

CHEM UA 225 - ORGANIC CHEMISTRY I

Fall 2016

v.1. 7 August 2015

Room: Global Center for Academic and Spiritual Life – Stern UC 50

Lecture: T/Th 11:00-12:15

Instructor:	Professor Bart Kahr	Office: Brown 656
		Office Hours: TBA
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Welcome to your first course in Organic Chemistry!

BEFORE YOU DO ANYTHING, PLEASE READ THIS SYLLABUS

The determination of the structures of organic compounds in the latter half of the 19th Century ranks, in my view, as one of the greatest collective achievements of humankind. It stands with the greatest works of art and should be appreciated as such. Many of you may be taking organic chemistry because it is a requirement for professional school. I hope that you will learn to not only master organic chemistry, but to cultivate an appreciation for it. Needless to say, you will do better at those things that you enjoy and educational researchers have shown that those students who aspire to understand achieve better scores than those students who aspire to perform well (get good grades). Please come to the subject with an open heart and mind, not expecting chore that must be conquered but rather something that you may fall in love with.

Organic chemistry is both a science, and a language. Because phenomena involving interactions of many atoms are exceedingly complex, it is impossible to reckon organic structure and reactivity from first physical principles (without a massive computer). For this reason, the experience of organic chemistry is quite different from general chemistry where many things are calculated algebraically with precision. Past experience tells me that some of you will think that the fuzzy logic of organic chemistry is liberating, while others will find it a frustration. For the latter group, try to think of organic chemistry like a language -- a graphical language in this case. In a language class, not everything makes sense. There

* Email is a terrible mechanism for communicating organic chemistry. Responding to questions requires drawing pictures. Come to office hours! If you feel that you need to speak to me urgently, you may email bart.kahr@nyu.edu, please put "CHEM 225 URGENT" in the title of the email and I will respond as soon I am able. There are many of you and one of me. Please be respectful in your use of email. I will not respond to questions such as "what is going to be on the test"? or "what grade am I going to get in class"?

are many exceptions to the rules. We learn by listening to others speak, by trying to speak ourselves. It requires experience as much as native intelligence. In organic chemistry learning happens by watching others draw, and by drawing ourselves. There are no shortcuts to practice in the language lab, there are no shortcuts to organic chemistry problems, to copying complex mechanisms. Work them. You must gain experience. Moreover, since organic chemistry is cumulative, if you don't get on the horse and learn to ride quickly, it will be a cold winter and a flowerless spring. Try not to fall behind. Catching up is tough.

For an insightful essay about the joys and frustrations of organic chemistry, See Barbara Moran's "How to Get an A- in Organic Chemistry?" in the *New York Times*, November 1, 2013.

<http://www.nytimes.com/2013/11/03/education/edlife/how-to-get-an-a-in-organic-chemistry.html?pagewanted=1& r=0>

Recitations:

Instructors:

110	TBA		8:00AM-9:15AM	[7E12_123
111	Angelo,Nicholas	nga207@nyu.edu	9:30AM-10:45AM	[7E12_LL33
112	Angelo,Nicholas	nga207@nyu.edu	11:00AM-12:15PM	[7E12_121
113	Angelo,Nicholas	nga207@nyu.edu	12:30PM-1:45PM	[7E12_129
114	Angelo,Nicholas	nga207@nyu.edu	8:00AM-9:15AM	[25W4_C-8
115	TBA		9:30AM-10:45AM	[7E12_LL27
116	TBA		11:00AM-12:15PM	[7E12_123
117	TBA		12:30PM-1:45PM	[7E12_123
120	Oswald,Jonathan	jpo280@nyu.edu	12:30PM-1:45PM	[25W4_C-13

A successful recitation is an important part of the life of any organic chemistry course. Here is the place where you can "let your hair down," ask questions, etc.

Recitation instructors will give 10 in recitation quizzes. You have to take at least 8. You can drop the two lowest scores.

Lectures:

Data I have collected over the years shows that students who attend lecture regularly earn about 10%-15% more points than those who do not attend lecture regularly. That is a big difference. Of course, it could be that student who attend lecture are the self-selected stronger students. There is no implication of causality here. But, I would hedge my bets and attend lecture. What happens in

lecture is the business of those who attend lecture. If you miss a lecture, don't worry about missing at notes. Study the text.

Required Texts: The following textbook is required for this class and is available at the university bookstore:

Maitland Jones and Steven A. Fleming, *Organic Chemistry*, Fifth Edition, ISBN 0393931498

You are strongly encouraged to buy the solutions manual:

Maitland Jones, Jr., Henry L. Gingrich, Steven A. Fleming, *Study Guide/Solutions Manual to Accompany Organic Chemistry*, Fifth Edition, ISBN 978-0-393-93659-9

Do not read the problem and then read the solution. Success in Organic Chemistry requires working problems. I urge you to work out as many problems in Jones as you possibly can. You may check your own performance by comparing your answers with those in the Study Guide. However, it is imperative that you first struggle with the problem before consulting the solutions manual. Even though it may appear that you “understand” the material on reading the Study Guide, you may be fooling yourself. Without the struggle you will not be giving your brain sufficient time to develop the neuronal connections that enable real long-term comprehension. To encourage you to work out the problems in the book, I will typically take one or two questions **directly** from the text.

The 5th Edition of Jones costs ca. \$150 and the study guide costs \$120. If cost is a concern, you are welcome to purchase older editions on-line for considerably less money (The 4th Edition is available from Amazon for \$15-\$20). The content is very similar and you will not be ill served by an older edition, but be aware that my references to the text with pertain to the 5th Edition (because I get it for free). Check with a friend to make sure that topics are covered in parallel.

The following Molecular Model Kit is required:

Maruzen, HGS Stereochemistry Molecular Model 4010 Student Set

Molecular modeling kits are very important. Use of models is permitted in exams.

How to study: Organic chemistry is a language. It is a graphical language. You must DRAW, DRAW, DRAW. Passive learning does not work. If you find it helpful to review a mechanism by watching Khan Academy videos, that is fine. But, this is passive learning. It doesn't work for organic chemistry. You must animate organic transformations in your mind's eye. This requires READING and REREADING when you do not understand, until the process comes to life inside your head. Learning is a painful ACTIVE process. That is how new connections are made between neurons, during struggle in a quiet room. Don't search for magic answers on some website. No shortcut exists to reading and writing. Of

course, reading and writing and DISCUSSING with your classmates is even better. Group work is valuable.

Homework: It is essential to work as many problems as you are able from Jones and Fleming in advance of recitations. You will only be able to benefit from recitation if you have struggled with the problems on your own. You will only be able to ask thoughtful questions in recitations if you have struggled with the problems in advance. You have to put yourself in the mix. It won't come to you. All the problems in Jones and Fleming are important. Please don't ask which are more important than others. If you want more problems still, buy an Amazon for a couple of dollars any other organic chemistry text published in the past 20 years. You will find many other similar problems. Moreover, sometimes, when you might be confused by a particular point in the Jones textbook, having a second presentation is sometimes the key to making the "nickel drop."

Laboratory: The laboratory portion will count for 25% of your final grade.

Exams: There are three in-class midterm exams. Arrive 10 minutes early. The exams will begin promptly at 11 AM. Please note the days and times NOW. You may drop your lowest score. If you miss an exam for a valid reason of which there are three – (1) illness, (2) religious observance, or (3) university sanctioned event (eg varsity sporting event) you may take a make-up exam. Make-up exams will not be the same as the in-class exam. I would recommend avoiding make-up exams if you are able. If you miss the final exam, even for one of the valid reasons list above, you will be receive a grade of Incomplete and must finish the course in a subsequent semester otherwise the "I" becomes a permanent "F". If you miss the final exam without a valid excuse, you will receive a grade of zero on the final.

What is on the Exams? You are responsible for the content of Jones and Fleming, Chapters 1-11. Full stop. Just because I don't talk about a particular subsection in lecture does not mean that you won't be responsible for it. My job as a lecturer is not to "go over" the textbook, it is to illuminate the textbook in whatever way that I am able by expressing key concepts in complementary or supplementary fashion. My job is to assist in helping the "nickel to drop" so to speak. Exam problems will resemble those found in the text. Lectures notes will NOT be made available on classes. The text is more than a sufficient resource. If you are confused about a particular topic, re-read Jones and Fleming, come to office hours, attend recitation. It is never necessary to ask "What is on the exam"? because I just told you. Again: You are responsible for the content of Jones and Fleming, Chapters 1-11.

Excused Absences: As per university regulations, you may be excused from an exam for religious observance or illness or a university sanctioned event if you make this known in advance of the examination. The illness or university event must be documented. You may take the missed exam as the lowest exam and

suffer no penalty. If you wish to take a makeup exam, you will be giving a different exam.

Exam Re-grade Policy: Any questions on the grading of an exam must be submitted to your recitation instructor at your next available recitation. If the query is deemed appropriate, the exam will be forwarded to Professor Kahr. The entire exam will then be re-graded by Professor Kahr. A higher or lower score may result. Do not alter your exam in any way after it is returned to you. If you make marks or erasures on your exam prior to a request for a re-grade, you will obviate the possibility of reconsideration. Be apprised that we reserve the right to copy examinations after they are handed in so as to guard against alteration. Be apprised that I have no hesitation in turning students over to the university's disciplinary machinations.

Statement Concerning Disabilities: New York University provides accommodations for qualified students with disabilities. To ensure that the most appropriate accommodations are provided, students should contact the Moses Center for Students with Disabilities (CSD) (212-998-4980). Special needs for the lecture or exams should be brought to attention of the instructor no later than September 25. You must deliver all required documentation by that time and be registered with the CSD. If you wait until the exam date or close to it to inform the instructor, we may be unable to provide appropriate accommodations.

Grading Scheme: The final course grade will be calculated as follows:

First Midterm: 18%
Second Midterm: 18%
Third Midterm: 18%
Recitation Quizzes: 9%
Final Exam: 30%
Lab: 25% (assigned by Professor Henssler)

Total 100% (considering two highest midterms)

The median grade in my Organic Chemistry classes has been historically ca. B-. That means as many students do better as do poorer than B-. Significant breaks in the distribution of numerical scores establishes your letter grade so that two students separated a tiny margin do not receive different grades. There is no "curve". I set the mean and look for breaks in the distribution. If everyone earns 95-100% of points, evenly distributed, the mean is 97.5 and everybody get an A. That outcome is unlikely.

Academic Dishonesty: I expect each of you to conduct yourselves honorably. Students who violate the university rules on academic integrity are subject to disciplinary penalties including the possibility of failure in the course and dismissal from the university. The university policies on academic honesty will be

strictly enforced. See: <http://cas.nyu.edu/page/academicintegrity>

Schedule

- Sept. 6. Introduction: When did modern chemistry begin and when did organic chemistry emerge as a distinct discipline?
Key idea: Where does organic chemistry sit in the realm of human intellectual activity
- Sept. 8. Chapter 1. Lewis structures, a good idea at the time, a serviceable idea now.
Key idea: Book keeping for electrons. Given a formula and a molecular geometry, where to put electrons and how many
- Sept. 13. Chapter 1. Quantum mechanics and molecular orbital theory for organic chemists
Key idea: What is a wave function? What is it a function of? Where does it come from?
- Sept. 15. Chapter 1. Quantum mechanics for organic chemists, Part II
Key idea: How to use wave functions (orbitals) to account for molecular structure and bonding.
- Sept. 20. Chapter 2. Alkanes part I. Nomenclature, constitutional isomerism
Key idea: What is in gasoline? Sigma bonding.
- Sept. 22. Chapter 2 Alkanes part II. Conformational analysis
Key idea: How do these molecules move?
- Sept. 27. Chapter 3 Alkenes. Structure
Key idea: Pi bonding. What's the big difference between sigma and pi?
- Sept. 29. Chapter 3 Alkenes. Addition reactions
Key idea: Pi bonds as potential points of attachments in synthesis
- Oct. 4. Chapter 4. Chirality
Key idea: Handedness, a geometric property...
- Oct. 6. **MIDTERM EXAMINATION 1 (Chapters 1-3)**
- Oct. 11. **FALL BREAK**

- Oct. 13. Chapter 4 Optical activity
Key idea: ...with chemical consequences.
- Oct. 18. Chapter 5 Cycloalkanes
Key idea: Rings and how they move and how much energy they cost.
- Oct. 20. Chapter 5 Polycyclic compounds
Key idea: From cool molecules to extended structures
- Oct. 25. Chapter 6 Alkanes: Substituents, heteroatoms, reactivity
Key idea: Concept of the leaving group. Where a substitution can happen.
- Oct. 27. Chapter 7 Substitution reactions and mechanism: S_N2
Key idea: First mechanism. How to represent it.
- Nov. 1. Chapter 7 Substitution reactions and mechanism: S_N1
Key idea: Difference between first and second order kinetics.
- Nov. 3. MIDTERM EXAMINATION 2. (Chapters 4-6)**
- Nov. 8. Chapter 8 Elimination reactions: E2
Key idea: How to make pi bond from substituted alkanes.
- Nov. 10. Chapter 8 Elimination reactions: E1
Key idea: Reiteration of difference between first and second order kinetics in context of elimination reaction.
- Nov. 15. Chapter 9 Instrumental analysis: Mass spectrometry and spectroscopy (UV-vis and infrared)
Key idea: Interaction with light and matter. How electromagnetic radiation excites electrons and why?
- Nov. 17. Chapter 9 Instrumental analysis: NMR fundamentals
Key idea: The Queen of organic spectroscopies and the basic theory about how it works.
- Nov. 22. Chapter 9 Instrumental analysis: NMR applications

Key idea: How NMR can be used to assign structure

Nov. 24. **THANKSGIVING BREAK**

Nov. 29. Chapter 10 More on addition reactions

Key idea: In the next four lectures will we encounter many examples of new reactions that are valuable. The key ideas that follow are less general and more idiosyncratic. Some memorization of outcomes and mechanisms is required here.

Dec. 1. Chapter 10 Polymerization and anti-Markonikoff addition

Key idea: How to get addition reactions to go "backwards" compared to the norm.

Dec 6. MIDTERM EXAMINATION 3 (CHAPTERS 7-9)

Dec. 8. Chapter 11 Halogenation, oxymercuration, epoxidation, cyclopropanation

Key idea: Here you are beginning to build your toolbox of reactions. Get a box and fill them with index cards

Dec 13. Chapter 11 Ozonolysis, hydrohalogenation, hydration, hydrogenation

Key idea: More index cards

Dec. 23. Friday 8:00 AM-9:50 AM

FINAL EXAMINATION (CUMULATIVE with 50% emphasis on CHAPTERS 10, 11)