



CAMOSUN COLLEGE
School of Arts & Science
Department of Chemistry & Geoscience

CHEM-231-001
Organic Chemistry 2
Summer 2020

COURSE OUTLINE

The course description is online @ <http://camosun.ca/learn/calendar/current/web/chem.html>

Ω Please note: This outline will not be kept indefinitely. It is recommended students keep this outline for their records, especially to assist in transfer credit to post-secondary institutions.

1. Instructor Information

(a) Instructor	Dr. Ryan Fradette
(b) Office hours	By email
(c) Location	F344A
(d) Phone	Alternative:
(e) E-mail	fradetter@camosun.bc.ca
(f) Website	

2. Intended Learning Outcomes

Upon completion of this course the 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.

3. Required Materials

(a)	Texts	Organic chemistry, Mechanistic Patterns, Ogilvie, 1st edition (hardcopy or e-text) Note: on the bookstore website the e-text is called: <i>Mobius IAC for Organic Chemistry 1e</i>
(b)	Other	A molecular model kit is recommended (molymod or similar)
(c)	Technology	The ability to access the Course D2L page and the email address you have supplied to Camosun on a daily basis The ability to scan and save as a PDF pages of hand written work to submit to the D2L course page

4. Course Content and Schedule

Lecture

Video lectures will be posted at approximately 10:30am each lecture day (Tuesday, Thursday, Friday)

A detailed course outline is posted below, relevant practice problems can be found on the course D2L page, completing them is recommended but they will not be collected or graded

The lecture grade will consist of the following:

- **D2L assignments (multiple choice)**
 - o They will be in the quiz section of the D2L page
 - o They will be posted on Tuesdays and will be due on Fridays at **5:00 pm**
- **Quizzes (short answer)**
 - o They will be distributed Thursdays at **noon** in the content section of the D2L page titled 'Blank Quiz Documents'
 - o They will be due on the same **Thursday** by **5:00 pm** in the D2L assignment dropbox as a PDF file (I use scannable to scan handwritten pages, but there are many free smart phone camera scanner apps. Or you can also annotate the blank PDF file directly if you have a tablet)
 - o If the timing of the quizzes is an issue please let me know as soon as possible
 - o They will cover anything up to and including material from the Tuesday lecture of the same week (with the exception of Quiz 1, the Chem 230 review quiz)
 - o The lowest of the 4 quiz grades will be dropped
- **Final Exam**
 - o TBA during week 8

Lecture Schedule	Tuesdays	Thursdays	Fridays
Week 1 (May 4 – 8)		Quiz 1	
Week 2 (May 11 – 15)			Assignment 1 due
Week 3 (May 18 – 22)		Quiz 2	Assignment 2 due
Week 4 (May 25 – 29)			Assignment 3 due
Week 5 (June 1 – 5)		Quiz 3	Assignment 4 due
Week 6 (June 8 – 12)			Assignment 5 due
Week 7 (June 15 – 18)		Quiz 4	Assignment 6 due

Lab

The lab will consist of 4 parts

- Part 1
 - o Weekly BACON (Biology and Chemistry Online Notes) tutorial assignments. You can sign up via the link below
 - o <https://learnbacon.com/courses>
 - o Our course is: Camosun College – Chem 231 – 001 Organic chemistry 2 (Fradette)
 - o Pin: RPRGXL
 - o The tutorials will be due weekly at 5:00 pm
 - o Only the quiz at the end is graded
- Part 2
 - o Virtual Reality Organic Chemistry Labs (NC state)
 - o Weeks 2 – 4, assignments will be posted in the content folder titled 'Lab Materials' one week before the due date
 - o <https://sites.google.com/ncsu.edu/ncstatevrorganicchemistrylabs/home>
 - o Due Mondays at 5:00 pm
- Part 3
 - o Spectroscopy Assignments (D2L quizzes)
 - o Due Monday June 1st, 5:00 pm
- Part 4
 - o Spectroscopy Quiz (written quiz)
 - o Distributed Monday June 8th at noon, due Monday June 8th at 5:00 pm

Lab Schedule	Mondays	Wednesdays
Week 1 (May 4 – 8)		
Week 2 (May 11 – 15)	Virtual reality lab 4 due	BACON Tutorial 1 & 2 due
Week 3 (May 18 – 22)	Virtual reality lab 5 due + (IR/MS seminar)	BACON Tutorial 3 due
Week 4 (May 25 – 29)	Virtual reality lab 2 due + (NMR seminar)	BACON Tutorial 4 due
Week 5 (June 1 – 5)	Spectroscopy MC Assignment due	BACON Tutorial 5 due
Week 6 (June 8 – 12)	Spectroscopy Quiz	BACON Tutorial 6 due
Week 7 (June 15 – 18)		BACON Tutorial 7 due

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 (p 186-227):

Curved arrows (doubly barbed and singly barbed), formal charges, resonance structures. (Students are encouraged to **review** this chapter on their own).

3. Review (7.2-7.8) and new material (7.9-7.11) of 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 p 280-282), Oxidation-reduction reactions (p 286-288), Grignard reagent (p288-294), organolithium and organometallic reagent (p294-297), carbon-carbon bond forming reaction, cyanohydrins, (p 299- 303),

catalysis of addition reactions, hydrate, hemiacetal (p 306- 313), stereochemistry of nucleophilic addition (p 314-317).

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, addition of hydrogen halides (Markovnikov and anti-Markovnikov), formation of ethers, 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 Friedel-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) – Lab Seminars

Electromagnetic spectrum

Nuclear magnetic resonance spectroscopy, ^1H NMR, ^{13}C NMR

Structure elucidation using IR (Ch 14, p 662-695), UV/VIS, MS (Ch 14 p 548- 661), and NMR spectra of alkylhalides, 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 using 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. Reactions controlled by orbital interactions (Chapter 20)

molecular orbitals (20.2)
The Diels-Alder reaction (20.3.1-20.3.2)
1,3-Dipolar cycloadditions (20.3.5-20.3.6.3)

5. Basis of Student Assessment (Weighting)

Lecture		
	6 x D2L Assignments	20%
	4 x Short answer quizzes (lowest dropped)	25%
	Final Exam	30%
Lab		
	7 x BACON tutorials	5%
	3 x Virtual Labs	5%
	D2L spectroscopy assignment	5%
	Spectroscopy quiz (short answer)	10%
Total		100%

Quizzes cannot be rewritten, the weight of any missed quiz will count as the lowest quiz mark and be dropped. Any subsequent missed quizzes will be transferred to the cumulative final exam, provided the instructor is notified prior to the quiz time.

Late virtual labs will incur a 10% penalty

No late D2L assignments or BACON tutorials will be accepted for marks

6. Grading System

- ☒ Standard Grading System (GPA)
☐ Competency Based Grading System

7. Recommended Materials to Assist Students to Succeed Throughout the Course

An excellent online organic basic organic nomenclature practice tool is available for free at

An alternative virtual organic chemistry textbook.

<https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/intro1.htm>

8. College Supports, Services and Policies



Immediate, Urgent, or Emergency Support

If you or someone you know requires immediate, urgent, or emergency support (e.g. illness, injury, thoughts of suicide, sexual assault, etc.), **SEEK HELP**. Resource contacts @

<http://camosun.ca/about/mental-health/emergency.html> or <http://camosun.ca/services/sexual-violence/get-support.html#urgent>

College Services

Camosun offers a variety of health and academic support services, including counselling, dental, disability resource centre, help centre, learning skills, sexual violence support & education, library, and writing centre. For more information on each of these services, visit the **STUDENT SERVICES** link on the College website at <http://camosun.ca/>

College Policies

Camosun strives to provide clear, transparent, and easily accessible policies that exemplify the college's commitment to life-changing learning. It is the student's responsibility to become familiar with the content of College policies. Policies are available on the College website at <http://camosun.ca/about/policies/>. Education and academic policies include, but are not limited to, Academic Progress, Admission, Course Withdrawals, Standards for Awarding Credentials, Involuntary Health and Safety Leave of Absence, Prior Learning Assessment, Medical/Compassionate Withdrawal, Sexual Violence and Misconduct, Student Ancillary Fees, Student Appeals, Student Conduct, and Student Penalties and Fines.

A. GRADING SYSTEMS <http://camosun.ca/about/policies/index.html>

The following two grading systems are used at Camosun College:

1. Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
90-100	A+		9
85-89	A		8
80-84	A-		7
77-79	B+		6
73-76	B		5
70-72	B-		4
65-69	C+		3
60-64	C		2
50-59	D		1
0-49	F	Minimum level has not been achieved.	0

2. Competency Based Grading System (Non GPA)

This grading system is based on satisfactory acquisition of defined skills or successful completion of the course learning outcomes

Grade	Description
COM	The student has met the goals, criteria, or competencies established for this course, practicum or field placement.
DST	The student has met and exceeded, above and beyond expectation, the goals, criteria, or competencies established for this course, practicum or field placement.
NC	The student has not met the goals, criteria or competencies established for this course, practicum or field placement.

B. Temporary Grades

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy at <http://camosun.ca/about/policies/index.html> for information on conversion to final grades, and for additional information on student record and transcript notations.

Temporary Grade	Description
I	<i>Incomplete:</i> A temporary grade assigned when the requirements of a course have not yet been completed due to hardship or extenuating circumstances, such as illness or death in the family.
IP	<i>In progress:</i> A temporary grade assigned for courses that are designed to have an anticipated enrollment that extends beyond one term. No more than two IP grades will be assigned for the same course.
CW	<i>Compulsory Withdrawal:</i> A temporary grade assigned by a Dean when an instructor, after documenting the prescriptive strategies applied and consulting with peers, deems that a student is unsafe to self or others and must be removed from the lab, practicum, worksite, or field placement.