

CHEM 422 / ENCH 422: Synthetic Organic Chemistry

Course instructor: Dr. Chantelle Capicciotti
CHE 405, Chernoff Hall; BOTT 625, Botterell Hall
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Web Site: onQ: <https://onq.queensu.ca/d2l/home/574442>

Lectures: Mondays 4:30-5:30 pm
Wednesdays 3:30-4:30 pm
Fridays 2:30-3:30 pm

- First 6 weeks: Lectures will be held on **zoom**, recordings will be posted on OnQ. Please see OnQ announcements and Calendar for Zoom link details.
- Last 6 weeks: Lectures will be held in **McLaughlin Hall, RM 306**. In person lectures will be recorded and posted on OnQ.

Tutorials: Mondays 12:30-1:30 pm

- First 6 weeks: Tutorials will be held on **zoom**, recordings will be posted on OnQ. Please see OnQ announcements and Calendar for Zoom link details.
- Last 6 weeks: Tutorials will be held in **Kinesiology & Health Studies, RM 106**. In person tutorials will be recorded and posted on OnQ.

TA: Joshua Kofsky, 15jk54@queensu.ca

Office Hours: Wednesdays 11:00 am – 12:00 pm.

- Office hours will be held on **zoom** for the entire semester. Please see OnQ announcements and Calendar for Zoom link details.
- If this time is not sufficient, please send me an email with “CHEM 422” in the subject line to set a date/time to meet. Can also post questions in the “Discussion Board” in OnQ.

Textbooks: Rather than have one required textbook, we will be using several textbooks as reference material and will also be using references from the primary literature. Textbooks are given below. These are recommended and are not required. Some are available as eBooks through the library.

S. Warren, P. Wyatt, *Organic Synthesis: The Disconnection Approach*, Wiley: N.Y., 2008. (Intermediate)
P. Wyatt, S. Warren, *Organic Synthesis: Strategy and Control*, Wiley: N.Y., 2007. (Intermediate)
Carey and Sundberg, *Advanced Organic Chemistry*, Part B (Intermediate)
Smith, M.B.; March, J. *March's Advanced Organic Chemistry*, 5th Ed. Wiley-Interscience, NY 2001 (reference)
Weeks, D.P. *Pushing Electrons*, 3rd Ed. Saunders, Fort Worth, 1998. (Elementary)
Eliel, E.L.; Wilen, S.H.; Doyle, M.P. *Basic Organic Stereochemistry*, Wiley: Chichester, 2001 (Advanced)
Nicolaou, K.C., Snyder, S.A.; *Classics in Total Synthesis II*, Wiley-VCH, New York, 2003 (Advanced)

Grading Scheme[§]

Exams - 1 Midterm; 1 Final Exam: **60% of overall grade**

Assignments/Presentations – 4 Assignments; 1 Presentation: **40% of overall grade.**

Midterm - Thurs. Feb. 17, 2022 worth 25 - 35% (whichever is better for you)

Final Exam: TBA – scheduled during exam period in April worth 25 - 35% (whichever is better for you)

- The midterm and final exam will be approximately 2 hrs in duration. You will be given a 3-hour window to complete the midterm/exam. The midterm/exam will be posted on OnQ and will be available for 24h. You can start it at any point within the availability period and will have 3h to complete. The midterm/exam will be **open book**, but you are to **work independently** and not collaborate with fellow classmates. **Any indication of a student not working independently will be considered a departure from academic integrity and sanctions will be issued as indicated below.**

Assignments: (individual or as groups of up to three – 3-4 assignments, ~3-4 weeks), worth 15 - 25% (whichever is better for you)

Presentation: (groups of ~ 3: TBA, tentatively weeks of March 28 – April 8, in class)
worth 15 - 25% (whichever is better for you)

§According to Queen's policy, students should delay finalizing any travel plans until after the examination schedule has been finalized. Exams will not be moved or deferred to accommodate employment, travel/holiday plans or flight reservations.

Tentative Course Outline

This course is an introduction to modern synthetic methods in organic chemistry. Principles of strategy in planning organic syntheses based on simple classifications of reagents and reactions, and on the control of stereochemistry will be discussed. Elements of carbon skeleton assembly, functional group transformations, and disconnection approach / retrosynthetic analysis will be covered.

I Introduction

Synthetic methods and general strategies
Efficiency in synthesis
Stereoselectivity/chirality in synthesis

II Disconnection Approach

General principles to the disconnection approach
Electrophilic aromatic substitution
Ethers, acetals and alcohols
1,1/1,2 and 1,3 difunctional compounds, enolate chemistry
Alkene/Alkyne synthesis including Wittig, Horner Wadsworth Emmons and metathesis reactions
1,5 and 1,6 dicarbonyl compounds
Ring syntheses: 3 membered rings
 Epoxides, aziridines and cyclopropanes
 Simmons Smith reaction, chemistry of carbenes
 Darzens condensation, chemistry of sulfur ylides
Ring syntheses: 4 membered rings

Oxetanes (Paterno Buchi reaction), azetidines and cyclobutanes
Ring syntheses: 5 and 6 membered rings
Cycloadditions and cyclizations: Baldwin's rules
Rearrangement Reactions
Pericyclic Reactions

III State-of-the-Art Methods

Selected state-of-the-art methods in synthesis not covered above will be presented

IV Total Synthesis of Selected Molecules

Selected examples of total synthesis will be presented. These may include:

Tropinone
Menthol
Reserpine
Quinine
Penicillin
Strychnine
Tabernosine
Squalene
Ibuprofen
Sildenafil (Viagra)
L-Dopa

Presentation (TBA, tentatively weeks of March 28 – April 8, in class)

Time: 20 minutes total – 15 minutes long and 5 minutes for questions

Topic: Either a synthesis (which should highlight some important reaction) or a synthetic methodology. Should be based on a publication within the last 5 years. Topic needs to be approved by Dr. Capicciotti

Format: Formal presentation in groups that will be assigned randomly by Dr. Capicciotti. Presentations will be carried out in sequence first with volunteers and then presentation order will be chosen at random. More details will be provided later in the course.

Key Dates: March 4th, groups assigned; March 11th, all topics must be approved.

Assignments

3-4 Assignments, given out approximately every 3 weeks. You will have 1 week to complete the assignment. Students can choose to hand in assignments individually or in groups of up to three students. **Note:** that if students hand in assignments as a group, all students will receive the same mark. If students choose to work as a group, they do not have to remain as the same group throughout the course but can change this as the course proceeds.

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

Late Policy

Assignments must be handed in on OnQ on or before the due date. Late assignments will be given a **penalty of 5% per day**. Extensions will be granted only in exceptional circumstances and must be discussed with me before the due date. Note all academic consideration for missed quizzes, tests, midterms, presentations, and assignments is now processed through the faculty portal, see Academic Considerations for Students in Extenuating Circumstances section below.

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**. This calculator sells for around \$25 at the Queen's Campus Bookstore, Staples and other popular suppliers of school and office supplies.

Plagiarism

Presenting another's ideas or phrasings as one's own without proper acknowledgement.

Examples: copying and pasting from the internet, a printed source, or other resource without proper acknowledgement; copying from another student; using direct quotations or large sections of paraphrased material in an assignment without appropriate acknowledgement; submitting the same piece of work in more than one course without the permission of the instructor(s).

Academic Integrity

Queen's students, faculty, administrators and staff all have responsibilities for supporting and upholding the fundamental values of academic integrity. Academic Integrity is constituted by the six core fundamental values of 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 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 <http://www.queensu.ca/artsci/academics/undergraduate/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.

Accommodations Statement

Queen's University is committed to achieving full accessibility for persons 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. If you are a student with a disability and think you may need accommodations, you are strongly encouraged to contact Student Wellness Services (SWS) and register as early as possible. For more information, including important deadlines, please visit the Student Wellness 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, not to exceed three months. Students receiving academic consideration must meet all essential requirements of a course. The Senate Policy on Academic Consideration for Students in Extenuating Circumstances was approved at Senate in April, 2017 (see <https://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: Dr. Chantelle Capicciotti

Instructor Email Address: c.capicciotti@queensu.ca

Statement of the Location and Timing of Final Examinations

As noted in Academic Regulation 8.2.1, "the final examination in any class offered in a term or session (including Summer Term) must be written on the campus on which it was taken, at the end of the appropriate term or session at the time scheduled by the Examinations Office." The exam period is listed in the key dates prior to the start of the academic year in the Faculty of Arts and Science Academic Calendar and on the Office of the University Registrar's webpage. A detailed exam schedule for the Fall Term is posted before the Thanksgiving holiday; for the Winter Term it is posted the Friday before Reading Week, and for the Summer Term the window of dates is noted on the Arts and Science Online syllabus prior to the start of the course. 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.

Copyright of Course Materials

All course material that is not from the textbook or other reference document is copyrighted by Dr. Capicciotti and is for the sole use of students registered in CHEM 422, ENCH 422 or CHEM 880. The material on the onQ website may be downloaded for a registered student's personal use, but shall not be distributed or disseminated to anyone other than students registered in CHEM 422, ENCH 422 or CHEM 880. Failure to abide by these conditions is a breach of copyright, and may also constitute a breach of academic integrity under the University Senate's Academic Integrity Policy Statement.