b>Week 2</b>			
Sept. 5	Drawing Structures, Formal Charge	1.12, 2.3	
Sept. 7	Electronegativity, Polar Bonds, Non-Covalent Interactions	2.1, 2	quiz
Sept. 9	Functional Groups, Isomers	3.1-2	
<b>Week 3</b>			
Sept. 12	Alkanes: Nomenclature, Properties, Conformations	3.3-5, 10.1	
Sept. 14	Conformations of alkanes	3.6-7	quiz
Sept. 16	Cycloalkanes: Properties, Nomenclature, Conformations	4.1-4	
<b>Week 4</b>			
Sept. 19	Cyclohexane Conformers	4.5-9	
Sept. 21	Organic Reactions and Mechanisms	6.1-5	quiz
Sept. 23	Polar Reactions, Arrow Notation	6.6; 7.9	
<b>Week 5</b>			
Sept. 26	Resonance and MO theory	2.4-6, 1.11	
Sept. 28	Acid-Base Chemistry	2.7-11	
Sept. 30	EXAM 1		EXAM
<b>Week 6</b>			
Oct. 3	Acid-Base Chem.; Kinetics and Thermodynamics	6.7-11	
Oct. 5	Alkenes: Structure, DU, and Nomenclature	7.1-6	
Oct. 7	Electrophilic Addition: Reaction with HX	7.7-11	
<b>Week 7</b>			
Oct. 10	Carbocation Reactivity and Rearrangements	7.7-11	
Oct. 12	Electrophilic Addition of X <sub>2</sub> to Alkenes	8.1-3	quiz
Oct. 14	Electrophilic Addition of H <sub>2</sub> O to Alkenes	8.4-5	
<b>Week 8</b>			
Oct. 17	Other Addition Reactions of Alkenes	8.6-9	
Oct. 19	Alkynes: Structure, Properties and Nomenclature	9.1	quiz
Oct. 21	Addition Reactions of Alkynes	9.3-6	
<b>Week 9</b>			
Oct. 24	Acid-Base Chemistry of Alkynes	9.7-8	
Oct. 26	EXAM 2		EXAM
Oct. 28	No Classes - Long Weekend		

**Week 10**

Oct. 31	Multistep Synthesis	9.9	
Nov. 2	IR: Theory, Functional Group Absorptions	12.5-8	
Nov. 4	IR Practice	12.5-8	

**Week 11**

Nov. 7	Stereochemistry: Chirality	5.1-4	
Nov. 9	Assigning Absolute Configuration	5.5	quiz
Nov. 11	Enantiomers, Diastereomers & Meso Cmpds	5.6-9	

**Week 12**

		5.10-12,	
Nov. 14	Stereochem. in Reactions; Atoms Other Than C	8.12-13	
Nov. 16	SN2: Kinetics and Mechanism	11.1-3	quiz
Nov. 18	SN2: Leaving Group and Nucleophile	11.1-3	

**Week 13**

Nov. 21	EXAM 3		EXAM
Nov. 23	No Classes - Thanksgiving		
Nov. 25	No Classes - Thanksgiving		

**Week 14**

Nov. 28	SN1	11.4-6	
Nov. 30	E1	11.7, 10-11	
Dec. 2	E2: Kinetics and Mechanism	11.7-9	

**Week 15**

Dec. 5	E2: Stereochemistry, Bulky Bases	11.7-9	
Dec. 7	Acid Cat. Subst. & Elim.; Sn1, Sn2, E1 & E2 Summary	11.12	quiz
Dec. 9	Applications to Synthesis	8.9, 9.2, 9	

**Final Exam: Wednesday, December 14 at 1:00 pm**

## CHEM 220 Laboratory – Fall 2011

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 this end, we will begin most labs with a prelab meeting. One of the main objectives of the prelab will be to highlight how the lab experiment relates to 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 120 points and is comprised of seven lab write-ups (70 points total), three lab quizzes (30 points), and a lab performance evaluation (20 points).

### Lab Outline:

<u>Week</u>	<u>Dates</u>	<u>Lab</u>	<u>Assigned Reading</u>	<u>Report due for:*</u>
1	Aug. 30, Sept 1	Check-in	Chp. 1, 2, 3	
2	Sep. 6, 8	Reaction of Isoamyl Alcohol with Acetic Acid	Chp. 12, 15, 16	
3	Sep. 13, 15	Reaction of Isoamyl Alcohol with Acetic Acid	Chp. 5, 14, 16	
4	Sep. 20, 22	Recrystallization of Benzoic Acid and Naphthalene	Chp. 8-10	Isoamyl alcohol
5	Sep. 27, 29	Solubility Testing	Chp. 4, 8-10	
6	Oct. 4, 6	Extraction	Chp. 11, 13	<b>Quiz 1</b>
7	Oct. 11, 13	Extraction	Chp. 11, 13	Recryst. Part I
8	Oct. 18, 20	Extraction	Chp. 11, 13	Recryst. Part II
9	Oct. 25, 27	Synthesis of Methyl Diantilis and Analogs, Part 1	Chp. 18, 19	Extraction
10	Nov. 1, 3	Synthesis of Methyl Diantilis and Analogs, Part 2	Chp. 15, 18, 19, 26	<b>Quiz 2</b>
11	Nov. 8, 10	Synthesis of Methyl Diantilis and Analogs, Part 2	Chp. 19, 26	
12	Nov. 15, 17	Limonene	Chp. 25, 26, 27	Diantilis, Part I
13	Nov. 22, 24	Thanksgiving--No Labs		
14	Nov. 29, Dec. 1	Limonene Characterization	Chp. 25, 26, 27	Diantilis, Part 2
15	Dec. 6, 8	Check-out		<b>Quiz 3</b> Limonene lab due 12/9/11 (by 5 pm)

\*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.

**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 will not be 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.

**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 Performance Matrix**

	<b>1 (poor)</b>	<b>2 (fair)</b>	<b>3 (good)</b>	<b>4 (outstanding)</b>
<b>Safety – Personal Attire</b>	Must be frequently reminded to wear safety glasses, appropriate clothing or footwear. Brings food, drink, cell phone or other electronic device into lab.	Need occasional reminding about safety glasses or clothing/footwear. Does not bring food, drink or personal electronic devices into lab.	<b>Consistently wears safety glasses. Wears appropriate clothing and footwear. Does not bring food, drink, or personal electronic devices into lab.</b>	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.
<b>Safety – Work Area and Hygiene</b>	Spills are not cleaned-up right away. Bench or hood is left in poor condition on multiple occasions.	Bench and fume hood are not always left in good condition.	<b>Keeps a clean, uncluttered work area. Bench and fume hood are cleaned at end of lab. Shared space (ie. reagent hood) is clean.</b>	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.
<b>Lab Equipment and Chemicals</b>	Improper disposal of chemicals on multiple occasions. Frequently fails to store equipment properly at end of lab. Leaves lids off reagents bottles.	Improper disposal of chemicals. May occasionally fail to store equipment properly at end of lab. Lids occasionally left off reagent bottles.	<b>Personal and shared equipment stored properly at end of lab. Lids kept on reagent bottles. Chemicals are disposed of properly.</b>	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.
<b>Preparation and Efficiency</b>	Misses prelab or is significantly late on multiple occasions. Or, uses lab time poorly.	Is late to prelab on more than one occasion or does not work efficiently in lab.	<b>Arrives on time or has been slightly late on one occasion. Works efficiently in lab.</b>	Arrives on time. Works efficiently in lab. Uses “downtime” effectively (such as to prepare for later parts of the experiment).
<b>Laboratory Technique</b>	Completes experiments with little attention to technique. Careless or abusive with instruments/equipment.	Basic proficiency at lab techniques. Or, not careful with equipment and/or instruments.	<b>Careful execution of lab techniques. Handles equipment, instruments and chemicals with care.</b>	Careful and skilled execution of lab techniques. Handles equipment, instruments and chemicals with care.