

**Faculty of Science Course Syllabus
Department of Chemistry
Introductory Organic Chemistry II
CHEM2402
Winter Term 2020**

- Instructor(s):** **Professor Frances Cozens** (e-mail frances.cozens@dal.ca, room 410 Chemistry, fourth floor).
Office hours: Mondays, Wednesdays and Fridays 10:30 am – 11:30 am. You are also welcome to e-mail me if you would like to make an appointment for a specific time. Please put CHEM 2402 in the subject line.
Dr. Reinaldo Moya-Barrios (e-mail rbarrios@dal.ca, room 1053 Chemistry, first floor, near the organic lab). Laboratory instructor, day-to-day supervision and all administrative matters for the CHEM 2402 laboratories.
Ms. Gaia Aish (email Gaia.Aish@dal.ca, room 106 Chemistry, first floor, near the first-year lab). Laboratory instructor, day-to-day supervision for the CHEM 2402 laboratories and tutorial help. Tutorials will take place in the Chemistry Concept room in the Resource Center.
- Lectures:** Potter Auditorium, KENNETH C ROWE Management Building - room 1028 (6100 Univ. Ave.); M/W/F 9:35-10:25 am; three hours per week
- Laboratories:** Sproull Organic Chemistry Laboratory, once per week, for three hours; starting on Friday, January 10, 2020 and ending on Friday, March 27, 2020.
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The following pages constitute the syllabus for this course, CHEM 2402. You can consider the syllabus to be a contract, which delineates responsibilities and expectations for both the students and the teaching team. You should review the syllabus at your earliest convenience, refer to it as necessary throughout the term, and contact the instructor with any questions and/or concerns you may have.

Course Description Credit hours: 3 Format: Lecture and Lab Hours weekly: 6

CHEM 2402 builds strongly on the information obtained in CHEM 2401 and focuses on the properties and reactions of alcohols, ethers, amines, nitriles, imines, enamines, the carbonyl-containing functional groups and aromatic compounds, along with spectroscopy in the laboratory. The reactions learned are also used in synthetic sequences. Detailed and complete reaction mechanisms are investigated. Multi-step synthetic sequences are developed and are an integral part of the course. Organic reactions, organic reaction mechanisms and organic multi-step reactions are the main features of CHEM 2402. The concepts of resonance and aromaticity are investigated and infrared (IR) spectroscopy is introduced in the laboratory. IR and NMR spectroscopies, and mass spectrometry are utilized in the laboratories for compound identification.

Course Prerequisites

PREREQUISITES: CHEM 2401.03 (**grade of C+ or better**). CHEM 2401 is the prerequisite for CHEM 2402. Students who have not obtained a grade of C+ or better, or an equivalent class from another institution, cannot take CHEM 2402. This requirement is to ensure students have sufficient understanding of the concepts taught in CHEM 2401 to be successful in CHEM 2402. As such, it is assumed that students have a reasonable grasp of the material in CHEM 2401 and have a good understanding of the specific reactions covered, as these concepts are the foundation for CHEM 2402. Please note: *material including but not limited to the reactions from CHEM 2401 is required to be successful in CHEM 2402 and may be present on any midterm test or the final examination in CHEM 2402. This also includes stereochemistry.* Students need to fully grasp the concepts and reactions in CHEM 2401 before entering CHEM 2402.

Course Objectives/Learning Outcomes

Students completing this course, will be able to:

- work safely in the organic chemistry laboratory and carry out synthetic reactions. This includes set-up and work-up, recrystallization, thin-layer chromatography, filtration, extraction, reflux and distillation
- interpret fundamental laboratory results related to organic chemistry
- use IUPAC rules to draw and name organic compounds
- draw and interpret proper Lewis structures, including comprehension of contributing resonance structures
- use reactions from CHEM 2401 in the development of synthetic schemes
- understand reactions of alcohols and ethers and use them in synthetic schemes
- understand reactions of carboxylic acids and their derivatives and use them in synthetic schemes
- understand reactions of aldehydes and ketones and use them in synthetic schemes
- understand reactions of imines and enamines and use them in synthetic schemes
- understand reactions of enols and enolates and use them in synthetic schemes
- understand reactions of benzene and other aromatics and use them in synthetic schemes
- understand the difference between a kinetic and thermodynamic controlled reaction
- use arrow pushing mechanisms for a wide variety of reactions
- predict and justify reactivity of organic compounds under a variety of experimental conditions
- use reaction coordinate diagrams to show the progress of a reaction
- propose reaction sequences and conditions for the preparation of simple organic compounds
- identify characteristic peaks in IR spectra
- interpret spectra; propose reasonable structures via interpreting mass spectral data, infrared and ^1H and ^{13}C NMR spectra

Key knowledge or skills expected of students coming into the course

All aspects of the material contained in CHEM 2401, CHEM 1011 and CHEM 1012 (or equivalents).

Required Course Materials

Lectures: **Class notes** will normally be available on the Brightspace class website shortly before the lecture. NOTE: Lectures notes are subject to change. The most up-to-date set of lecture notes will be available on Brightspace. Annotated lecture notes will not be posted to Brightspace and are not available. Students are encouraged to write their own notes during the lectures.

Textbook: The official textbook is: "Organic Chemistry" **8th Edition**, by Paula Y. Bruice. This book is available at the University Bookstore as a hard copy or ebook. In CHEM 2402, "Organic Chemistry" by Bruice will be followed closely and lecture notes will be based on the material from this book. The material that will be on the midterm tests and the final examination will be covered in the PowerPoint slides that will be available on Brightspace.

Other textbooks (in the Library and the Chemistry Resource Centre) are sometimes helpful as different books explain certain concepts better than others, but assigned material for this course will be defined in terms of the official textbook.

Problem sets: (and answers) and other aids will be provided on the Brightspace class website. Please visit the Brightspace platform often to keep up-to-date on the class material.

How to do well in CHEM 2402

There is no doubt that CHEM 2402 includes a lot of material and is a significant step-up from CHEM 2401. CHEM 2402 is a course that requires discipline and considerable studying to do well. Studying and keeping up with the material is key for a successful outcome. It is also recommended that the practice problems are thoroughly worked through prior to viewing the answers.

Here are some additional tips for success:

Attend class. There is a clear and direct correlation between skipped lectures and poor results in this course. This cannot be stressed enough! Even though the class will follow the textbook closely, the more classes you attend the better you will do!

Take good notes. Taking your own notes will help you to learn. Even though class notes are provided the more you write your own notes the better you will do.

Study. Keep up with the material. It is critical to stay up with the material. The material in CHEM 2402 cannot be learned the day before the final examination.

Practice. Do the problem sets as soon as possible after they appear on the Brightspace and do NOT look at the answers until the problem set is complete. Attend the scheduled tutorials in the concept room!

Organic Concepts

Organic Chemistry tutorials/office-hours will be held in the Concept Room, room 122 in the Chemistry Building. These tutorials/drop in help sessions will primarily be given by Ms. Gaia Aish. Currently the scheduled weekly times are: Monday: 1:00-2:00 pm, Wednesday: 10:30-11:30 am, and Thursday: 11:00-12:30 pm (subject to change). Concept Room will start Monday, January 13th, 2020. Additional tutorial hours will be added for tests and specific topics. Note that the current hours are subject to change: altered or additional Concept Room hours will be posted on Brightspace, via announcements. The Concept Room provides a great resource to stay up-to-date with the class material and is provided to help you be successful in CHEM 2402.

Laboratory

For assistance regarding the laboratory component, contact Dr. Reinaldo Moya-Barrios or Ms. Gaia Aish. The first day of labs is Friday, January 10 and the last day of labs is Friday, March 27, 2020.

- CHEM 2402 Laboratory Manual, Winter 2020 (**required**) – available from the Dalhousie bookstore.
- Hardcover laboratory notebook (**required**)
- Safety glasses are **mandatory** (including students with prescription glasses) for CHEM 2402 labs; must have CSA-Z94-3 or ANSI Z87 rating.
- Lab Coats 100% cotton and long-sleeved are **mandatory** for CHEM 2402 labs. Your lab coat must fit properly and must reach to near the knees. Sleeves must not be rolled up.

Lab coats and safety glasses are available from the Dalhousie University bookstore, or you can provide your own as long as they meet standards and ratings.

If you miss a laboratory because of illness, a make-up lab can be arranged. All make-up labs must be completed by Friday, March 27, 2020. No make-up labs will be offered after March 27, 2020. In addition, all experimental work must be completed by the last day of experiments, March 27, 2020.

Safety Module: All students who are enrolled in a class with a laboratory component must do the Chemistry Safety Module in a given academic year. The Laboratory safety map needs to be completed in every laboratory a student works.

Chemicals and laboratory equipment can pose serious hazards and must be treated with an appropriate amount of caution. Part of your training involves understanding the hazards within a chemistry laboratory and learning the measures that must be taken in order to maximize your safety and that of your peers and teachers.

As part of your chemistry laboratory class requirement, you are required to successfully complete a Chemistry Safety Module inside the deadline: see the Laboratory Manual for details. Students who do not successfully complete this requirement will not be allowed to continue to perform experiments in any Dalhousie undergraduate chemistry laboratory nor will be allowed to make up any experiments missed. Successful completion of the Safety Module includes reading this General Safety Statement, obtaining a perfect mark (e.g., 5/5) on five online safety quizzes, and completing a safety map in lab for each of the chemistry labs that you occupy. After the completion of these requirements you should feel comfortable working in a chemistry laboratory and have the tools you need to promote a safe laboratory environment.

Note: If you completed the safety module in the Fall term then you do not need to complete it again this term.

WHMIS: WHMIS, or the Workplace Hazardous Materials Information System, is a global harmonized system used to classify and label hazards and regulate handling procedures within industry and academic fields, especially those in science. Regardless of your chosen field of study within science being familiar with WHMIS is a significant asset. As such, the Department of Chemistry requires ALL students participating in their laboratory programs to complete WHMIS 2015 training provided by the Environmental Health and Safety Office. This training course is provided through the Dalhousie College of Continuing Education. Upon completion of your WHMIS 2015 course you will receive a Letter of Completion (as a PDF document) via email from the College of Continuing Education (cceehs@dal.ca) within 3 business days. Please ensure that you register and complete the WHMIS course well in advance of the letter submission deadline. After you have received your Letter of Completion please upload the PDF document to the Brightspace site. Instructions on how to register for the course and upload your letter of completion can be found on the Brightspace Site. The due date to complete the 2015 WHMIS training is January 26th 2020, 11:30 pm.

Note: the WHMIS training is valid for three (3) years. If you have completed this training within the last 3 years please upload your WHMIS 2015 Course letter of completion as a PDF file as indicated on the Brightspace site.

Course Assessment

In order to pass CHEM 2402 the laboratory section of the class must be passed with a grade of at least 10/20 marks (50%).

In addition, a minimum grade of 40/100 marks (40%) on the final examination is required in CHEM 2402 to pass the class.

And a minimum total grade of 50/100 marks (50%) for the combined class material is required in CHEM 2402 to pass the class.

Mid-term tests and the final examination are “closed book,” i.e., no cheat-sheets. There will be two, 50-minute mid-term tests during regular class time. The mid-term tests will take place during class-time on **Wednesday, February 5th**, and on **Monday, March 23th**. There will be **no make-up mid-term tests**. A midterm test missed with appropriate documentation will result in grading option 5.

In CHEM 2402 you are required to write BOTH midterm tests and the final examination. If you are absence from a midterm due to illness or a significant personal issue please complete the Dalhousie Student Declaration of Absence and send an email to fcozens@dal.ca with the appropriate midterm subject header: Missed CHEM 2402 Midterm 1/Midterm 2. Only students who submit a completed Dalhousie Student Declaration of Absence will receive an exemption for the midterm test. If no Dalhousie Student Declaration of Absence is completed and submitted to fcozens@dal.ca prior to the midterm test or 48 hours after the date of the midterm test the student will receive a mark of 0 on the missing midterm test. Midterm tests will be returned to the student. Queries about the grading of an individual test will be welcomed, if the midterm test is not taken from the room in which the midterms are returned. Midterm tests or the final examination should NOT be written in red ink.

The three-hour final examination (time and place to be scheduled by the Registrar) will cover the entire course. The final examination may include some questions from the laboratory portion of the course and may include reactions covered in CHEM 2401. A student may write a make-up final examination if the final examination was missed with a justifiable, documented medical reason. The date and time of the make-up examination will be decided a few days after the CHEM 2402 final examination has been written and will be at the end of the regular examination period. The student is responsible to contact the instructor at fcozens@dal.ca to arrange the make-up final examination in CHEM 2402. The instructor will not contact the student. Failure to contact the instructor prior to the final examination date or within 24 hours after the final examination and to provide appropriate documentation for the missed final examination will result in a grade of 'INC' for CHEM 2402. CHEM 2402 has no supplementary examination. The University policy is that final examinations are not returned to students.

Marking Schemes

CHEM 2402 has four grading options. All grading options are calculated automatically, and the best letter grade for each student is then applied: students do not need to pre-select a grading option. In each case, a minimum mark of 40% must be obtained on the final examination in CHEM 2402 to pass the class. Any less than 40% on the final examination in CHEM 2402 will automatically result in a grade of "F" in CHEM 2402.

Option 1

Term-Test 1: 15%
Term-Test 2: 15%
Laboratory: 20%
Final exam: 50%

Option 2

Term-Test 1: 7.5%
Term-Test 2: 7.5%
Laboratory: 20%
Final exam: 65%

Option 3

Term-Test 1: 12.5%
Term-Test 2: 7.5%
Laboratory: 20%
Final exam: 60%

Option 4

Term-Test 1: 7.5%
Term-Test 2: 12.5%
Laboratory: 20%
Final exam: 60%

With an SDA where only one term-test is written **Option 5:**

Term-Test: 15%
Laboratory: 20%
Final exam: 65%

A minimum grade of 10/20 is required in the laboratory portion of CHEM 2402 to pass the class.

A minimum grade of 40/100 marks for the final examination is required in CHEM 2402 to pass the class.

A minimum total grade of 50/100 marks for the combined class material is required in CHEM 2402 to pass the class.

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)		

Course Policies

Email

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

Cancelled Classes

In the case of a weather-related closure of the University, a DalAlert email will be sent to all students, faculty and staff. Other information can be found at www.dal.ca/storm.html. In the event that CHEM 2402 needs to be cancelled, notification will be sent by email and a notice will be placed on the classroom door.

Laboratories

E-mail Dr. Moya-Barrios (rbarrios@dal.ca) as soon as possible if there is a problem regarding your registration. Please state your student number in your e-mail. The laboratories are in Rooms 121–125P of the Chemistry Building (“Sproull Organic Chemistry Laboratory”). *The first laboratory is on Friday, January 10th.* The schedule of experiments is in the laboratory manual and on the Brightspace site. *Safety is very important.* Failure to comply with safety instructions given by the Instructor and/or a Teaching Assistant will result in expulsion from the laboratory. Approved eye protection and a cotton laboratory coat are required at all times within the laboratory. The CHEM 2402 Laboratory Manual *for this academic year* is required, as is a hardcover laboratory notebook.

The laboratory sessions are an essential part of this course. The details of assessment in the laboratory will be given in the laboratory and can be found in the CHEM 2402 Laboratory Manual. In order to pass CHEM 2402, the laboratory part must be passed. Therefore, *attendance at the laboratory sessions is mandatory.* Students should arrive at the laboratory on time and well-prepared. Questions concerning how the laboratories are run and about the material covered in the laboratory should be directed to the Laboratory Instructor.

Although they are obviously related, the lectures and the laboratories have a different emphasis in what they teach. Nevertheless, material in the laboratories will complement the information from the lectures, and *vice-versa*. The midterm tests and final examination may include questions from the laboratory part of the course.

A student who is repeating CHEM 2402 may be exempt from the laboratory, but a laboratory waiver is not automatic. The student must apply for a waiver at the beginning of the term. Apply by e-mail to Dr. Moya-Barrios at rbarrios@dal.ca, stating your student number and the year and the term in which you last took CHEM 2402. A waiver may be given at the discretion of Dr. Moya-Barrios, who follows these guidelines: *i.* Lab exemptions are only valid until the end of the academic year following that in which laboratory credit was granted. *ii.* The laboratory mark must have been at least 60%. *iii.* The overall mark for the course must have been 40%, or better. A student with a laboratory waiver will receive the laboratory mark that was awarded in the most recent attempt.

Course Content

Lectures. The following topics are expected to be covered in CHEM 2402 and are listed below. (Class lecture notes will be available on Brightspace).

Nomenclature. Review the material from CHEM 2401. Synopses on drawing organic molecules and nomenclature are now available on the Brightspace site. You should review this material. A problem set reviewing the reactions covered in CHEM 2401 is also available. Students should carefully work through the CHEM 2401 review problem set at the start of CHEM 2402.

Reactions of alkenes, alkynes and alkyl halides.

Spectroscopy. Review the material on nuclear magnetic resonance (^1H and ^{13}C NMR) spectroscopy and mass spectrometry (MS) from CHEM 2401. *You will need this for the first lab!* (A summary of ^1H and ^{13}C NMR

spectroscopy with a chart of typical chemical shifts is on the Brightspace site.)

A list of Chapter sections will be available on Brightspace and is subject to change.

Infrared Spectroscopy. Chapter 13. (presented in the laboratory).

Alcohols and ethers. Chapter 10.

Organocuprates. Chapter 11.

Carboxylic Acids and Derivatives. Chapter 15.

Aldehydes and Ketones. Chapter 16.

Imines and Enamines. Chapter 16.

Reactions of Enols and Enolates. Chapter 17.

Reactions of Aromatics. Chapters 8 and 18.

Developing Organic Synthesis. Chapter 18.

**Faculty of Science Course Syllabus (Section B)
Organic Chemistry II CHEM 2402**

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://www.dal.ca/academics/important_dates.html

University Grading Practices

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

Missed or Late Academic Requirements due to Student Absence (policy)

https://www.dal.ca/dept/university_secretariat/policies/academic/missed-or-late-academic-requirements-due-to-student-absence.html

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/academic-advising.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/services-support/student-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>