

**ENCH 245**  
**Applied Organic Chemistry**  
Winter, 2022

**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.

**Instructor:** Prof. Graeme Howe

**Instructor Contact Information:**

Chernoff Hall, Rm 512, Ph: (613) 533-6089, email: [graeme.howe@queensu.ca](mailto:graeme.howe@queensu.ca)

**Office Hours:** Tuesdays and Thursdays – 2:30PM to 3:30PM (via Zoom)

Tuesday Zoom Meeting:

<https://queensu.zoom.us/j/97818651480?pwd=T3dScTNEeHh1ekVOS3A4aXZjeFUwQT09>

Meeting ID: 978 1865 1480; Passcode: 414322

Thursday Zoom Meeting:

<https://queensu.zoom.us/j/96648966248?pwd=SGcxUjc3MzNzemh0aWlCbUlXT1hiQT09>

Meeting ID: 966 4896 6248; Passcode: 062800

If the above office hours are inconvenient or insufficient, additional appointments can be scheduled via email.

**Teaching Assistants:**

Mark Aloisio ([mda5@queensu.ca](mailto:mda5@queensu.ca))

Neil Grenade ([nlg2@queensu.ca](mailto:nlg2@queensu.ca))

Joshua Kofsky ([jk167@queensu.ca](mailto:jk167@queensu.ca))

Pascal Vogt ([pmv1@queensu.ca](mailto:pmv1@queensu.ca))

**Tutorials:** Wednesdays 10:30AM – 11:30AM, via Zoom; **Tutorials begin Jan. 19, 2022**

Last Name Begins With...	Zoom Meeting Info
A – Cl	<a href="https://queensu.zoom.us/j/96107216890?pwd=SzQyYUVma1p1ZnErbnpEYXpTNVfVzZ09">https://queensu.zoom.us/j/96107216890?pwd=SzQyYUVma1p1ZnErbnpEYXpTNVfVzZ09</a> Meeting ID: 961 0721 6890 Passcode: 291593
Co – Ho	<a href="https://queensu.zoom.us/j/92655800255?pwd=QmdqMGdHODB5ZEpaRHpVcU5ldFpZdz09">https://queensu.zoom.us/j/92655800255?pwd=QmdqMGdHODB5ZEpaRHpVcU5ldFpZdz09</a> Meeting ID: 926 5580 0255 Passcode: 270610
Hu – O	<a href="https://queensu.zoom.us/j/99722424215?pwd=YmROUVhTVEE2dzBZNUQzSkdRR0ttZz09">https://queensu.zoom.us/j/99722424215?pwd=YmROUVhTVEE2dzBZNUQzSkdRR0ttZz09</a> Meeting ID: 997 2242 4215 Passcode: 432060
P – Z	<a href="https://queensu.zoom.us/j/91269137345?pwd=R3M2Z0JVS1g1YkxWcFc0cndUTnY1dz09">https://queensu.zoom.us/j/91269137345?pwd=R3M2Z0JVS1g1YkxWcFc0cndUTnY1dz09</a> Meeting ID: 912 6913 7345 Passcode: 386325

**Textbook:** *Organic Chemistry*, 2<sup>nd</sup> 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.

**Lectures:** Lecture material will be pre-recorded and distributed through the course website. PDF copies of the slides and any additional material deemed essential will also be released via the OnQ site. If in-person activities are permitted after February 28<sup>th</sup>, 2022, synchronous lectures will be held in **Kingston Hall, Rm 101** at the following times:

- Tuesdays at 11:30 AM
- Wednesdays at 1:30 PM
- Fridays at 12:30 PM

**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 portion of this course is supervised by Dr. Jason Vlahakis (vlahakis@queensu.ca) and will consist of **5 Virtual Laboratory Experiments** (and possibly an additional **3 In-Person Laboratory Experiments** if permitted after Feb 28, 2022). Students will watch a training video and **individually** write and submit a laboratory report for each virtual experiment. These can be completed at any time convenient for the student before the submission deadline, but it is highly recommended that you adhere to the suggested time frames. The prelab/lab report is submitted together as **one** Word document (as an assignment named Lab 1, Lab 2, Lab 3, Lab 4, and Lab 5) within onQ, and will be marked electronically by TAs. Watching each video will take about 1 hour and writing each laboratory report will probably take about 3 – 5 hours. More information about specific labs will be posted on onQ – follow closely the posted information/marking schemes.

**WEIGHT for LABS:** If we are NOT permitted to return to in-person labs after Feb 28, 2022, the lab reports for Virtual Experiments 1, 2, 3, 4, and 5, will be worth 5% each, giving a total weight of 25% to the laboratory portion of the course. If we ARE permitted to return to in-person labs after Feb 28, 2022, the lab reports for Virtual Experiments 1, 2, 3, 4, and 5, will be worth 3.5% each, and in-person Experiments 6, 7, and 8 will be worth 2.5% each, giving a total weight of 25% to the laboratory portion of the course. The in-person labs will be performance-based only and will not require a full lab report. More detailed Lab Info/Schedule/Due Dates will be posted within the ENCH 245 onQ site. The lab reports have strict due dates. You can watch the Virtual Lab videos at the suggested times in the schedule, or at any other convenient time for your schedule, but **reports are all due at strict exact times, always plan ahead, no extensions will be given. Normally lab reports are due within one week, we have extended this due date now to 2 weeks after the recommended start time.**

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

**Examinations:** There will be two online open-book midterms and a closed-book final. These examinations are scheduled on the following dates:

**Mid-term 1** – Friday, February 4<sup>th</sup>, 2022 @ 5PM

**Mid-term 2** – Friday, March 11<sup>th</sup>, 2022@ 5PM

**Final** – TBD

## Grading Scheme

- Laboratory (5 Virtual experiments + 3 In-person experiments, if permitted) 25%
- Mid-Term 1 15%
- Mid-Term 2 15%
- Final Exam 45%

Students must pass **both** the lecture and the laboratory 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 reagents 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.
  - b. Equilibria, rates, and  $pK_a$  – Ch. 12; Problems 2, 3, 7, 8, 10.
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. Nucleophilic acyl addition/condensation – Ch. 11; Problems 1 – 5.
  - f. Conjugate addition – Ch. 22, p. 498 – 513; Problems 2, 3, 4, 10.
  - g. 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.
  - a. Diels Alder reaction
  - b. 1,3-Dipolar cycloadditions
  - c. Baeyer-Villiger Rearrangement

d. Beckmann 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.**

**Remote Exams**

For exams being offered remotely, Regulation 7.2.3. [Restrictions on Assessment](#) is waived. Remote exams will be allowed in the last two weeks of classes and in the study period designated by Senate prior to the examination period in order to accommodate the limited number of online proctoring seats available.

## 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](http://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 behaviour 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.

### **Notice of Recording**

Synchronous (live) classes will be delivered in this course via in-person delivery and through a video conferencing platform supported by the University [MS Teams, Zoom]. Steps have been taken by the University to configure these platforms in a secure manner. Classes will be recorded with video and audio (and in some cases transcription) and will be made available to students in the course for the duration of the term. The recordings may capture your name, image or voice through the video and audio recordings. By attending these live classes, you are consenting to the collection of this information for the purposes of administering the class and associated coursework. If you are concerned about the collection of your name and other personal information in the class, please contact the course instructor to identify possible alternatives.

To learn more about how your personal information is collected, used and disclosed by Queen's University, please see the general [Notice of Collection, Use and Disclosure of Personal Information](#).

### **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.uslclwww/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.uslclwww/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:** Prof. Graeme Howe

**Instructor Email Address:** [graeme.howe@queensu.ca](mailto:graeme.howe@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.