

Course syllabus for Chemistry 109C

Organic Chemistry

Class meets: M, W, F **10:00 – 10:50 AM** **Chem 1179** **Spring 2007**

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Office Hours: Tue 12:30- 1:30 PM; Fri 11:00-12:00 AM
Course website: <http://www.chem.ucsb.edu/~kalju/chem109C>

Textbooks:

Required: Paula Y. Bruice, Organic Chemistry, 5th Ed., Prentice Hall, 2007
Recommended: (a) Study Guide and Solutions Manual, (b) Molecular Model Kit
Textbook website: <http://www.prenhall.com/bruice/details.html>

The Course:

Chem 109C is the last course of a three-course sequence (Chem 109A-B-C). The Chem 109 sequence provides the students fundamentals of organic chemistry and is mainly intended for students in the field of chemistry and biology.

The current course, Chem 109C, has three foci:

- 1) Exploration of molecular orbital (MO) theory in predicting chemical reactivity. We will review basic concepts of the MO theory and discuss how orbital symmetry considerations allow predicting stereochemical outcomes of pericyclic reactions.
- 2) Structure and reactions of organic compounds found commonly in living organisms: carbohydrates, lipids, amino acids, peptides, nucleotides, nucleic acids, and coenzymes. These topics make up the bulk of the course
- 3) Application of organic chemistry in design and synthesis of drugs and polymers. Substituent effects on reactivity and ionization of substituted benzenes will be discussed in relation to quantitative structure-activity relationships (QSAR).

Expectations of Students:

- 1) Attendance and taking good lecture notes is expected. Supplementing the lecture notes with study notes based on the textbook is a good way to improve your chances to be successful in this course.
- 2) The practice problems in the book are an excellent way to learn the material. Try to answer them as you read the textbook. I strongly recommend that you do at least the ones I have suggested in the syllabus. The answers to these problems are not to be turned in, but you are likely to do well in the exam when you can independently answer majority of the practice problems.
- 3) “Vitamin” problems are two un-graded homework assignments each week that you are strongly encouraged to solve independently. They will be posted on the course website at the beginning of each week and are “due” each Friday; answer strategies will be discussed in the Friday class.
- 4) Graded quizzes are unannounced (i.e. “pop” quizzes). The quiz questions will be very similar to the “vitamin” problems that we have worked out in the class. The highest three quiz grades will be counted in your final grade. At least 5 quizzes will be given during the quarter. If you miss a quiz for any reason, this will be one of your dropped scores.
- 5) Two mid-terms and a final exam will be given. The two mid-terms test your *knowledge* of topics covered prior to exam. The final exam will cover all the topics that were taught in this course and also tests your ability to *understand* the material. Exam questions will be largely based on material covered in the lecture.
- 6) There are no make-up exams. If you know in advance that you will have a legitimate reason (UCSB sports team, field trip, surgery, etc.) to miss an exam, inform the instructor at least one week in advance and provide the appropriate written documentation. In case of medical emergency, provide a verifiable doctors excuse stating that you “could not take the exam due to an illness”.
- 7) Honesty and academic integrity must be always preserved. While working with others is encouraged outside the classroom, you must answer the quiz and exam questions individually. All exams will be closed book; no calculators or other materials are permitted.
- 8) No student shall give, sell, or otherwise distribute to others or publish any electronically available course materials or recordings made during any course presentation without the written consent of the instructor.
- 9) The grade is based on the number of points out of 450 points total. Grading will be based on the curve but you have to meet a certain level to get grade higher than F. Your points will come from the following sources:

Midterm 1:	100 pts
Midterm 2:	100 pts
Final exam:	190 pts
Quizzes:	60 pts total

Topics covered:

The following table shows the order of topics, reading, and suggested problems. Sometimes I make references to my Biochemistry Lecture slides; these are strictly optional and not required to be successful in this course (they may help you in understanding the relevance of chemistry to biology, though).

The problems cover topics that I consider to be important. I suggest that you look at all of these problems and try to do as many as possible. You should try to work each problem to the best of your ability before you look at the answer.

Week 1: April 2 – April 6

Molecular Orbital Theory. Review of principles of organic reactivity. Electron delocalization revisited, conjugated π systems. Frontier orbital theory and the Diels-Alder reaction, Ultraviolet Spectroscopy of conjugates π systems. We will go over the key concepts from Chapters 1.6, 1.22, 7.1, 7.5, 7.6, 7.9, 7.11, 7.12, 12.16. Hopefully, this is a review for most of you.

Practice problems: 12 (34, 35, 36, 46, week1 vitamin problem)

Carbonyl Reactivity, Part 3. Reactivity due to an α -carbon in carbonyl compounds. The acidity of the α -hydrogen. Keto-enol tautomerization. Reactivity of enols and enolates. Halogenation at the α -carbon. Alkylation of the β -carbon in α,β -unsaturated aldehydes and ketones. Aldol addition and aldol condensation. A Claisen condensation of esters. Decarboxylation of 3-oxocarboxylic acids. Modern synthetic strategies for carbon-carbon bond formation using enolate chemistry. Examples of biological reactions involving the α -carbon. This is Chapter 18.

Practice problems: 18(1, 5, 8, 11, 20-26, 29, 30, 48, 50, 53, 55, 67, 72)

Week 2: April 9 – April 13

Carbohydrates. Focus in on structure, stereochemistry, and reactions. Essentially all of Chapter 22 is relevant. If you have modeling kit, practice building open and closed-chain forms of D-glucose, D-mannose, and D-galactose. See my Biochemistry Lecture Slides if you want to learn more about properties and biological roles of saccharides.

Practice problems: 21(4, 10, 17, 18, 27, 30, 33-41, 53, 54)

Week 3: April 16 – April 20

Carbohydrates / Amino Acids. Focus in on structure, stereochemistry, and reactions. Do not worry remembering pK_a values of individual amino acids. Chapter 22.1 – 22.6 will be covered. If you have modeling kit, practice building amino acids glycine, alanine, serine, cysteine, aspartic acid, glutamic acid, lysine, phenylalanine, and tyrosine.

Practice problems: 22 (8-11, 44, 46, 48, 51, 52, 63)

Week 4: April 23 – Apr 27

Midterm I on Wednesday, Apr 25. Test topics: Material covered in weeks 1 – 3.

Peptides and Proteins. Focus in on analysis and synthesis of peptides and proteins (Chapter 22.7 – 22.12). See my Biochemistry Lecture Slides if you want to learn more about properties and biological roles of peptides and proteins.

Practice problems: 22(45, 54, 55, 64, 65, 66)

Week 5: April 30 – May 4

Catalysis. Everything in Chapter 23. See my Biochemistry Lecture Slides if you want to learn more about enzyme catalysis.

Practice problems: 23(14, 20, 28, 29, 30, 35, 36)

Coenzyme Mechanisms. This is a very information-rich chapter and we are not required to study all of it (unless you are planning to go to medical school, of course!). I will cover the Introduction, the redox chemistry of NAD^+/NADH (Chapter 24.2), some aspects of the chemistry of FAD and FMN (Chapter 24.3), and the chemistry of tetrahydrofolate (Chapter 24.8)

Practice problems:

Week 6: May 7 – May 11

Coenzyme Mechanisms (continued).

Lipids. Focus in on structure, properties, and reactions. However, do not worry about memorizing data such as melting point values or percentages in food. I plan to cover Chapters 26.1 to 26.5 first. If time permits, I will bring in extra material beyond what the textbook provides about analysis of lipids. See my Biochemistry Lecture Slides if you want to learn more about properties and biological roles of peptides and proteins.

Practice problems:

Week 7: May 14 – May 18

Biosynthesis of terpenes and cholesterol (Chapter 26.8 - 26.10). Synthetic steroids. (Chapter 26.11)

Nucleosides and Nucleotides. Focus is on structure and reactivity. Chapters 27.1 – 27.6 will be covered.

Practice problems:

Week 8: May 21 – May 25

Nucleic acids. Focus in on structure, function, and biosynthesis. However, no need to memorize the codon table. Chapters 27.7 – 27.12 will be covered. See my Biochemistry Lecture Slides if you want to learn more about properties and biological roles of nucleic acids.

Nucleic Acids. Focus is on analysis and chemical synthesis (Chapters 27.15-27.16). If time permits, review for Midterm II.

Practice problems:

Week 9: May 28 – June 1

Memorial Day Holiday on May 28

Mid-term II on Wednesday, May 30. Test topics: Material covered in weeks 4– 8

Synthetic Polymers. Only a brief overview will be given on radical polymerization, cationic polymerization, and anionic polymerization. Polymerization of dienes is discussed. Stereochemistry of polymerization. Chapter 28.1 – 28.4 will be covered.

Practice problems:

Week 10: June 4 – June 8

Organic Chemistry of Drugs. Focus will be on principles of lead modification, and combinatorial synthesis. Supplementary material in addition to Chapters 30.1-30.3 and 30.11 will be used.

Quantitative Structure Activity Relationships in Drug Design. We will start by reviewing reactivity and ionization behavior of substituted benzenes to rationalize substituent effects; then proceed to show how electronic substituent parameters are obtained. Supplementary material in addition to Chapters 16.3 – 16.5 and Chapters 30.9 will be used.

Final Exam. Time T.B.A.

Good luck! — Kalju.