

CHEM 3201: Advanced Organic Chemistry I

Fall 2024

Prospectus

*****PRELIMINARY VERSION (Last Updated: September 2)*****

Who: Prof. Dr. Jeff Manthorpe
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What:

Course Objectives: The overall objective of this course is to learn how to determine the structure of small organic molecules that contain the elements C, H, N, O, S, Si, P, F, Cl, Br, and/or I. This involves several techniques: elemental analysis, mass spectrometry, infrared spectroscopy, nuclear magnetic resonance spectroscopy, and ultraviolet spectroscopy (and they will be covered in that order).

Structure determination involves three steps:

1. Determination of **molecular formula** or several possible formulae
2. Determination of **functional groups** present in the molecule
3. Determination of **bond connectivity** (how the different pieces of the molecule connected together)

Topics to be Covered (in order)

Chapter In Text	Topic (Step(s) Associated with that Technique)	Approx. Dates	Midterm/Final Exam Coverage			
1	Molecular Formulae/Elemental Analysis (Step 1)	Sep 5, 10, 12	MT I	MT II	MT III	Final
3	Mass spectrometry: Part 1 – basic theory, instrumentation, and sampling techniques (primarily Step 1)	Sep 12, 17, 19,				
4	Mass spectrometry: Part 2 – fragmentation and structural analysis (primarily step 1 but also to a minor extent steps 2 and 3)	Sep 19, 24, 26, Oct 1				
2	IR (infrared) spectroscopy (primary technique for Step 2)	Oct 3, 8, 10				
5	NMR (Nuclear Magnetic Resonance) spectroscopy: part 1 – basic concepts and ¹ H NMR (Step 3 but can be related to steps 1 and 2 as well)	Oct 10, 15, 17				
6	NMR spectroscopy: part 2 – ¹³ C NMR (Step 3 but can be related to steps 1 and 2 as well)	Oct 29, 31, Nov 5				
7	NMR spectroscopy: part 3 – Spin–spin coupling in NMR spectra (Step 3)	Nov 5, 7, 12, 14				
8	NMR spectroscopy: part 4 – Other topics in 1D NMR – exchange processes, decoupling, nOe, conformational analysis, stereochemistry (Step 3 but can be related to Steps 1 and 2 as well)	Nov 19, 21				
9	NMR spectroscopy: part 5 – advanced NMR: 2D experiments (Step 3)	Nov 26, 28, 30				
10	UV spectroscopy (Steps 2 and 3)	Dec 3, 5				
11	Combined spectral problem solving (Steps 1, 2, and 3 because this chapter integrates all of the course material)	If time allows				

Why:

The ability to determine the identity of a compound is a fundamental, vital and critical skill of every chemist and biochemist. Think about it this way: If you don't know what you compound have, even if you can say fascinating and important things it does, you are missing a most basic piece of the story.

When and Where:

Lectures: Tuesdays and Thursdays 10:05 to 11:25 (Tory Building, Room 236) *Note: room may change

Tutorials: Thursdays 16:05 to 17:25 (St. Patrick's, Room 435) *Note: room may change

Office Hours: To be determined.

Important Dates (Midterm dates are tentative!):

Thursday, September 5: First lecture

Thursday, September 5: First tutorial

Week of October 14 (maybe Oct 7): Midterm I (after Chapter 2/Infrared Spectroscopy)

Saturday, October 19–Sunday, October 27: Fall break. No classes.

Week of November 4 or 11 (tentative): Midterm II (after Chapter 6/¹³C NMR Spectroscopy)

Week of November 18 or 25 (tentative): Midterm III (after Chapter 8 or maybe Chapter 9)

Thursday, December 5: Last lecture AND last tutorial

Friday, December 6: Classes follow a Monday schedule to make up for Thanksgiving on October 10 (does not apply to this course)

Monday, December 9–Saturday, December 21: Final Exam period.

A few days before Final Exam: 1 or 2 review sessions

DATE and TIME of the FINAL EXAM will be scheduled by the university during the final examination period (Dec 9–Dec 21). **The examination will be three hours in duration and will cover all of the course material (i.e., the exam will be cumulative).**

How:

Evaluation:

Midterm Examination I	15%
Midterm Examination II	15%
Midterm Examination III	15%
Assignments (ca. 3-6)	15%
<u>Final Examination</u>	<u>40%</u>
Final Grade	100%

Examination format: Midterm exams will be held outside of class time. Practice exams and solutions will be posted on Brightspace. There will be special tutorials to go over the solutions to the practice exams, as well as your exams.

NOTE: You are allowed to drop your grade from ONE of the midterm exams if it will result in a higher final grade. The weight of the dropped midterm examination will be added to the value of your final examination. Similarly, if you are unable to attend a midterm examination for any reason (documented illness, etc.), the weight of that midterm exam will be added to your final exam.

Important qualifier: A grade of at least 45% on the final exam is required to pass the course.

NOTE: Compassionate grading (SAT/UNSAT) is no longer in effect.

Lecture and Tutorial Formats: Lectures and tutorials will be in person but recorded and posted online for review and/or students who are unable to attend live.

Lecture material will be presented (both in videos and in class) in a combination of electronic slides and writing on the slides via a tablet or traditional chalkboard delivery. Slides will be available on Brightspace the day before class or earlier, but usually will be available well in advance. Students are expected to print the slides and bring them to class or bring the slide preloaded on a tablet computer. An effort will be made to leave appropriately sized gaps in the slides so that additional material may be written in the appropriate place. Students are also expected to have some extra paper handy.

Brightspace: Brightspace will be used to distribute handouts (notes) and assignments. Brightspace email will be used to distribute notices regarding the class. Brightspace also has a discussion board that students can use to discuss problems and things related to the course. I will monitor and participate in these discussions. Please check it regularly. Any students who do not have access to Brightspace should speak to me ASAP to make alternate arrangements to receive class notices and handouts.

Handouts: *Handouts should be printed with a MAXIMUM of 2 slides per page.* Many slides contain images with critical details that cannot be seen if printed smaller than 2 slides per page. The slides do contain colour but can be printed in black and white. The colours have been chosen so that they will still appear reasonably well when printed in black and white.

Practice Problems from Textbook: Problems associated with each chapter will be assigned by the instructor and will be drawn from the course textbook. It is the responsibility of the student to do these problems. They will not be handed in for grading. However, students are free (and encouraged) to ask questions of the instructor about the problems.

Assignments: There will be several assignments throughout the course that will be submitted for grading. The total value of the assignments will be 15% of your final grade; hence the value of each assignment will ultimately depend on the number of assignments. Assignments will be submitted via an electronic dropbox on Brightspace.

The first assignment will be after Chapter 3 and potentially after any chapter after that, but likely will not be after *every* chapter; we will skip some or combine two chapters into one assignment.

All assignments must be done individually! Students may work together on practice problems and are encouraged to do so. There will likely be an assignment accompanying most chapters of the course. This means that every week you will have something to do – either an assignment or a midterm exam; therefore ***IT IS IMPERATIVE THAT YOU KEEP UP WITH THE COURSE!*** ***THE NUMBER ONE REASON STUDENTS DROP THIS COURSE IS THAT THEY FELL BEHIND!***

Midterm and Final Examinations: The midterm and final examinations will administered as outlined above. All exams are *open book* (you may use the course textbook but not your notes) and cumulative. *You are permitted to write notes in your textbook and use flags on useful pages. You may not insert additional paper into your book.* All students are required to write all the midterms (University policies on exemptions for illness, family emergencies, *etc.* and academic misconduct apply to midterm exams). Examinations and solutions and solutions from previous years will be made available through Brightspace for use as studying tools.

Textbooks and other required materials:

1) ***MANDATORY TEXTBOOK: Introduction to Spectroscopy (fifth edition, 2015)*** by Pavia, Lampman, Kriz, and Vyvyan (publisher: Cengage, ISBN: 978-1-285-46012-3): It is available at the Carleton University Bookstore for \$?? plus tax (to be updated). It is also available through online booksellers such as Chapters/Indigo and Amazon.

The fourth edition (2009) is also acceptable but not recommended. The fifth edition contains more problems, including solved problems, and the topic of rewritten and restructured mass spectrometry. There

is an *international edition of the 4th edition*; however, be aware that it is printed on poorer quality paper and **lacks the answers to the practice problems.**

As the exams are open book, *electronic versions of the textbook are not acceptable. You must have your own hardcopy of the textbook.*

2) **Molecular Visions Model Kit (*Highly Recommended*)**: These molecular model kits are an excellent balance of affordability and accuracy. They are available at Haven Books (waiting to hear the price but I'm guessing about \$35 after taxes) or online at http://www.molecularvisions.com/molecular-model-kits/cat_1.html (kit #1, \$50.08 (after taxes and shipping)). They are also useful for organometallic and inorganic chemistry—money well spent! They are also permitted on all examinations.

Prerequisites: *Carleton University students:* CHEM 2204 or 2206 or 2208. *Students of other universities:* Two one-semester organic chemistry courses. At most universities this will be either two courses in second year or one in first year and another in second year. *If you wish to take this course for credit at your institution be sure to obtain a letter of permission from your university.* If your university requires further information about this course please contact me (the instructor).

Students with Disabilities/Paul Menton Centre Registrants: Students registered with the Paul Menton Centre for Students with Disabilities at Carleton or the equivalent office at their institution will be adequately accommodated. However, students are hereby notified that in order to receive accommodation, they must present the appropriate paperwork (electronic or hard copy) to the instructor ***NO LATER THAN ONE WEEK IN ADVANCE.***

Academic Integrity: The consequences of copying, plagiarism, and other forms of cheating are substantial. The Carleton University Academic Integrity Policy can be found online at [Carleton University's Academic Integrity Policy](#). It is **YOUR RESPONSIBILITY** to know the contents of these policies so it is highly recommended that you read them.

Within the context of this course, an academic integrity offence will automatically result in an F for a first offence. If you commit a second offence, the penalty is a one-year expulsion from your academic program. The penalty for a third offence is expulsion from the university.

In the last four years I had one offence in this course (CHEM 3201) and 14 offences in CHEM 3202. All 14 students were found guilty, including one student who was caught twice in the same course in the same term.

*****IT IS AN ACADEMIC INTEGRITY OFFENCE TO REPOST OR SHARE COURSE MATERIALS (including but not limited to course notes, assignments, exams, and/or solutions thereto) WITH PEOPLE AND/OR ONLINE RESOURCES OUTSIDE OF CARLETON UNIVERSITY.*** THIS APPLIES NOW AND IN THE FUTURE; i.e., if you post course materials somewhere online (e.g., Chegg) next fall, it is still an academic integrity offence and penalties will apply. This means at minimum, your credit in this course may be revoked.**

While the above policy may sound heavy-handed, it is actually for your benefit and the benefit of students in future years. The supply of exam and assignment questions in this course is not infinite. If the supply of questions of reasonable and appropriate difficulty is exhausted, there is little choice but to make questions more difficult. And you wouldn't want that, would you?

Time Demands and Tips for Success in this Course

- In order to be successful in this course you must spend an *average* of 10 hours per week working on it:
 - Attend the lectures and tutorials
 - Take 10 to 20 minutes before listening to a lecture and look over the notes
 - Spend 10 to 20 minutes after the lecture to review the day's notes
 - Set aside 2 hours a week to read that week's material from the textbook
 - Set aside *at least 2 hours a week* to do the problems from the textbook
- ASK QUESTIONS!
- BE DISCIPLINED AND STAY ON SCHEDULE! DON'T FALL BEHIND!

Academic Accommodations, Regulations, Plagiarism, Etc.

Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University. More information can be found at: <https://students.carleton.ca/course-outline/>

University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here:

<https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/>

Academic Accommodations for Students with Disabilities

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. For more details, visit the [Paul Menton Centre website](#).

Addressing Human Rights Concerns

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the [Department of Equity and Inclusive Communities](#) at equity@carleton.ca.

Religious Obligations

Please contact me with requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#).

Survivors of Sexual Violence

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are

supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: <https://carleton.ca/sexual-violence-support/>

Accommodations for Missed Work

Carleton recognizes that students may experience unexpected, temporary incapacitation (i.e., illness, injury, or extraordinary circumstances outside of a student's control). As a result, Carleton has put into place a protocol for students to apply for accommodations using a self-declaration form in the event of missed work. The form can be found at:

<https://carleton.ca/registrar/wp-content/uploads/self-declaration.pdf> Note that these forms should be used for short-term concerns related to missed work; if you are experiencing chronic, ongoing challenges which necessitate a broader solution, I recommend reaching out to the Paul Menton Centre and/or the Care Support team.

For Pregnancy

Please contact me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#).

Accommodation for Student Activities

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the [Senate Policy on Accommodation for Student Activities \(PDF, 25KB\)](#).

Academic Integrity

Academic Integrity is upholding the values of honesty, trust, respect, fairness, responsibility, and courage that are fundamental to the educational experience. Carleton University provides supports such as academic integrity workshops to ensure, as far as possible, that all students understand the norms and standards of academic integrity that we expect you to uphold. Your teaching team has a responsibility to ensure that their application of the Academic Integrity Policy upholds the university's collective commitments to fairness, equity, and integrity.

(Adapted from [Carleton University's Academic Integrity Policy](#), 2021).

Examples of actions that do not adhere to Carleton's Academic Integrity Policy include:

- Plagiarism
- Accessing unauthorized sites for assignments or tests
- Unauthorized collaboration on assignment and exams
- Using artificial intelligence tools such as ChatGPT when your assessment instructions say that it is not permitted

Please review the checklist [linked here](#) to ensure you understand your responsibilities as a student with respect to academic integrity and this course.

Sanctions for Not Abiding by Carleton's Academic Integrity Policy

A student who has not upheld their responsibilities under Carleton's Academic Integrity Policy may be subject to one of several sanctions. A list of standard sanctions in science can be found [here](#).

Additional details about this process can be found on [the Faculty of Science Academic Integrity website](#). Students are expected to familiarize themselves with and follow the Carleton University [Student Academic Integrity Policy](#). The Policy is strictly enforced and is binding on all students.

Student Rights & Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the [7 Rights and Responsibilities Policy](#) for details regarding the expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.

Student Concerns

If a concern arises regarding this course, **your first point of contact is me**: Email or drop in during student hours and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):



Note: You can also bring your concerns to [Ombuds services](#).

Assistance for Students

Academic and Career Development Services: <http://carleton.ca/sacds/>

Writing Services: <http://www.carleton.ca/csas/writing-services/>

Peer Assisted Study Sessions (PASS): <https://carleton.ca/csas/group-support/pass/>

Math Tutorial Centre: <https://carleton.ca/math/math-tutorial-centre/>

Science Student Success Centre: <https://sssc.carleton.ca/>