

CHEM 421 – Structure, Dynamics & Synthesis I (SuperChem) – Fall 2008

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Class Time: Mondays & Fridays, 2-3:20pm, Schaap Science Center rm 2130.

While the class officially ends at 3:20pm, and the formal teaching for the day will be done at that time, I plan to remain in the classroom until 3:50pm. This extra time is envisioned as an opportunity to continue discussions, provide extra help or additional practice problems as necessary, and for mentorship in graduate/professional issues. We will also use this extra half hour to give you a full two hours on test dates!

Office Hours: Your success in this course is one of my top priorities and I therefore attempt to be available as often as possible to meet with students. In addition to the extra half hour after class on Mondays and Fridays, I am interested in arranging a specific time each week for a help session. Perhaps 2pm on Wednesdays would work well? We can discuss this during the first two classes and come to a consensus.

Beyond these regularly scheduled times, I also try to keep an "open door policy". If my lab door is open or unlocked, come right in and I can usually help you. If I am in the middle of research or working on deadline (more likely on Tuesdays & Thursdays), I will ask you to return later. You can also make an appointment by phone, email or in person.

Finally, as the enrollment in this class is relatively small, if there are common concerns or misconceptions I am happy to try to tackle them in lecture or to schedule an additional class meeting time to address them!

Textbook (required): *“The Art of Writing Reasonable Organic Reaction Mechanisms, 2nd Edition”, by Robert B. Grossman. The most up to date printing of this is the 4th printing (each successive printing corrects more errata.) Consult the [errata](#) link on the text’s web page to ascertain which version you have and for corrections of all known errata. If you bought the text new from the Hope bookstore, it will be either a third or 4th printing. This is an excellent text, and for most of what we do it will also serve as my “lecture notes” – we’ll meander through the text together, spending most of our time working problems together, with you presenting not only the solutions, but the fundamental scientific explanations behind those solutions. I will supplement this with handouts and supplemental problems and projects as needed to increase the breadth of the course beyond solely a mechanisms course, though mechanisms will remain the primary focus.*

Textbook web site: <http://www.chem.uky.edu/research/grossman/textbook.html> – Not only does this site have a very thorough set of corrections for all known errata, but also has the complete solutions manual online. **WARNING:** *Please be cautious in your use of the solutions. Once you see the answer worked out for you it easy to think “oh, ok, I get it” without ever really understanding how to arrive at the answer for yourself. TRY EVERY PROBLEM and come up with a reasonable answer that satisfies you BEFORE consulting the solutions!*

Other resources: Access to your CHEM 221/231 or equivalent sophomore organic text (generally McMurry’s 6th Edition of “Organic Chemistry” will be assumed) will be very valuable throughout the semester. Other items that could be helpful are the solutions manual to that text, your notes from that course sequence, and a model kit. Additional practice and remedial work on mechanisms is available in a workbook entitled “Pushing Electrons” by Daniel P. Weeks (now in its third edition.) However do not purchase any of these if you don’t have them – I’ll help you find access to them!

Prerequisites: You must have successfully completed a one-year, college-level organic chemistry course (e.g., CHEM 221/231) with grades of C- or better in each semester. In general a much higher proficiency with organic will be presumed, and you are responsible for correcting any deficiencies in your organic

chemistry background (though I am of course happy to assist you.) The requirement of CHEM 343 as a pre- or co-requisite is a formality which I will not enforce this year, as any kinetics or thermodynamics concepts involved in this course will be taught in a self-contained manner, building only on what you have learned in general and organic chemistry courses.

Goals: The basic goal of this course is to provide you with a broadened and deepened conception of organic chemistry (including organometallic chemistry), in preparation for either entering the field as a bachelors level organic chemist or making a smoother transition to graduate level course work in organic or any other field of chemistry or biochemistry.

In sophomore organic chemistry, we divided the chemistry by functional group and then by reaction, while learning mechanisms along the way. In this advanced organic course, we will divide the chemistry by mechanistic type, reviewing reactions and fundamental concepts along the way. This course can also be thought of as a bridge to further study. Graduate level organic courses often include five core courses – mechanisms, reactions, synthesis, physical organic, and spectroscopy (or structure determination). My hope is *not* to duplicate any of these courses in their entirety, but rather to give you a large amount of the first topic, and at least a taste of each of the next three, sufficient to assure a seamless transition to any of these courses at the graduate level, or to provide you with a solid foundation for a bachelors level career in organic chemistry. (It is my belief that the degree to which we cover organic spectroscopy in CHEM 221/231 at Hope is sufficient to allow you to enter into the graduate level course in this area, while other required and elective courses at Hope allow you to delve more specifically into spectroscopic theory if that is your interest.)

I will attempt to tailor the emphases of the course to the interests and foci of you, the students. Nevertheless the following list should outline the skills and content areas in which I expect you to gain new proficiency. The course will provide an excellent refresher of the content of CHEM 221/231, but a working knowledge of that material will be largely assumed. The course will build on that foundation with several fundamental goals. Upon successful completion of the course you will have:

- Learned basic patterns for major mechanistic classes in organic reactions including:
 - Nucleophilic substitution,
 - Polar addition and elimination reactions,
 - Carbonyl reactivity,
 - Aromatic chemistry,
 - Carbanionic, carbocationic, and free radical intermediates,
 - Pericyclic reactions,
 - Oxidation and reduction,
 - Organometallic reactions.
- Gained the ability to predict reasonable mechanisms for new or complex reactions based on the fundamental mechanistic types and principles outlined above.
- Been exposed to additional classes and specific examples of reactions outside the scope of the sophomore organic curriculum.
- Refreshed and increased your proficiency in stringing individual reactions into multi-step syntheses. (*Time permitting &/or in individual projects*)
- Become acquainted with a brief survey of the techniques by which the reasonable mechanisms you can now propose might be experimentally evaluated. (*Time permitting &/or in individual projects*)
- Gained increased experience and proficiency at searching the literature, summarizing information, and presenting detailed chemical concepts both formally and informally.
- Attained familiarity with some practical skills and aspects of “life as a chemist beyond Hope” (not “life as a hopeless chemist”!)

Assessment: Your progress in this course will be evaluated in multiple ways. Initial preparation and review of fundamental concepts will be evaluated with a pretest early in the semester. Your mastery of new course content will be evaluated with two full exams, a midterm and a cumulative final, each 2 hours long. Your daily preparation (as well as your scientific communication skills and your understanding of an individual special topic) will be evaluated with a class participation grade. The participation grade will include three components: a grade on your special project, an assessment of your presentation of selected homework problems in class (evaluated for each of you at least five times throughout the semester)*, and your general participation in class discussion and debate throughout the semester.

<u>Item</u>	<u>Value</u>	<u>Date</u>
<i>exams</i>		
Organic chemistry review test	50 pts	Friday 9/19 , 1:55-3:55pm
Midterm exam	100 pts	<i>Fri 10/13 or 10/24</i> , 2-4pm (TBD)
Final exam	150 pts	Tuesday 12/9 , 10:30am - 12:30pm
<i>in class</i>		
Individual Project	100 pts	tbd individually
General class participation	50 pts	cumulative 9/1 – 12/5
<u>Homework presentation*</u>	<u>50 pts</u>	<u>evaluated at least 5x/semester</u>
TOTAL	500 pts	

* **One important note:** *If your evident class preparation and performance presenting the homework (or your performance on the midterm exam) necessitates, I reserve the right to convert the existing 50 point homework presentation grade to 50 points of in class quizzes and/or graded homework assignments. I hope and expect this will not be necessary.*

The sum total points you earn in the course will determine your letter grade. A point total of 470 guarantees you no worse than an A, 410 a B, 340 a C, and 250 a D-. (+/- grades will be used within all grade ranges.) This scale may be adjusted down (*i.e.*, toward a better grade for a given point total) but not up. Therefore it is in everyone's best interest for everyone in the class to do as well as possible – you are not directly competing with one another in any way!

Attendance: Your prompt (and prepared) attendance at all class meetings is expected. This class will be conducted in an interactive format much of the time, and will include a substantial amount of time with you at the board presenting mechanisms and other homework. Your participation (in discussion and homework) makes up 20% of your course grade. Therefore, while a rare absence for illness or college sanctioned event will be excused, any unexcused absence or excessive excused absence will negatively impact this component of your grade, as well as your learning in the course. Please note that the “review” and midterm exams will be two hours long. I have slated them for days when your schedules indicate your ability to stay for an extra hour. See me ASAP if you note any conflicts. You must plan to take all exams at the scheduled time. Please note that the final exam for this class is on Tuesday, December 9, from 10:30am-12:30pm. Plan your travel at the end of the semester with this in mind! If you have prior knowledge of a serious conflict that is outside of your control with any scheduled exam, you must contact the instructor well before the date of the exam or quiz to ask for approval to take the exam at a different time. Approval is not granted automatically and should not be assumed, but allowance will be possible for conflicts that are beyond the control of the individual.

Study Hints: As in earlier organic chemistry courses, your success in this course will require a significant amount of effort. Although the concepts of organic chemistry are generally no more difficult than those of other areas chemistry, there is a lot of new material to master in this class. In addition, this course will intentionally be challenging to make it an effective bridge to graduate level course work. Efficient learning of organic chemistry takes time and requires a regular study schedule. To better reflect graduate level courses, the new content will be tested with only a midterm and a final! Last minute

cramming before an exam is not an effective study method. This is true for college and graduate school courses in general, but for this course in particular. You should plan to spend about ten to twelve hours each week outside of class studying organic chemistry and working problems. Indeed most of that time should be spent doing problems! You may need to increase this suggested time if you are having difficulty, but you should not spend a long time on a concept or problem that you don't understand before you seek help. Please see me to get help as soon as possible. Organic chemistry is necessarily cumulative – you can't just “learn it for the test” or skip the parts you don't understand. Whatever you don't learn today will haunt you tomorrow (and next month, and on the final, and in graduate school or on the job one day.) *The longer you wait, the more difficult it will be to catch up on material that you have not mastered.* Be proactive!

Reading the assigned material is a necessary part of studying organic chemistry, but you must actively work with the material to become proficient with the concepts and their applications. It is important to work each of the problems within the chapter as you come to the problem in your reading of the chapter. It is necessary to memorize some facts, rules, and definitions that are important to the understanding of organic chemistry, but you should be selective about how much you try to memorize. For example, it is generally not useful to memorize answers to problems, large tables of numerical data, or specific mechanistic examples. It is far more important to know how to solve a problem than it is to just “know” the answer. Questions on exams will seldom be exactly the same as questions from the text, but many will be similar. To reflect this, your homework grade will not just be based on putting up a right answer, but in explaining how you got to that answer!

In fact, the class itself will focus to a large extent on the “homework”. I'll certainly spend a fair amount of time “lecturing”, but the majority of the time will be spent with you presenting the problems, bouncing ideas off me and one another, and learning by doing. Think of it as lab work for your brain! Most of your career as a chemist, and indeed much of any education you pursue beyond the undergraduate level will be this sort of discussion and problem format!

Homework Problems: Chemistry is all about problems. As organic chemists we solve problems in the lab. We know we understand a concept if we can use that concept to solve or explain a problem. Working problems is essential to learning organic chemistry. You cannot expect to be able to solve problems in real life or on exams if you do not practice working similar problems while you are studying. *Many problems on tests will be similar to problems in the text.* You should work the problems within the chapters as you encounter them. You should also divide up the end of chapter problems over the course of the weeks we will be studying that chapter and progress through them on a regular basis. From time to time I may specifically assign certain problems for certain dates, or give you other problems outside those in the text. However I expect you to be working problems at all times, and coming to class with problems completed (or at least very thoroughly attempted) and ready for discussion. This will be a significant (10% portion) of your grade. I do NOT want to explicitly collect and grade homework, or to give you in class or take home “quizzes”. However I do reserve the right to do so if I do not feel you are adequately prepared for class, or if your performance on the midterm dictates that this is necessary.

In real life, problems are often worked in groups, or individually but with the group as a sounding board. I therefore heartily encourage you to work together. However you should also be sure you work some problems on your own. Otherwise it may not be apparent to you whether you truly have a personal and independent understanding of the material – if you can ONLY do the problems with your classmates, then maybe it is only your classmates that are doing the problems and you are just along for the ride!

You should use the solutions manual to check your completed answers, but be aware that some problems may have more than one correct answer. Do not immediately go to the solutions given online for the answer if you are having difficulty. If you can't solve a problem, look over the material related to the problem in the text and in your notes. If you still don't understand how to solve a problem, I strongly

encourage you to come in to see me and/or discuss the problem with your classmates. You may need to do some digging, or go to the library. Don't wait to ask questions until just before an exam – that was a bad idea in sophomore organic with our 5 exams – with just a midterm and a final it would be suicidal!

Individual Projects: Independent projects will involve choosing a topic from among several options presented by the instructor (with the goal of broadening the course beyond only covering mechanisms), researching that topic in supplemental texts, review manuscripts and articles, and articles in the primary literature, creating a general review of the topic with a few specific literature examples, and presenting a 20-30 minute talk. You will be judged on the accuracy and quality of the review, appropriateness of scope, clarity of communication (verbal delivery and presentation materials). You will have a minimum of 4 weeks to prepare for this. You'll want to use this time wisely, showing me outlines and drafts along the way. Spreading the work out over four weeks will also allow you to keep up with the other material in class while you are preparing your project. Further details and a list of topics will be available at the end of September.

Academic Integrity: Please review the Code for Academic Integrity contained in the Hope College Catalog. It is expected that we will all follow this code in this course.

You are encouraged to work homework problems together and to study together if this is effective for the individuals involved. The wholesale copying of another's work (whether that is a classmate's work or the solutions posted online) is not acceptable. You must come to class with your own worked solutions, capable of presenting the solutions and your logic behind them to the class.

Individual projects are to be your own work and reflect your own literature research and synthesis of ideas. You are expected to put these together from textbooks, reviews, and the primary literature, but plagiarism (wholesale stealing of entire passages or complete ideas, even if cited) will not be tolerated. You may get help from the instructor, classmates, or others in researching and preparing your talk, but the bulk of the work must be yours. I do encourage you to practice your talks before one another or other students or faculty, and to show me your notes and/or slides in advance.

No help may be given to or received from others on any quiz or examination. No books, review sheets, or notes may be used to assist a student during any quiz or examination.

Students who have been found to have violated the Code for Academic Integrity will receive zero credit for that assignment, quiz, or exam. That grade of zero for the assignment, quiz, or exam will **not** be dropped or replaced in calculating the final grade for the class. Any substantial or willful violation of the Code will be reported to the College administration as mandated by the Code.

I do not write letters of recommendation for any student who has been found to violate the Code for Academic Integrity.

CHEM 421 – SuperChem I Fall 2008 – Tentative Class Schedule (Test Dates Final)

Day	Date	Tentative Topic	Notes
F	8/29	Introduction, Review, Chapter 1	
M	9/1	Chapter 1, Review CHEM 221/231	Review McMurry 6 th : Ch 1-5,9,12,13,14,8-11,15
F	9/5	Chapter 1, LaaCBH #1	"Life as a Chemist Beyond Hope" #1 – Grad School
M	9/8	Chapter 1, Review CHEM 221/231	Review McMurry 6 th : Ch 6-8,10,11,14.1-7,17,18
F	9/12	Chapter 2	<i>Last day to register for October GRE Subject Test*</i>
M	9/15	Chapter 2, Review CHEM 221/231	Review McMurry 6 th : Ch 19-26
W	9/17	<i>Help Session 1-3pm</i>	<i>Review ACS Practice Test</i>
F	9/19	REVIEW TEST (CHEM 221/231)	Two Hours – 1:55-3:55pm !!!
M	9/22	Chapter 2, Introduce Projects	Project choices given
W	9/24	<i>Help Session 1-3pm</i>	<i>Go over Review Test</i>
F	9/26	Chapter 2	
M	9/29	Chapter 3	Project choices due
F	10/3	Chapter 3	<i>Last day to register for November GRE Subject Test*</i> <i>Wayne State Chemistry Graduate Research Symposium Sat 10/4</i>
M	10/6	Chapter 3	Final project assignments made
Th	10/9	<i>TENTATIVE Practice GRE Date</i>	<i>Time & Date to be confirmed 2 weeks prior</i>
F	10/10	Chapter 3, LaaCBH #2	"Life as a Chemist Beyond Hope" #2 – Great Books
M	10/13	<i>Fall Break</i>	<i>Relax, catch up on orgo?</i>
W	10/15	Monday Schedule – Chapter 4	<i>(Make sure you talk to Weds 2pm & 3pm profs)</i>
F	10/17	Chapter 4	Also McMurry 6 th Ed 14.5, 14.6, Ch 30
Sat	10/18	<i>October GRE Subject Test Date*</i>	<i>Registration deadline 9/12 (9/19 for late fee)</i>
M	10/20	Catch-up / Review	
W	10/22	<i>Help Session 1-3pm</i>	<i>Review for Midterm Exam</i>
F	10/24	MIDTERM EXAM (Ch 1-3)	Two Hours – 1:55-3:55pm !!!
M	10/27	Chapter 4	
W	10/29	<i>Midterm Exam Returned</i>	<i>Go over your exam without the key first!</i>
F	10/31	Chapter 4, <i>Midterm Exam Key Posted</i>	<i>Hertz Foundation fellowship deadline**</i> <i>Sat 11/1 – West Mi Undergrad Science Research Conf @ VARI</i> <i>Fri 10/31 - Sun 11/2 – Midstates Consortium Undergraduate</i> <i>Research Symposia (LifeSci @ Chicago, PhysSci @ Wash U)</i>
M	11/3	Chapter 4	<i>NSF GRFP deadline 11/3-10 depending on area**</i>
W	11/4	<i>Help Session 1-3pm</i>	<i>Go over Midterm Exam together</i>
F	11/7	Presentation Day 1	
Sat	11/8	<i>November GRE Subject Test Date*</i>	<i>Registration deadline 10/3 (10/10 for late fee)</i>
M	11/10	Chapter 5	
F	11/14	Presentation Day 2	
M	11/17	Chapter 6	
F	11/21	Presentation Day 3	
M	11/24	Presentation Day 4, Chapter 6	
F	11/28	<i>Thanksgiving Recess</i>	<i>Eat turkey, enjoy family & friends, study orgo?</i>
M	12/1	Chapter 6, LaaCBH #3, Surveys	"Life as a Chemist Beyond Hope" #3 – Odd glassware, cool toys, and lab rat life skills
F	12/5	Chapter 7 / Review	<i>Additional review session before final TBA</i>
Tu	12/9	FINAL EXAM (cumulative)	NEW TIME – 12:30-2:30pm SSC 2130

* See www.GRE.org for registration and information on the Graduate Record Exam General and Subject tests – you can register for the subject test up to one week late for a fee.

** For application materials and more information on these highly competitive national fellowships, see www.nsfgrfp.org and www.nsf.gov/grfp for the National Science Foundation Graduate Research Fellowship Program, and www.hertzfoundation.org for the Fannie & John Hertz Foundation Graduate Fellowship. See me and/or your research mentor for more information and mentorship in applying. Information on these and other broadly applicable national fellowship opportunities will be provided as I become aware of them, but you should also discuss other opportunities with your research mentor and/or academic advisor.