DALHOUSIE UNIVERSITY

Syllabus CHEM2401 Fall 2020

Introductory Organic Chemistry: Structure, Concepts of Mechanisms and Spectroscopy
Department of Chemistry

Teaching Team

Lecture Material: Dr. Alison Thompson, she/her (CHEM2400@dal.ca)
Virtual Lab material: Gaia Aish, she/her (ochemlab@dal.ca)

Learning Activities

Weekly overview (asynchronous)

- Connecting students with the teaching team, weekly expectations and the Dalhousie experience
- Video posted every Tuesday on Brightspace

Lecture Material (asynchronous)

- Modules 1-6: videos, resources, practice problems
- Posted on Brightspace

Virtual Lab material (synchronous and asynchronous)

- 10 virtual labs, content delivered asynchronously
- 10 synchronous sessions, scheduled during your lab block (as per your academic schedule)
- 9 lab assignments, submitted via Brightspace

Review (asynchronous)

- Review of concepts included in Modules and Virtual Lab, prepared by the Teaching Team in response to common queries – one will be posted before each CAPA assignment, as well as at key times during the terms
- Video posted on Brightspace, as needed

Drop-in Q&A (synchronous)

- Chemistry-based help, these sessions are optional, but will be your main way of getting help with lecture and lab material
- Weekly with Gaia and Dr. Thompson during your scheduled lab block each week

Appointments (synchronous)

- One-on-one meetings for administrative items and support related to an individual student
- **NOT chemistry-based help**
- Gaia or Dr. Thompson: 9.00-9.30 AST on Mondays and Fridays
- 10-minute Appointments bookable by students via link on Brightspace

Course Description

Organic chemistry is introduced through an examination of bonding, conformation and stereochemistry. Spectroscopic methods (MS, IR, ^{1}H and ^{13}C NMR) are used to determine the structures of compounds. Alkanes, alkenes, alkynes and alkyl halides are presented with an emphasis on the mechanisms of their reactions.

Prerequisites

CHEM 1011.03/CHEM 1012.03 or equivalent (grade of C- or better)

NOTE: for students wishing to take CHEM2402, please note that the prerequisite is CHEM2401 with a grade of C+ or better.

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Learning Objectives

Students passing CHEM2401, will be able to:

- understand and use IUPAC nomenclature rules
- draw and name organic compounds
- identify common functional groups found in organic compounds
- use VSEPR and Lewis theory to draw good/proper Lewis structures
- identify major/minor contributors for species that feature resonance stabilization
- draw and identify bonding orbital components according to hybridization theory
- use an understanding of structure and acid-base reactivity to predict pKa values
- use an understanding of structure and acid-base reactivity to predict equilibrium constants, K
- use curly/curved arrows to depict mechanisms
- use mechanisms to propose reaction coordinate diagrams
- rationalize and/or suggest suitable choices of base to effect deprotonation under precise conditions
- draw and identify constitutional, conformational and configurational isomers
- draw and identify least/most stable conformations
- draw and interpret perspective diagrams, Newman projections and Fischer projections
- predict and rationalize torsional strain and bond angle strain (ring strain)
- draw, interpret and predict stability for chair conformations of cyclohexanes
- apply Cahn-Ingold-Prelog rules to identify isomers (geometrical *E/Z*, stereochemical *R/S*)
- structurally identify organic compounds based on mass spectrometry and NMR spectroscopic data
- predict mass spectrometry and NMR spectroscopic data based on structure of organic compounds
- calculate and apply double bond equivalents in the analysis of organic compounds
- identify molecular ions in electron ionisation/electron impact (EI) mass spectrometry
- predict and rationalise the effects of C, Br and Cl isotopes in mass spectrometry
- rationalise ^{1}H and ^{13}C spectral information using introductory-level NMR theory
- predict and rationalise ^{1}H and ^{13}C chemical shifts
- predict and rationalise multiplicity patterns based on n+1 rules in ^{1}H and ^{13}C NMR spectroscopy
- predict and rationalise integrals in ^{1}H NMR spectroscopy
- apply considerations of structure, bonding and equilibrium to predict and rationalize reactivity
- propose reasonable curly/curved arrow-pushing mechanisms for substitution and elimination reactions
- propose reasonable curly/curved arrow-pushing mechanisms for reactions of alkenes and alkynes
- apply considerations of stereospecificity, stereoselectivity and regioselectivity to the reactions of alkyl halides and related species, alkenes and alkynes
- construct and interpret rate equations
- construct and interpret reaction coordinate diagrams
- propose and interpret synthetic sequences/routes for the preparation of complex organic species
- understand essential experimental techniques
- apply experimental techniques in a variety of virtual lab situations
- interpret experimental results and write scientific passages

Materials

Supplies for hands-on virtual lab

As denoted on Brightspace. A short shopping list will be provided. Lab manuals do not need to be purchased. A hardcover lab notebook is required, but it can be "used/recycled" (shared with other courses).

Textbook

Organic Chemistry, Professor Paula Y. Bruice, 8th Ed., available as eText (online) via Dalhousie bookstore, or in hard copy from other suppliers

Model kits

Some students find model kits useful to enhancing understanding of molecular bonding and structures

Brightspace

Lecture Modules and Virtual Lab resources: https://dal.brightspace.com

Teams

Dalhousie-supported Microsoft product for synchronous Virtual Lab Sessions, Review Sessions, and Appointments: accessible via the "waffle" on MyDal, login via your Dalhousie email address

LON-CAPA

For assignments, term-tests and the final exam: http://capa.conceptsinchemistry.ca

Assessment

Component		Weight (% of final grade); see below for three grading options	Date
Virtual lab		20 (must earn at least 10/20 to pass CHEM2401)	See below
Online lecture-based assignment Module 1:	Functional groups and nomenclature	Maximum 10	11.59pm AST Sept 15th 2020
Online lecture-based assignment Module 2:	Structure and bonding		11.59pm AST Sept 29th 2020
Online lecture-based assignment Module 3:	Acidity and basicity		11.59pm AST Oct 6th 2020
Online lecture-based assignment Module 4:	Isomerism		11.59pm AST Oct 27th 2020
Online lecture-based assignment Module 5:	Characterisation		11.59pm AST Nov 17th 2020
Online lecture-based assignment Module 6:	Organic reactions		11.59pm AST Dec 8th 2020
Term-test 1	Modules 1-2 and Lab 1,2,4	Maximum 10	8.30-9.30am AST Oct 9th 2020
Term-test 2	Modules 1-5 and Lab 3,5-8	Maximum 10	8.30-9.30am AST Nov 20th 2020
Final exam	Modules 1-6 plus all virtual lab materials	60 (must earn >40% on final exam to pass CHEM2401)	Scheduled exam period, posted by Registrar's Office

Grading Options

CHEM2401 has three 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.

Component	Option 1 weight (%)	Option 2 weight (%)	Option 3 weight (%)
Laboratory	20	20	20
Lecture-based online assignments	0	10	10
Term-Test 1	10	0	10
Term-Test 2	10	10	0
Final exam	60	60	60

Conversion of numerical grades to final letter grades follows Dalhousie's 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)		

Requirements and Policies

Virtual Lab

Laboratory work (2 hours per week, synchronous, every week) is an integral part of this class. The virtual lab work will help you to learn and appreciate practical techniques and will help you to understand lecture topics. The detailed running of the laboratories will be handled by Ms. Gaia Aish (ochemlab@dal.ca), assisted by Teaching Assistants (TAs).

Virtual lab material will begin on Tuesday September 8th, 2020: lab material and schedule are available on Brightspace. Please note that the first 50 minutes of the lab time-slot is OPTIONAL drop-in Q&A with Gaia and Dr. Thompson. **The last 50 minutes is a REQUIRED session. The required synchronous sessions will begin on Tuesday September 15th, 2020.** A microphone and webcam are required: a smart phone is sufficient, though not recommended.

M: 13.35-15.25 (required 14.35-15.25)
T: 14.05-15.55 (required 15:05-15:55)
W: 14.05-15.55 (required 15:05-15:55)
R: 14.05-15.55 (required 15:05-15:55)
F: 14.05-15.55 (required 15:05-15:55)

- Laboratory experiments and reports will closely relate to the lecture material during the online Fall 2020 term. Students granted lab exemptions are invited and encouraged to participate in the virtual lab exercises since the new virtual lab material is examinable on term tests and the final exam. Lab exempt students who choose to take the virtual lab in Fall 2020 will receive whichever lab grade is highest at the end of term (2020 or the previous academic year).
- Regardless of your standing in other parts of the class, you can only get credit for CHEM2401 after you have earned credit for the laboratory (minimum score= 50%, 10/20).
- No lab exemptions will be granted in future years based on your score in the virtual 2020 lab.
- To pass the course students **must submit** at least 9 out of the 10 virtual lab assignments. Late assignments will not be accepted. If you submit 9 out of 10 virtual lab assignments, you will receive a score of zero on the missing assignment.
- **Attendance is required during the synchronous virtual lab session** (1 hour, weekly). **Students are allowed to miss one session with no penalty**. If you need to miss an additional virtual lab session, arrangements can be made by contacting ochemlab@dal.ca: typically a makeup assignment will be offered. You do not need to use the Student Declaration of Absence Form.
- Students that are concerned about their ongoing access to the synchronous virtual lab due to reasons beyond their control (time zone differences, internet reliability, webcam access, family obligations, etc.) are expected to outline their concerns via email to ochemlab@dal.ca by Monday, September 14th.
- In an effort to ensure academic integrity in the virtual lab, lab work will be analyzed for uniqueness using Dalhousie approved plagiarism software (Urkend). For each lab assignment, rules on collaboration will be outlined within the assignment.
- During these uncertain times we understand that everyone faces new and unexpected challenges. As such, if you are failing to meet the expectations of the virtual lab the most important thing will be to stay in contact with Gaia via ochemlab@dal.ca.

Assignments, tests and exams

- In accordance with the principles of Dalhousie's Academic Integrity policies, all submissions must be your own work, and not involve input from, or the provision of answers by, other individuals or groups either in person or via web-based services.
- Term-tests and final exam will be conducted "closed book" via LON-CAPA. You will be responsible for all material in the Modules and Virtual Labs, as well as the assigned sections in the text-book.
- Lecture-based online assignments, one for each Module: students may complete as many of the practice assignments as they wish, as needed to become familiar with the material. All of the questions in the practice assignments database are included in the database of questions used to generate the six graded assignments, alongside many new questions. Completion of the graded assignments is "all or nothing": all six count towards the 10% allocated for this assessment component. Students may take each graded assignment twice, with the best score for each assignment counting for the overall grading scheme. Different questions will appear in the two graded assignments for any one Module, should students decide to take two assignments. Students get one "try/attempt" per question.
- The two Term-Tests will be held during the scheduled lecture time, 08.30-09.30 AST.
- **No make-ups are available.** Students who miss a test do not need to provide documentation to justify their absence, do not need to provide a Declaration of Absence form, and do not need to inform Dr. Thompson of their absence. The best of the three grading options (see next page) will be applied in calculating all final letter grades. Students are not required to pre-select an option.
- Students who are ill for the Final Examination must inform Dr. Thompson (CHEM2400@dal.ca) at least 8 hours **prior to the scheduled examination**.
- Only **one** Make-up Final Examination will be arranged (see the University Regulations, Calendar).
- There is no supplemental examination for CHEM2401.

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Content

Lecture Material

Module	Starting	Name (sections in textbook, *Organic Chemistry* by Professor Paula Y. Bruice, 8th edition)	LON-CAPA online assignment due
1	Sept 8th 2020	**Functional groups and nomenclature** (3.1-3., 4.2, 5.2, 5.4, 7.1, 7.2)	11.59pm, Sept 15th 2020
2	Sept 15th 2020	**Structure and bonding** (Ch1, 2.12, 3.8, 3.9, 5.3, 6.2, 7.3, 8.1-8.12 plus tutorials pages 382 and 563)	11.59pm, Sept 29th 2020
3	Sept 29th 2020	**Acidity and basicity** (2.1-2.9, 2.12, 7.10, 8.9-8.10 plus tutorial on page 80)	11.59pm, Oct 6th 2020
4	Oct 6th 2020	**Isomerism** (3.11-3.16, 4.1-4.15, 4.17, 4.18, 6.14-6.15)	11.59pm, Oct 27th 2020
5	Oct 27th 2020	**Characterisation** (5.1, 13.1-13.4, 14.1-14.14, 14.7, 14.8, 14.20, 14.21, 14.23)	11.59pm, Nov 17th 2020
6	Nov 17th 2020	**Organic reactions** ▪ Substitution reactions: 9.1-9.5, 9.12, 9.13, 9.15, 9.17, 10.1, 10.3, 10.6-10.7, 10.12 ▪ Elimination reactions 9.6-9.13, 9.15, 9.17, 10.4, 10.9-10.10 ▪ Reactions of alkenes 5.1-5.12, 6.1-6.9, 6.12, 6.16, 8.12 plus tutorial starting on page 225 ▪ Reactions of alkynes 7.1-7.12	11.59pm, Dec 8th 2020

Virtual Lab Assignments

	Starting	Virtual lab topics	Prelabs and lab assignments due dates
1	Sept 8th 2020	1) Chemdraw for Small Molecules	**Prelab:** 11.59pm, Monday, Sept 14th 2020 11.59 pm, Tuesday, Sept 22nd 2020
2	Sept 15th 2020	2) Thin Layer Chromatography	11.59 pm, Tuesday, Sept 29th 2020
3	Sept 22th 2020	3) Crystalline Compounds	**Prelab:** 11.59pm, Monday, Sept 28th 2020 11.59 pm, Tuesday, Oct 13th 2020
4	Sept 29th 2020	4) Acids & Bases	11.59 pm, Tuesday, Oct 6th 2020
5	Oct 13th 2020	5) Naturally Occurring Molecules	**Prelab:** 11.59pm, Monday, Oct 19th 11.59 pm, Tuesday, Nov 3rd 2020
6	Oct 20th 2020	6) Isomerism	11.59 pm, Tuesday, Nov 3rd 2020
7	Oct 20th 2020	7) Select Topics in Separations	**Prelab:** 11.59pm, Monday, Oct 26th 2020 11.59pm, Tuesday, Nov 10th 2020
8	Nov 3rd 2020	8) Characterization	11.59pm, Tuesday, Nov 24th 2020
9	Nov 17th 2020	9) Organic Synthesis	11.59pm, Tuesday, Dec 8th 2020

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.
http://www.dal.ca/cultureofrespect.html

Recognition of Mi'kmaq Territory

Dalhousie University acknowledges 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. Contact the Indigenous Student Centre (1321 Edward St, elders@dal.ca).
https://www.dal.ca/campus_life/communities/indigenous.html

Student Accessibility & Accommodation

The Advising and Access Services Centre (AASC) 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).
https://www.dal.ca/campus_life/academic-support/accessibility.html
A note taker may be required as part of a student's accommodation. If you are interested, please contact AASC at 902-494-2836; for more information contact notetaking@dal.ca.

Student Code of Conduct

Everyone in the Dalhousie University community is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie University 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.
https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html

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

Student Resources and Support

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 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

Research Lab Safety

- https://www.dal.ca/content/dam/dalhousie/pdf/dept/safety/lab_policy_manual_2007.pdf

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