CHEM 2310 • Advanced Organic Chemistry 1 • Fall 2018
MW 1200 – 1315, 228 Eberly Hall

Instructor: Dr. Yiming Wang
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Office hours (subject to revision): W 1000 – 1200, F 1400 – 1600, and by appointment
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Official course description: A discussion of the tools, both modern and classical, that are the basis of mechanistic interpretations of relations between structure and reactivity. Special emphasis is placed on the detailed molecular level analysis of organic molecules, including the transient reactive intermediates: carbanions, carbocations, carbenes, and radicals, to develop a predictive sense for reactivity. The factors that influence equilibria, product distribution, and reaction mechanisms are also explored.

Prerequisites: Enrollment as a graduate student in chemistry, a grade of A– or higher in CHEM 0320/0740, a grade of B+ or higher in CHEM 1310, or instructor permission.

Learning objectives: *This is a graduate-level course in organic reaction mechanisms and the principles of physical organic chemistry*. By the end of this course, you should be able to: 1) predict or rationalize the outcome of a reaction on the basis of molecular structure and chemical principles; 2) propose a reasonable mechanism for a reaction using known reactivity patterns and experimental data; 3) select and apply appropriate experimental tools to elucidate a reaction mechanism.

Diagnostic quiz: A diagnostic quiz on undergraduate organic chemistry (allotted time: 30 min, 50 pts.) will take place during the first class meeting. The quiz will be scored but will not count towards your course grade. A low score on the quiz (< 25 pts.) indicates insufficient preparation for the course. If you received a low quiz score, you are strongly encouraged to schedule an appointment with me to discuss strategies to patch up gaps in your knowledge of chemistry, improve your test taking skills, or, in some cases, discuss whether it would be beneficial to postpone enrollment in CHEM 2310 until next year.

Grading policy: Course performance will be evaluated using the total number of points earned on quizzes, problem sets, and exams as a guide. Final letter grades will reflect a combination of how well learning objectives are met (*see the grading criteria below*) with consideration (up to $^1/_3$ of a letter grade) of the quantity and quality of effort exerted. Letter grades will neither be assigned using an absolute scale, nor fitted to a predetermined distribution ("on a curve"): you are not competing against your classmates.

- Two graded quizzes: 2 × 50 pts. = 100 pts. (10%)
- Three problem sets: 3 × 100 pts. = 300 pts. (30%)
- Two midterm exams: 2 × 150 pts. = 300 pts. (30%)
- Final exam: 300 pts. (30%)* $\sum$ = 1000 pts. (100%)

* If you did well on both midterm exams and quizzes, you may elect to not take the final, in which case the sum of your midterm and graded quiz scores will be scaled by a factor of $^7/_4$.

Grading criteria: An **A+/A/A–** grade indicates a *deep understanding* of the course material, characterized by the ability to consistently and creatively apply concepts and extrapolate broad-based knowledge to solve problems on chemical systems not explicitly described during lecture or in the problem sets. A **B+/B** grade indicates a *good understanding* of the course material, characterized by the accurate recall of concepts and facts discussed during lecture, though ability to deal with unfamiliar chemical systems is somewhat limited. A **B–** grade indicates a *partial understanding* of the course material, characterized by an incomplete or flawed recall of concepts and significant gaps or errors in factual knowledge. A **C** grade indicates an *inadequate understanding* of the course material, characterized by widespread gaps or errors in conceptual understanding and factual knowledge. A **D/F** grade reflects unacceptably low effort or the result of disciplinary action following a serious infraction of academic integrity.

Required textbooks: *Available from the University bookstore and online retailers:* **I.** Norman, R. O. C.; Coxon, J. M. *Principles of Organic Synthesis*, 3rd ed.; CRC Press: Boca Raton, Fla., 1993 (ISBN 0748761624). **II.** Anslyn, E. V.; Dougherty, D. A. *Modern Physical Organic Chemistry*; University Science Books: Mill Valley, Calif., 2006 (ISBN: 1891389319). A student solutions manual for *Modern Physical Organic Chemistry* is available. I can lend you my copy for short periods of time to check answers to end-of-chapter exercises.

Recommended resources: I. A useful collection of guidelines and practice problems for arrow pushing: Grossman, R. B. *The Art of Writing Reasonable Organic Reaction Mechanisms*, 2nd ed.; Springer: New York, 2003 (ISBN 0387954686). **II.** An excellent review of undergraduate organic chemistry: Clayden J.; Greeves, N.; Warren, S. *Organic Chemistry*, 2nd ed.; Oxford University Press: Oxford, 2012 (ISBN 0199270295). **III.** A graduate organic chemistry workbook: Burgess, K. *Organic Chemistry by Inquisition*; Inquisition Press, 2009 (ISBN 0615290744). **IV.** A concise primer on orbital interactions in organic chemistry: Kirby, A. J. *Stereoelectronic Effects*; Oxford University Press: Oxford, 1996 (ISBN 0198558937).

Assigned reading: At the end of each Wednesday class meeting, portions of *Principles of Organic Synthesis* or *Modern Physical Organic Chemistry* (on average 25 – 30 pages per week) will be assigned as required reading for the following week. It is important to come to class prepared by doing the assigned reading before class.

Graded quizzes: Two graded quizzes (allotted time: 30 min, 50 pts. each) will take place from **1245** to **1315** on **19 Sep** and **10 Dec 2018.** The first quiz will cover the basic language of organic chemistry reviewed in the first four weeks of class, including structure, bonding, and the curved arrow formalism. The second quiz will focus on material covered after the second midterm.

Problem sets: Three problem sets (100 pts. each) will be assigned as homework. The problem sets offer a valuable opportunity to practice your problem solving skills and deepen your understanding of the course material. You will be given at least two weeks to work on them. *Please start them early!* I will be happy to help you arrive at the correct answer during office hours, but only after you have made an honest attempt to solve the problem on your own. Unexcused late problem sets will be assessed a penalty of 1/3 of its original point value each day after the due date. Working with your classmates is permitted and encouraged. *However, the solutions you submit need to reflect your own understanding, and plagiarism will not be tolerated.* If you obtain a key insight for solving a problem from a classmate, please include an acknowledgement for their contribution. Illegible responses may incur a loss of credit.

Exams: Two midterm exams (allotted time: 90 min, 150 pts.) will take place from **1200** to **1330** on **17 Oct** and **14 Nov 2018**. Midterm exams will focus on the topics covered after the previous exam or quiz. Nevertheless, due to the nature of the course material, the reappearance of fundamental concepts from earlier lectures is unavoidable. The final exam (allotted time: 180 min, 300 pts.) will be cumulative. During each exam, you may bring one $8^{1}/_{2}$″ × 11″ sheet of handwritten notes and a molecular model set of your choosing. No other exam aids are permitted (no calculators). You will be provided with scrap paper to work out your answers, but only the responses in your exam packet will be graded. Illegible responses may incur a loss of credit. Except under rare circumstances, exams cannot be made up. However, you may take the exam up to 24 hours before the scheduled time if you anticipate a conflict.

Points recovery policy: For the graded quizzes and midterm exams, you may choose *one* free response question for recovery of up to the full point value of that problem by finding the primary reference on which the problem is based and concisely summarizing (500 – 750 words, 1 – 2 figures or schemes) the main findings of the study.

Absences: If you have a planned absence for a family obligation, medical appointment, or religious observance, please let me know as soon as possible, in order for reasonable accommodations to be made. If you were absent for a quiz, midterm, or problem set due date due to an emergency, please provide documentation to have your absence excused. Alternate assignments or a modified grading scheme can be arranged in the case of excused absences, while an unexcused absence may result in a zero grade.

***Student Opinion of Teaching Surveys*:** Students in this class will be asked to complete a *Student Opinion of Teaching Survey* by the Office of Measurement & Evaluation of Teaching (OMET). Surveys will be sent via Pitt email and appear on your *CourseWeb* landing page during the last three weeks of class meeting days. Your responses are anonymous. Please take time to provide comments, suggestions, and criticisms for any aspect of the course, including format, content, policies, and overall effectiveness. Your feedback is very valuable, and your responses will be taken into account in future iterations of this course.

***University Policies on Academic Integrity*:** Students in this course will be expected to comply with the University of Pittsburgh's Policy on Academic Integrity. Any student suspected of violating this obligation will be required to participate in the procedural process, initiated at the instructor level, as outlined in the University's *Guidelines on Academic Integrity* (provost.pitt.edu/sites/default/files/academic_integrity_guidelines.pdf). In particular, please take note of the following University statement on academic integrity:

> *Cheating/plagiarism will not be tolerated. Students suspected of violating the University of Pittsburgh Policy on Academic Integrity, from the February 1974 Senate Committee on Tenure and Academic Freedom reported to the Senate Council, will be required to participate in the outlined procedural process as initiated by the instructor. A minimum sanction of a zero score for the quiz or exam will be imposed.*
> — Academic Integrity Statement for Syllabi

***University Policies on Disability Services*:** If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services (DRS, www.studentaffairs.pitt.edu/drs/), 140 William Pitt Union, (412) 648-7890, drsrecep@pitt.edu, (412) 228-5347 for P3 ASL users, as early as possible in the term. Disability Resources and Services will verify your disability and determine reasonable accommodations for this course.

Course schedule & outline (subject to change; check Blackboard for announcements):

Problem set due dates: 12 Sep, 10 Oct, and 7 Nov 2018

27 Aug – 17 Sep 2018 (7 class meeting days): Lewis structures and valence bond theory, orbital interactions, stereoelectronic effects, thermochemistry, conformational analysis and strain, aromaticity.

Quiz #1: 1245 – 1315, 19 Sep 2018, 228 Eberly

19 Sep – 10 Oct 2018 ($6^3/_5$ class meeting days): Acid-base theories, stereochemistry, transition state theory, kinetic analysis, catalysis. **No class 15 Oct (Fall Break)**

Midterm #1: 1200 – 1330, 17 Oct 2018, 228 Eberly

22 Oct – 12 Nov 2018 (7 class meeting days): Linear free energy relationships, kinetic isotope effects, and other tools for elucidation of reaction mechanisms.

Midterm #2: 1200 – 1330, 14 Nov 2018, 228 Eberly

19 Nov – 12 Dec 2018 ($6^3/_5$ class meeting days): Hückel theory, Möbius and Hückel aromaticity, pericyclic reactions, Woodward–Hoffmann rules. **No class 21 Nov (Thanksgiving Break)**

Quiz #2: 1245 – 1315, 10 Dec 2018, 228 Eberly

Final exam: 14 Dec 2018, time and location TBA