

Department of Chemistry
Intermediate Organic Chemistry
Chemistry 3401
Winter 2023

Dalhousie University is located in Mi'kma'ki, the ancestral and unceded territory of the Mi'kmaq. We are all Treaty people.

We acknowledge the histories, contributions, and legacies of the African Nova Scotian people and communities who have been here for over 400 years.

Lecture: Dr. Norm Schepp, nschepp@dal.ca
MWF, 10:35 to 11:25 am, Chem 223 (in-person)

Laboratory: Dr. Reinaldo Moya Barrios; rbarrios@dal.ca Office: Chemistry 1053
Organic labs are located in the Sproull Organic Laboratories, Chemistry 121-125P
All labs are in-person. CHEM 3401 labs start on Friday, January 13, 2023

Course Description (from the Calendar):

Topics presented include aromatics, heterocycles, amines, enolate anions and other methods for forming C-C bonds, concerted reactions, carbohydrates and some heteroatom chemistry. There is a continuing emphasis on the principles of mechanistic organic chemistry. Students work independently in the laboratory on the preparation, purification, and characterization of organic compounds.

Course Prerequisites

Organic chemistry involves both a great deal of memorization and understanding. Much like a language, you must possess a memorized vocabulary (reactions), but also a correct understanding of syntax and grammar (thinking mechanistically, and knowing how and when to apply reactions) to have success in this course. You are expected to have a FLUENT command and understanding of the material from CHEM 2401 and 2402. Being able to draw correct Lewis structures, produce legible structures with reasonable geometry, evaluate resonance contributors and draw curved arrow mechanisms will be necessary for success in this course. Organic synthesis is a cumulative discipline, and it is expected that you have retained knowledge of reactions and concepts covered in preceding courses. You will be both explicitly and implicitly tested on material covered in CHEM 2401/2402.

Course Objectives/Learning Outcomes

Organic synthesis allows the synthesis of molecules that broadly impact our lives through application in healthcare, materials science, food processing and fundamental research. Organic chemistry has the reputation of being a difficult topic, however the degree of difficulty depends on how you approach the subject. While the study of organic chemistry does involve substantial memorization, you will gain the most understanding with the least amount effort from this course by seeking to understand trends in the chemistry you see, rather than treating each reaction as an isolated concept to be memorized.

Appreciating trends and patterns gives you the maximum ability to apply what you have learned to predict the outcome of reactions that are new, either to you, or to science. In CHEM 3401, we will examine some of the most important carbon-carbon bond forming reactions, including reactions on aromatic heterocycles. An overview of chemistry for introduction and manipulation of common heteroatoms is provided. Simple stereochemical considerations are introduced. After successful completion of the course, students will be able to formulate multi-step syntheses of molecules of moderate complexity, containing multiple functional groups, with some knowledge of how to develop strategy based on considerations of reactivity.

Course Materials

Lecture

- *“Organic Chemistry”* by Jonathan Clayden, Nick Greeves, Stuart Warren. Oxford University Press, 2nd Edition, 2012. This book is available at the bookstore and will be the textbook I provide readings from.
- Using molecular models is encouraged to understand conformation and selectivity. These will be permitted during examinations, but they are not required.
- Non-graded practice problems and their solutions will be made available on a regular basis. Successful study habits in organic chemistry typically involve actively, frequently, and repetitively practicing drawing mechanisms for the reactions under study, rather than simply reviewing the mechanism and attempting to reproduce the mechanism for the first time under evaluation.

Lab

- Chem 3401 Laboratory Manual from academic year 2022-2023.
- Hard-covered laboratory notebook
- Safety glasses (prescription glasses that are not safety glasses are not sufficient)
- Approved lab coat

2015 Workplace Hazardous Materials Information System (WHMIS) training: All students must complete the 2015 WHMIS training (provided through the Dalhousie College of Continuing Education) and upload proof of completion. Students who completed this training in the 2022 Fall term or within the last three (3) years do not need to redo it this term, they simply will upload proof of completion to Brightspace.

Deadline: Sunday, January 15, 2023.

Laboratory Safety course: All third and fourth-year students working **in person** in the Department of Chemistry labs are required to complete this online course, also developed by the Environmental Health and Safety Office. Just like for the WHMIS course, you will receive a **Letter of Completion** (as a PDF document) via email from the College of Continuing Education (cceehs@dal.ca). After you have received your **Letter of Completion** please upload the PDF document to the Brightspace site. If you completed this course during this academic year, simply upload the proof of completion to Brightspace.

Deadline: Sunday, January 22, 2023.

Useful Websites

Various websites are available containing information that complements that presented in the course, or may be of use in assignments.

Primary literature:

There are many journals. A small set of important chemistry journals are shown below. To access these from home, the URL must be accessed through Dalhousie's library proxy server. See:

<https://libraries.dal.ca/help/remote-access.html>

American Chemical Society Journals: <http://pubs.acs.org>

Royal Society of Chemistry Journals: <http://www.rsc.org/journals-books-databases/>

Angewandte Chemie International Edition: (German Chemical Society):

[http://onlinelibrary.wiley.com/journal/10.1002/\(ISSN\)1521-3773](http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1521-3773)

Scifinder Scholar is a useful tool for searching the chemical literature:

<https://libraries.dal.ca/research/scifinder-scholar.html>

Databases:

Aldrich: Chemical Catalogue, with physical properties and select NMR spectra of compounds

<http://www.sigmaaldrich.com>

SDBS: Database of NMR, IR, MS spectra for many compounds. http://sdbs.db.aist.go.jp/sdbs/cgi-bin/direct_frame_top.cgi

Bordwell pK_a database: Extensive database of pK_a's <http://www.chem.wisc.edu/areas/reich/pkatable/>

Course Assessment

Midterm 1	Feb 15, in-class	15%
Midterm 2	March 22, in-class	20 %
Assignment 1	Feb 6 out, Feb 10 due	5%
Assignment 2	Mar 13 out, Mar 17 due	5%
Final Exam	3 hr, in-person, during exam schedule	35 %
Laboratory		20%

Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (<50)
A- (80-84)	B- (70-72)	C- (55-59)	

All chemistry courses, unless stated otherwise, have a minimum grade requirement of C- for their prerequisite chemistry courses. Students with grades below C- in the prerequisite chemistry courses can only register with the permission of the instructor for the course.

Course Policies

Office hours. Send me an email to arrange an appointment for an in-person meeting in Room 212 (or, if necessary, an online Teams meeting) when you have questions. You can also drop in to Room 212 and see if I am available for a quick question.

Email. It is your responsibility to read your Dalhousie email, as class notifications may be sent by email.

Course Policies on Missed or Late Academic Requirement

If you are ill or otherwise experiencing a personal emergency at the time of a midterm test, e-mail me when convenient to inform me of the situation, and fill out a Student Declaration of Absence form (available at Brightspace) at an appropriate time. Many circumstances can count as personal emergencies, and I am happy to help you to the best of my ability in accommodating unexpected life circumstances that may take priority over this course for you. While make-ups are NOT offered for midterms or assignments, in the case of a missed midterm/assignment due to illness or another prearranged situation, the weighting of the final exam will change to make up the missing marks. Late assignments will not be accepted.

If you are ill for the final exam, notify me prior to the start of the final exam. A make-up test will be offered.

Course Policies related to Academic Integrity

You are required to complete assignments ON YOUR OWN, without any outside assistance of any kind, including assistance from other classmates.

Course Content

Lectures. The topics expected to be covered in Chemistry 3401 are listed here in the approximate order in which they will be discussed. Chapters in which these topics appear in the required text are noted. The lectures may include material that is not in the text-book and for which you will be responsible.

- 1) Adding groups to Aromatic Rings, including Aromatic Heterocycles
Electrophilic Aromatic Substitution, Chapter 21
Nucleophilic Aromatic Substitution, Chapter 22 pages 514 - 527
Organopalladium: Stille and Suzuki Reactions, Chapter 40
- 2) Carbonyl Chemistry
Aldol Condensations and related reactions, Chapter 26
Claisen Condensation, Chapter 26
Conjugate Addition, Chapter 22 pages 498 - 511
- 3) Electrocyclic Chemistry
Diels-Alder Cycloadditions, Chapter 34
Sigmatropic Rearrangements, Chapters 35
- 4) Further reactivity (if time permits)
Class notes

**Faculty of Science Course Syllabus (Section B)
Fall/Winter 2022-23**

University Policies and Statements

This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate

Academic Integrity

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

Information: https://www.dal.ca/dept/university_secretariat/academic-integrity.html

Accessibility

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

Information: https://www.dal.ca/campus_life/academic-support/accessibility.html

Student Code of Conduct

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

Code: https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

Diversity and Inclusion – Culture of Respect

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

Statement: <http://www.dal.ca/cultureofrespect.html>

Recognition of Mi'kmaq Territory

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) (elders@dal.ca).

Information: https://www.dal.ca/campus_life/communities/indigenous.html

Important Dates in the Academic Year (including add/drop dates)

<https://academiccalendar.dal.ca/Catalog/ViewCatalog.aspx?pageid=viewcatalog&catalogid=117&chapterid=-1&topicgroupid=31821&loadusercredits=False>

University Grading Practices

https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html

**Faculty of Science Course Syllabus (Section C)
Fall/Winter 2022-23**

Student Resources and Support

Advising

General Advising https://www.dal.ca/campus_life/academic-support/advising.html

Science Program Advisors: <https://www.dal.ca/faculty/science/current-students/undergrad-students/degree-planning.html>

Indigenous Student Centre: https://www.dal.ca/campus_life/communities/indigenous.html

Black Students Advising Centre: https://www.dal.ca/campus_life/communities/black-student-advising.html

International Centre: https://www.dal.ca/campus_life/international-centre/current-students.html

Academic supports

Library: <https://libraries.dal.ca/>

Writing Centre: https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html

Studying for Success: https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html

Copyright Office: <https://libraries.dal.ca/services/copyright-office.html>

Fair Dealing Guidelines <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

Other supports and services

Student Health & Wellness Centre: https://www.dal.ca/campus_life/health-and-wellness.html

Student Advocacy: <https://dsu.ca/dsas>

Ombudsperson: https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html

Safety

Biosafety: <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

Chemical Safety: <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

Radiation Safety: <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

Scent-Free Program: <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>

Dalhousie COVID-19 information and updates: <https://www.dal.ca/covid-19-information-and-updates.html>