ENCH 245
Applied Organic Chemistry
Winter, 2023

LECTURE: Chernoff Hall, Room 117: Mon 9:30 AM, Wed 10:30 AM, Fri 9:30 AM
TUTORIAL: Chernoff Hall, Room 117: Fr 8:30 AM (starting Jan 20)
LAB: Chernoff Hall, Room 118. Three Sections: 002 Mon 2:30 pm; 003 Tues 8:30 AM; 004 Tues 2:30 PM

Course Description

ENCH 245 is an organic chemistry course offered to students in Engineering Chemistry and Chemical Engineering. The course builds on concepts introduced in ENCH 211 and ENCH 212 and will primarily focus on the introduction to organic reactions and the mechanisms for some important chemical transformations. Examples of industrial chemical processes will be used throughout the course to demonstrate the practical applications of these reactions. The laboratory component of this course will provide students with experience in organic synthesis and the practical aspects of the chemistries covered in lecture.

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Lab: Chernoff Hall, Room 118.
Office Hours and Evening Help Sessions: TBA

TUTORIAL Teaching Assistants
Samantha Hollands
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Shannon Whitty
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Textbook: *Organic Chemistry*, 2nd Edition; Clayden, J.; Greeves, N.; Warren, S. Oxford University Press, New York, 2012.
Note: The following chapters of this textbook were covered in ENCH 211 and ENCH 212: Chapters 2, 4, 5, 7, 8, 12, 14, 15, 16, and 17. You are responsible for all the assigned reading, which may be changed or supplemented during the course.

Lecture Notes: PDF copies of the slides and any additional material deemed essential will be released via the OnQ site.

Problems: Each chapter has a series of problems. Students are expected to complete these problems to supplement the material covered in lecture. Answers to these questions are available in the "Solutions Manual" that accompanies the textbook. Additional practice questions can be sourced from most organic chemistry textbooks.

Laboratory: The laboratory will consist of 10 in-person laboratory experiments. The first lab check-in sessions will begin **Jan 9–10**, depending on your section. Please purchase the **2023 ENCH 245 Laboratory Manual** and **carbon-copy lab notebook** in Chemistry Stores (Room 109, Chernoff Hall) before your first lab session, if possible. You will work with a lab partner to conduct experiments and write a combined lab report each week, submitted to your TA. The lab manual has further details, and a Schedule of Lab Experiments is posted on the ENCH 245 onQ site, along with an Announcement containing laboratory information.

Grading Scheme

- Laboratory (10 in-person experiments) 25%

Department of Chemistry Policy on Missed Labs: Laboratory work is an integral part of this course. All labs must be completed to pass the course. It is the responsibility of the student to notify the Lab Coordinator when a lab cannot be completed at the scheduled time. In exceptional circumstances, the following considerations will be given if a scheduled lab cannot be completed at the assigned time. Whenever possible, provisions will be made for a make-up lab preferably shortly before or after the missed experiment. The lab may be completed during the following academic year and a course mark of IN will be assigned until the missing work is completed. In rare circumstances, other accommodations may be made. For further information please consult the Laboratory Manual or Lab Coordinator.

OnQ: Grades and relevant information will be posed on the onQ site for this course.

Examinations: Three examinations are scheduled on the following dates:

> ***Mid-term Exam 1*** **– Wed February 1, 2023 @ 5:30 – 6:30 PM, Chernoff Auditorium**
> ***Mid-term Exam 2*** **– Wed March 8, 2023 @ 5:30 – 7:30 PM, Chernoff Auditorium**
> ***Final Exam*** **– TBA (3-hr duration)**

Grading Scheme

- Laboratory (10 in-person experiments) 25%
- Mid-Term 1 10%
- Mid-Term 2 20%
- Final Exam 45%

Students must pass **both** the lecture (out of 75) **and** the laboratory (out of 25) components to pass the course. If a student does not pass both components, they will effectively fail the course.

Learning Outcomes

Upon completion of this course, students will be able to:

1. Identify reactive sites in organic molecules within the context of the reaction mechanisms of chemical transformations.
2. Decipher classes of mechanisms for important chemical transformations and draw complete reaction mechanisms for these reactions.
3. Predict the outcomes of chemical reactions based on specific regents and conditions.
4. Apply developed mechanistic understandings to address problems that are translatable to reactions of industrial importance.
5. Use tools and techniques commonly required for the synthesis of organic molecules.

Course Outline

The following list represents course topics, associated readings, and selected problems from the assigned textbook. You are expected to have reviewed **ALL** of this material.

1. **Introduction to Reaction Mechanisms**: Ch. 5 & Ch. 39 (Review only)
   a. Ionic reactions – Ch. 5; Problems 1, 2, 3, 4.
2. **Nucleophilic addition and substitution**: Ch. 6, 9, 10, 11, 15, and 22
   a. Nucleophilic addition to carbonyl groups – Ch. 6, p. 125 – 137; Problems 1, 2, 4, 7 – 10.
   b. Organometallic reagents – Ch. 9; Problems 1, 2, 4, 5.
   c. Nucleophilic alkyl substitution – Ch. 15 (Review); Problems 1, 2, 3, 5.
   d. Nucleophilic acyl substitution – Ch. 10; Problems 1 – 6.
   e. Equilibria, rates, and mechanisms – Ch. 12; Problems 2, 3, 7, 8, 10.
   f. Nucleophilic acyl addition/condensation – Ch. 11; Problems 1 – 5.
   g. Electrophilic Aromatic Substitution (Review) – Ch. 21.
   h. Conjugate addition – Ch. 22, p. 498 – 513; Problems 2, 3, 4, 10.
   i. Nucleophilic aromatic substitution – Ch. 22, p. 413 – 527; Problems 6 – 9.
3. **Enols and Enolates** – Ch. 20, 25, and 26.
   a. Alkylation of enolates – Ch. 25; Problems 1, 2, 4, 5, 6.
   b. The Aldol reaction – Ch. 26, p. 614 – 640; Problems 1, 3, 4, 6, 9.
4. **Electrophilic Addition to Alkenes** – Ch. 19; Problems 1, 2, 3, 5, 7.
   Hydration, isomerization, dihalides, halohydrins, solvolysis, oxymercuration-reduction, Wacker-Hoest Process, Hydroboration-oxidation, epoxidation, peroxy acids.
5. **Oxidations and Reductions** – Ch. 23.
   Oxidation numbers/states, hydride reductions, metal-catalyzed hydrogenation and hydrogenolysis, dissolving metal reductions, carbonyl reductions (p. 528 – 534), oxidations (p. 544 – 547), oxidizing agents, oxidation of alkenes, oxidation of alcohols, Jones oxidation, Swern oxidation.
6. **Cycloaddition and Rearrangements** – Ch. 34; Problems 1, 2, 8, 11; Ch. 36; Problems 2, 8.
   Diels Alder reaction, 1,3-Dipolar cycloadditions, Baeyer–Villiger Rearrangement, Beckmann Rearrangement. *If time permits*: Carbocation Rearrangements/Fuel Chemistry, Pinacol Rearrangement, Cumene hydroperoxide Rearrangement.
7. **Free Radical Reactions** – Ch. 37; p. 970 – 974; 977 – 1002.
   Homolysis, structure of radicals, bond dissociation energies, initiation, propagation, termination, cross-linking, radical addition, scission/fragmentation, atom abstraction, radical rearrangement, industrial examples, polymer modifications, oxidative degradation of polymers, halogenation of alkenes, free radical halogenation and polymerization.
8. **Industrial Polymerization**
   Review of key reactions in polymer chemistry.

Grading Method

All components of this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to Queen's Official Grade Conversion Scale:

Queen's Official Grade Conversion Scale

Grade	Numerical Course Average (Range)
A+	90-100
A	85-89
A-	80-84
B+	77-79
B	73-76
B-	70-72
C+	67-69
C	63-66
C-	60-62
D+	57-59
D	53-56
D-	50-52
F	49 and below

Timing of Final Examinations

The exam dates for each Term are listed on the Faculty of Arts and Science webpage under "Important Dates." Student exam schedules for the Fall Term are posted via SOLUS immediately prior to the Thanksgiving holiday; for the Winter Term they are posted on the Friday before Reading Week, and for the Summer Term they are individually noted on the Arts and Science Online syllabi. **Students should delay finalizing any travel plans until after the examination schedule has been posted. Exams will not be moved or deferred to accommodate employment, travel/holiday plans or flight reservations.**

Academic Integrity

Queen's students, faculty, administrators and staff all have responsibilities for upholding the fundamental values of academic integrity; honesty, trust, fairness, respect, responsibility and courage (see www.academicintegrity.org). These values are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University (see the Senate Report on Principles and Priorities http://www.queensu.ca/secretariat/policies/senate/report-principles-and-priorities).

Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments and their behavior conform to the principles of academic integrity. Information on academic integrity is available in the Arts and Science Calendar (see Academic Regulation 1 http://www.queensu.ca/artsci/academic-calendars/regulations/academic-regulations/regulation-1), on the Arts and Science website (see https://www.queensu.ca/artsci/students-at-

queens/academic-integrity), and from the instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

Calculator Policy

As noted in Academic Regulation 9.2, "Calculators acceptable for use during quizzes, tests and examinations are intended to support the basic calculating functions required by most Arts and Science courses. For this purpose, the use of the **Casio 991 series calculator** is permitted and is the only approved calculator for Arts and Science students."

Technology

Web Browsers – onQ performs best when using the most recent version of the web browsers, Chrome or Firefox. Safari and Edge are strongly discouraged as these web browsers are known to cause issues with onQ.

Internet Speed – While wired internet connection is encouraged, we recognize that students may be relying on a wireless connection. A minimum download speed of 10 Mbps and up to 20 Mbps for multimedia is recommended. To test your internet speed, https://www.speedtest.net/

For technology support ranging from setting up your device, issues with onQ to installing software, contact ITS Support Centre https://www.queensu.ca/its/itsc

Copyright of Course Materials

Course materials created by the course instructor, including all slides, presentations, handouts, tests, exams, and other similar course materials, are the intellectual property of the instructor. It is a departure from academic integrity to distribute, publicly post, sell or otherwise disseminate an instructor's course materials or to provide an instructor's course materials to anyone else for distribution, posting, sale or other means of dissemination, without the instructor's *express consent.* A student who engages in such conduct may be subject to penalty for a departure from academic integrity and may also face adverse legal consequences for infringement of intellectual property rights.

Acknowledgement of Territory

Queen's University is situated on traditional Anishinaabe and Haudenosaunee Territory.

Accommodations for Disabilities

Queen's University is committed to achieving full accessibility for people with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. The Senate Policy for Accommodations for Students with Disabilities was approved at Senate in November 2016 (see https://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/senateandtrustees/ACADACCOMMPOLICY2016.pdf). If you are a student with a disability and think you may need academic accommodations, you are strongly encouraged to contact the **Queen's Student Accessibility Services (QSAS)** and register as early as possible. For more information, including important deadlines, please visit the QSAS website at: http://www.queensu.ca/studentwellness/accessibility-services/

Academic Considerations for Students in Extenuating Circumstances

Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances that are beyond their control and are interfering with their ability to complete academic requirements related to a course for a short period of time. The Senate Policy on Academic Consideration for Students in Extenuating Circumstances is available at http://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/senateandtrustees/Academic%20Considerations%20for%20Extenuating%20Circumstances%20Policy%20Final.pdf

Each Faculty has developed a protocol to provide a consistent and equitable approach in dealing with requests for academic consideration for students facing extenuating circumstances. Arts and Science undergraduate students can find the Faculty of Arts and Science protocol and the portal where a request can be submitted at: http://www.queensu.ca/artsci/accommodations. Students in other Faculties and Schools who are enrolled in this course should refer to the protocol for their home Faculty.

If you need to request academic consideration for this course, you will be required to provide the name and email address of the instructor/coordinator. Please use the following:

Instructor Name: Dr. Jason Z. Vlahakis
Instructor Email Address: vlahakis@queensu.ca

Discussion Guidelines

University is a place to share, question and challenge ideas. Each student brings a different lived experience from which to draw upon. To help one another learn the most we can from this experience please consider the following guidelines.

1. Make a personal commitment to learn about, understand, and support your peers.
2. Assume the best of others and expect the best of them.
3. Acknowledge the impact of oppression on the lives of other people and make sure your writing is respectful and inclusive.
4. Recognize and value the experiences, abilities, and knowledge each person brings.
5. Pay close attention to what your peers write before you respond. Think through and re-read your writings before you post or send them to others.
6. It's ok to disagree with ideas, but do not make personal attacks.
7. Be open to being challenged or confronted on your ideas and to challenging others with the intent of facilitating growth. Do not demean or embarrass others.
8. Encourage others to develop and share their ideas.