COURSE SYLLABUS

COURSE TITLE: CHEM-231: Organic Chemistry 2

CLASS SECTION: 001A and 001B

TERM: Winter 2024

COURSE CREDITS: 3

DELIVERY METHOD(S): On Lansdowne campus in Fisher classroom and Lab

Camosun College campuses are located on the traditional territories of the Lək̓ʷəŋən and W̱SÁNEĆ peoples. We acknowledge their welcome and graciousness to the students who seek knowledge here.
Learn more about Camosun's Territorial Acknowledgement.

For COVID-19 information please visit https://legacy.camosun.ca/covid19/index.html

Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable explanation in advance, you will be removed from the course and the space offered to the next waitlisted student.

INSTRUCTOR DETAILS

NAME: Dr. Larry Lee

EMAIL: leel@camosun.bc.ca

OFFICE: F344B

HOURS: Please see posted schedule on office door F344B or as posted on D2L

As your course instructor, I endeavour to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me. Camosun College is committed to identifying and removing institutional and social barriers that prevent access and impede success.

CALENDAR DESCRIPTION

This course is a continuation of CHEM 230. Topics include: aromatic compounds, aldehydes and ketones, carboxylic acids and derivatives, amines, amino acids and peptides and carbohydrates. The laboratory experiments are mainly directed towards the syntheses of various organic compounds.

PREREQUISITE(S):

All of:

- C in CHEM 121
- C in CHEM 230

CO-REQUISITE(S):

EXCLUSION(S):

COURSE LEARNING OUTCOMES / OBJECTIVES

Upon completion of this course a student will be able to:

1. Utilize the specialized vocabulary and nomenclature based on the IUPAC system for organic compounds including aldehydes, ketones, benzene & its derivatives, carboxylic acids and their derivatives, amines, and carbohydrates according to their structures and functional groups present.
2. Compare and contrast the general physical properties such as stability, acidity and basicity, melting and boiling point, and water solubility.
3. Describe the chemical properties of the above classes of organic compounds, and relate any differences and similarities.
4. Draw a synthetic route outlining the preparation of some of the compounds above and their reactions, including details such as stereochemistry of selected reactions and mechanisms, stability of transition states, intermediates, products, and factors affecting the outcome.
5. Utilize the concepts of functional group transformations and reaction mechanisms to explain organic reactions.
6. Demonstrate an ability to use the method of retrosynthetic analysis to interconvert the above classes of organic compounds.
7. Communicate an understanding of the phenomena of proton and carbon-13 nuclear magnetic resonance spectroscopy and to interpret and predict the spectroscopic data for the classes of organic compounds listed above.

REQUIRED MATERIALS & RECOMMENDED PREPARATION / INFORMATION

a) Organic chemistry, Mechanistic Patterns, Ogilvie, 2nd edition, available through Top Hat https://app-ca.tophat.com
b) Access to Desired to Learn (D2L) https://online.camosun.ca
c) Lab Manual Chem 230/231, Camosun College, 2018, by Nasr Khalifa
d) A molecular model is highly recommended. You can borrow one from Camosun College.
e) Safety glasses is required and Lab coat is strongly recommended

COURSE SCHEDULE, TOPICS, AND ASSOCIATED PREPARATION / ACTIVITY / EVALUATION

a) The following schedule and course components are subject to change with reasonable advance notice, as deemed appropriate by the instructor.

WEEK	DATE RANGE	ACTIVITY or TOPIC	OTHER NOTES
1	Jan 8 – 12	IR spectroscopy	Work sheet 1 Lab
2	Jan 15 – 19	Expt 11 Oxidation reactions	Experiment
3	Jan 22 – 26	Mass Spectroscopy	Work sheet 2
4	Jam 29 – Feb 2	Expt 14 Reduction reactions	Experiment
5	Feb 5 – 9	NMR Spectroscopy	Worksheet 3
6	Feb 12 –16	Expt 13 Grignard reactions	Experiment
7	Feb 20 – 23	Reading Break	
8	Feb 26 – Mar 1	Test 1 (Feb 29 or March 1 During Lab period)	Test 1
9	Mar 4– 8	Expt 12 Diels Alder Reactions	Experiment
10	Mar 11 – 15	Expt 17 Wittig reactions	Experiment
11	Mar 18 – 22	Natural product synthesis	Experiment
12	Mar 27 - 31	No lab	Good Friday
13	April 3– Apr 6	Test 2 (During lab period)	Test 2
14	Apr 11 – Apr 15	REVIEW	REVIEW
15	April 17-25	Final exam week	Final

a) Students registered with the Centre for Accessible Learning (CAL) who complete quizzes, tests, and exams with academic accommodations have booking procedures and deadlines with CAL where advanced noticed is required. Deadlines scan be reviewed on the CAL exams page. http://camosun.ca/services/accessible-learning/exams.html

b) **Scheduled lectures** are 50 minutes per class on Tues Wed, Thurs In class face–to–face
Scheduled labs are 170 minutes per week (2h and 50 min)

Class schedule:	Lectures	Tu, W	4:30 – 5:20 pm	F214
	Lecture	Thurs	9:30 – 10:20 am	F262
	Lab	Thurs (001B)	2:30 – 5:20 pm	F354
	Lab	Fri (001A)	8:30 –11:20	F354

c) Spectroscopy Worksheets will be available on D2L. These are to be submitted prior to a due date and these will be graded. Chapter worksheets are not graded, but answers will be provided. Students are encouraged to do worksheets to assist with comprehending the organic chemistry associated with this term.

c) Quizzes through D2L (Desired to Learn) – There will be chapter quizzes 10–20 questions with specific due dates. These question will mainly be multiple choice based.

d) The textbook is a good resource for concepts – use this textbook as a reference for learning.

e) Powerpoint notes are available on D2L

Detailed Course Outline:

1. Review: Functional Groups Chapter 2 (p 57-80):
Hydrocarbons, heteroatoms, carbonyl containing, intermolecular forces, physical properties, systematic naming. (students are encouraged to review this chapter on their own)

2. Review of curved arrow mechanism: Chapter 5 (p186-227):

Curved arrows (doubly barbed and singly barbed), Formal charges, Resonance structures. (students are encouraged to review this chapter on their own).

3. π-bonds as electrophiles: **Reactions of carbonyls and related functional groups (Chapter 7)**

Carbonyl and other carbon-heteroatom as electrophilic centre (p 273-277), Hydride addition p280-282), Oxidation-reduction reactions (P 286-288), Grignard reagent (p288-294), organolithium and organometallic reagent (p294-297), carbon-carbon bond forming reaction, cyanohydrins, (p299- 303), catalysis of addition reactions, hydrate, hemicacetal (p 306- 313), stereochemistry of nucleophilic addition (p314-317).

4. Review: π-bonds as nucleophiles. **Reaction of alkenes (Chapter 8)**
(this chapter was covered in CHEM 230, Students are expected to review this section on their own). The review will cover. Addition of water (Markovinikov and AntiMarkovnikov), formation of ethers, and epoxides,

5. The Chemistry of Benzene and Its Derivatives: (Chapters 9, 10)

Conjugated Systems in acyclic systems, bond rotation, bond lengths, heat of hydrogenation (p 400-405)
Aromaticity, stability of benzene, Huckel's rule (p410-412)
Anti-aromaticity (p 412), non-aromatic (p413-414). Heteroatoms in aromaticity (p 415 -416)
Aromatic ions (p416-418), Molecular orbital analysis (Frost cycles) [418-421). Annulenes (p 412-413), Polycyclic aromatic rings (423-225)
Electrophilic aromatic substitution (p 423-449): electrophiles, first substitution, nitration, halogenation, sulfonation, mechanism of electrophilic aromatic substitution reactions
Friedel-Crafts alkylation and acylation. Limitation of Friedal-Crafts alkylation (p452-444).
Nomenclature (pp49)
Second substitution, reactivity, orientation (P449-463)

Third substitution, reinforcement and opposition P463-466)
Nucleophilic aromatic substitution reactions (Ch 15.9), diazonium salts (Sandmeyer reaction –p743-747. Synthetic applications (p476-482). Summary (p 482-483)

6. Spectroscopy: (Chapter 13, 14)

Electromagnetic spectrum
Nuclear magnetic resonance spectroscopy, ^{1}H NMR, ^{13}C NMR
Structure elucidation using IR (Ch 14, p 662-695), UV/VIS, MS (Ch 14 p548- 661), and NMR spectra of alky halides, alcohols, alkenes, alkynes, carbonyl compounds, carboxylic acids, aromatic compounds, amines, nitriles.

7. **π-bonds as electrophiles**: **(Chapter 15) Carboxylic acid derivatives and their reactions**

Nucleophilic acyl substitution reactions: structure and reactivity, basic, neutral, acidic conditions (p698-70716), Acid-base hydrolysis of amides, carboxylic acid activation, Esterification, Amides, anhydride, reduction of carboxylic acids and derivatives. (p725-733), Organometallic reagents to acid derivatives. Summary page 748-749)

8. π-bonds with hidden leaving groups (Chapter 16): Reaction of acetals and related compounds.

Reversible and irreversible acetals, acetals as protecting groups (p771-776). Acetals in sugars and carbohydrates (p776—781), Imines, hemiaminals, enamine, oxime, semicarbazide, reductive amination (p 787), Wolff_Kischner reduction (p789-791). Heterocycle formation using hidden leaving groups: pyrroles and furans (p792-793).

9. **Carbonyl based nucleophiles: (Chapter 17)**

Aldol, Claisen, Wittig and related enolate reactions. Acidity of carbonyl compounds (p 812-817). Keto-enol equilibria (p 813-814). Alpha halogenation (p818-821), alkylation of enolates(p 821-826), alkylation of enamines (p 824-827). Aldol reaction (p 827-846): Crossed aldols: Claisen-Schmidt reaction (p 830-832), Crossed aldol using strong base (p 832-836), Elimination (dehydration of aldol p,837-841), Intramolecular aldol (p841-844), retrosynthetic analysis of aldols (p 844-846). Claisen condensation (p 846-849). Other aldol related reactions: Nitrogen based electrophiles (Mannich reaction p 850), (Henry reaction p 851-852), Phosphorus based electrophile (Wittig 859-860). Retrosynthetic analysis of aldol related reactions (p660-863). 1,3-Dicarbonyl compounds (p863-871): acetoacetic ester synthesis, malonic ester synthesis, decarboxylation. Knoevenagel condensation (p871-874), Retrosynthetic analysis usind dicarbonyl compounds (p876-879). Summary (p 879-889)

10. Selectivity and reactivity in Enolate reactions (**Chapter 18**):

Direct and conjugate addition to α,β-unsaturated carbonyl compounds: 1,4- vs 1,2-additions, addition (901-914): Thermodynamic vs kinetic control (p 903-906),organocopper reagents (p 908-909). Michael addition (p909-914). Robinson annulation (p 914-916). Regioselectivity in ketone nucleophiles, kinetic and thermodynamic control (p819-921). Unpolung nucleohiles: Dithianes (p941-943)

11. The Chemistry of Amines: (Chapter 8)

Classification of amines, synthesis of amines, Gabriel synthesis (p531), Azide (p531)
Sandmeyer reaction (covered in aromatics – P 743-747)
Reaction of amines to imines and enamines (covered in Ch 16). Reductive amination (p 787)

12. Carbohydrates: (Covered in acetals Ch 16 p776-781)

-Structure; ketoses, aldoses, pyranoses, furanoses
-Fischer projections, D- and L- designation
-Mutarotation of glucose
-Glycosides, the anomeric effect
-Reactions of monosaccarides as alcohols
-Disaccharides and polysaccharides

EVALUATION OF LEARNING

DESCRIPTION		WEIGHTING
Online assessment D2L (all quizzes combined)		15%
Term Test 1 (Thurs February 29, 2024 or Fri Mar 1, 2024)*		15%
Term Test 2 (Thurs April 5, 2024 or Fri April 6, 2024)*		15%
Laboratory (lab reports written and videos)		25%
Final exam		30%
	TOTAL	100%
Note: * student may write exam in either lab date. Inform the instructor by email.		

If you have a concern about a grade you have received for an evaluation, please come and see me as soon as possible. Refer to the Grade Review and Appeals policy for more information. http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf

COURSE GUIDELINES & EXPECTATIONS

All lectures and labs will be face–to–face, unless otherwise noted in the lab schedule or given an order by Camosun College (BC health officer). Class attendance is highly recommended. It is not mandatory, but a higher success rate is obtainable with showing up to class, taking writing notes, asking question, and keeping engaged.

Term tests are compulsory and the mark for any single term test or combination of term tests is **not** replaced by the final exam mark except as described below.

D2L quizzes are mandatory and are given a due date.

A zero is give as the mark for any quiz or final exam not written and for which no official medical excuse is provided. The medical excuse must be dated within the week of the exam and must be handed in within two weeks of the exam date. **The medical excuse must provide sufficient information to establish that the student was not able to write the exam due to his/her medical condition. Students will also be required to give written**

consent for information about their medical condition to be disclosed to the instructor. Any such information obtained is treated as confidential.

The final exam at the end of the course will cover all course material.

During the experimental work, students are expected to wear safety glasses and closed toe footwear. No sandals, flip–flops, or bare feet allowed in the labs. It is highly recommended that students wear a lab coat to protect you from acids and bases, and odorous chemicals. All students must abide by laboratory safety rules.

You will be expected to show up for the lab on time. At the beginning of the lab, I will go over safety precautions and any demonstration of experimental techniques.

Students must read the lab and prepare a flow chart (as a pre-laboratory requirement). By preparing for the lab, this will make the lab experience more enjoyable as you become efficient and successful at synthesizing and analyzing the products.

As Chemistry is a practical science, there are expectations that you attend all the lab periods. No more than one lab maybe missed without a medical excuse as this will compromise the learning outcomes. You must notify the instructor regarding your absence within the same week of the missed lab, otherwise a zero is given to that lab period.

All labs are due within one week of completion of lab work, unless otherwise noted by the instructor or posted on D2L or prior instructor permission has been granted, or an accommodation is in-place. The format of the report will be post–lab questions or video format or a full written report of the experimental work and summary of the data. All work must be submitted in D2L assignment folder.

Student may share data when working in partners, but each student must submit their own report. In the event, that reports are too similar, a warning or a zero will be given to the report.

Late labs and worksheets will be penalized at 10% for each week late. Once labs or worksheets are returned to students, no late work can be submitted for grading. Answers to worksheets will be posted on day of return.

At least 70% of lab work must be submitted for grading and at least 50% lab score must be obtained to pass this course

All D2L quizzes will be due two weeks from the posted date.

Final exam is schedule April 15-24, 2024 Do not make travel arrangements during this period unless you know your exam schedule.

SCHOOL OR DEPARTMENTAL INFORMATION

A science help center is available for additional help, but please contact me for help.

STUDENT RESPONSIBILITY

Enrolment at Camosun assumes that the student will become a responsible member of the College community. As such, each student will display a positive work ethic, assist in the preservation of College property, and assume responsibility for their education by researching academic requirements and policies; demonstrating courtesy and respect toward others; and respecting expectations concerning attendance, assignments, deadlines, and appointments.

SUPPORTS AND SERVICES FOR STUDENTS

Camosun College offers a number of services to help you succeed in and out of the classroom. For a detailed overview of the supports and services visit http://camosun.ca/students/.

Academic Advising	http://camosun.ca/advising
Accessible Learning	http://camosun.ca/accessible-learning
Counselling	http://camosun.ca/counselling
Career Services	http://camosun.ca/coop
Financial Aid and Awards	http://camosun.ca/financialaid
Help Centres (Math/English/Science)	http://camosun.ca/help-centres
Indigenous Student Support	http://camosun.ca/indigenous
International Student Support	http://camosun.ca/international/
Learning Skills	http://camosun.ca/learningskills
Library	http://camosun.ca/services/library/
Office of Student Support	http://camosun.ca/oss
Ombudsperson	http://camosun.ca/ombuds

Registration	http://camosun.ca/registration
Technology Support	http://camosun.ca/its
Writing Centre	http://camosun.ca/writing-centre

If you have a mental health concern, please contact Counselling to arrange an appointment as soon as possible. Counselling sessions are available at both campuses during business hours. If you need urgent support after-hours, please contact the Vancouver Island Crisis Line at 1-888-494-3888 or call 911.

COLLEGE-WIDE POLICIES, PROCEDURES, REQUIREMENTS, AND STANDARDS

Academic Accommodations for Students with Disabilities

The College is committed to providing appropriate and reasonable academic accommodations to students with disabilities (i.e. physical, depression, learning, etc). If you have a disability, the Centre for Accessible Learning (CAL) can help you document your needs, and where disability-related barriers to access in your courses exist, create an accommodation plan. By making a plan through CAL, you can ensure you have the appropriate academic accommodations you need without disclosing your diagnosis or condition to course instructors. Please visit the CAL website for contacts and to learn how to get started: http://camosun.ca/services/accessible-learning/

Academic Integrity

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.13.pdf for policy regarding academic expectations and details for addressing and resolving matters of academic misconduct.

Academic Progress

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.1.pdf for further details on how Camosun College monitors students' academic progress and what steps can be taken if a student is at risk of not meeting the College's academic progress standards.

Course Withdrawals Policy

Please visit http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.2.pdf for further details about course withdrawals. For deadline for fees, course drop dates, and tuition refund, please visit http://camosun.ca/learn/fees/#deadlines.

Grading Policy

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf for further details about grading.

Grade Review and Appeals

Please visit http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf for policy relating to requests for review and appeal of grades.

Mandatory Attendance for First Class Meeting of Each Course

Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable reason in advance, you will be removed from the course and the space offered to the next waitlisted student. For more information, please see the "Attendance" section under "Registration Policies and Procedures" (http://camosun.ca/learn/calendar/current/procedures.html) and the Grading Policy at http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf.

Medical / Compassionate Withdrawals

Students who are incapacitated and unable to complete or succeed in their studies by virtue of serious and demonstrated exceptional circumstances may be eligible for a medical/compassionate withdrawal. Please visit http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.8.pdf to learn more about the process involved in a medical/compassionate withdrawal.

Sexual Violence and Misconduct

Camosun is committed to creating a campus culture of safety, respect, and consent. Camosun's Office of Student Support is responsible for offering support to students impacted by sexual violence. Regardless of when or where the sexual violence or misconduct occurred, students can access support at Camosun. The Office of Student Support will make sure students have a safe and private place to talk and will help them understand what supports are available and their options for next steps. The Office of Student Support respects a student's right to choose what is right for them. For more information see Camosun's Sexualized Violence and Misconduct Policy: http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.9.pdf and camosun.ca/sexual-violence. To contact the Office of Student Support: oss@camosun.ca or by phone: 250-370-3046 or 250-3703841

Student Misconduct (Non-Academic)

Camosun College is committed to building the academic competency of all students, seeks to empower students to become agents of their own learning, and promotes academic belonging for everyone. Camosun also expects that all students to conduct themselves in a manner that contributes to a positive, supportive, and safe learning environment. Please review Camosun College's Student Misconduct Policy at http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.5.pdf to understand the College's expectations of academic integrity and student behavioural conduct.

Changes to this syllabus: Every effort has been made to ensure that information in this syllabus is accurate at the time of publication. The College reserves the right to change courses if it becomes necessary so that course content remains relevant. In such cases, the instructor will give the students clear and timely notice of the changes.