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

CHEM-231-002A/B/C
Organic Chemistry 2
Winter 2019

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. Larry Lee		
(b) Office hours	See schedule on D2L or email me for appointment		
(c) Location	F344B		
(d) Phone	250-370-3463	**Alternative:**	
(e) E-mail	leel@camosun.bc.ca		
(f) Website	www.online.camosun.ca (D2L)		

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) Organic chemistry, Mechanistic Patterns, Ovilvie, 1st edition
(b) Lab Manual Chem 231, Camosun College, 2018 by Nasr Khalifa

(c) Other: Student solution manual to the textbook is recommended
A molecular model set is highly recommended
Lab coat is required
Safety glass is required

4. Course Content and Schedule

Hours of Delivery: 3 hour of lectures and 3 hours of labs. Duration: 15 weeks.

Lectures (002 A,B,C)

9:30-10:20: Mon and Thurs (F300) , Wed (F360)

Labs (B group)	**Labs (A group)**	**Labs (C group)**
14:30 – 17:20 Monday	14:30 –17:20 Tues	18:30 – 21:20 Tues

All labs are in **F354** unless otherwise noted on the F354 door**. You must go to your registered lab section** . Only a medical note will grant you permission to work in a non registered lab. Estimated out-of-class: at least 6 hours per week.

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)

4. 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 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 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

Lab schedule – please see attached handout.

- Final exam at the end of the course will cover **all** course material.
- At least a passing grade on lab marks must be achieved in order to write the final exam.
- You must pass both the lecture portion and the lab portion in order to pass the course.
- You must provide your own **safety glasses**. Prescription glasses are OK, but sunglasses are NOT. You must wear these safety glasses at all times while you are in the lab. You will not be allowed to carry out experiments without safety glasses.
- Lab reports are due one week after the completion of the experiment (at the beginning of next lab period). Late labs will be given a 10% deduction for each day. No late labs are graded after the seventh day.
- Lab grade consists of five labs and student evaluation for preparation, safety, and cleanliness
- Students are expected to come to lab on time – late arrivals will be penalized.
- All lab reports must be typed and bound in a duo tang folder.

5. Basis of Student Assessment (Weighting)

(a)	Laboratory	Lab Experiments	25%
(b)	Online	Ogilvie – on line activity	10%
(c)	Assignment	Take home	10%
(d)	Exams (3)	Feb 11 or 12, 2019 (2 h) April 1 or 2, 2019 (2 h) Final exam (April 15-26)	10% 10% 35%

6. Grading System

[X] Standard Grading System (GPA)

[ ] Competency Based Grading System

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

The materials for this CHEM 230 and CHEM 231 are purchased as a package that contains the hardcover textbook by Ogilvie, 1st edition, the student solution manual, and the on-line e-text book by Ogilvie. Within the on-line component is Chemistry animations and on-line quizzes. There are also self−assess assignments with answers posted on desired to learn (D2L).

Alternative on−line sources are Khan Academy and a virtual organic chemistry textbook.
https://www2.chemistry.msu.edu/faculty/reusch/virttxtjml/intro1.htm
A chemistry drawing program is available in all the computers in F358.
The program is called Accelrys draw.
Alternatively, I am available outside my office hours. Please email to schedule appointment.

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	*Incomplete*: 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	*In progress*: 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	*Compulsory Withdrawal*: 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.

Organization Of The Lab Report

Title of the experiment: State the title of the experiment you have just carried out.

Date: Write the date on which you did the experiment.

Name: Your name and lab partner's name (if applicable)

Objective: State what you want to achieve by doing the experiment in one or two sentences. Be very brief and to the point.

Procedures: You can write the following: Please refer to Chem. 230/231 lab manual, 2005 Edition. pp. xx-xx. Record any changes to the given procedures.

Data: Organize any data, whether numerical or descriptive, in a **neat table** (or tables if applicable). Report masses of products and their melting points (include the CRC handbook values for comparison). Any relevant data recorded on a rough data sheet should be copied here. Do not forget to write **chemical equations** here.

Discussion and Calculations: In this part of the report, you will make sense out of the data you have obtained. If you obtain a product, calculate the **percentage yield**. (yield, m.pt. are worth one mark each). Provide a physical description of your product. Show **all** the calculations you do, but there is no need to be repetitive. For example, if you perform 3 or 4 titrations using the same two solutions, then you only need to show the calculation for one trial. In cases where you have not obtained the results you were hoping for, provide a very brief explanation.

Conclusion: In no more than two sentences, state what you have achieved by doing the experiment. (Example: The reduction of nitrobenzene using Sn in aqueous HCl, followed by treatement with acetic anhydride, gave acetanilide in 72% yield. The melting point of the recrystallized product is 111-113 ^{o}C).

Answers To Questions: In cases where questions are asked during or at end of experimental procedures, provide the answers here.

- Lab reports should be typed**, include sample calculations** (written in pen). TIf you are not using a computer to graph data, use graph paper. If your report does not follow the format given above, it may be deemed unacceptable and you may have to resubmit it. The new report will be considered late if it is not submitted on the same due date.
- Lab reports are normally due one week after the assigned date for the experiment. You will be informed in advance if there are any changes to the due date.
- The report is marked out of 20. For every day the report is late, you lose 10% (two) marks.
- Excessive spelling mistakes will result in a deduction of marks. The lab report must be written using standard academic writing. Avoid the use of personalizing the report with "I", "you", "our", "we". The report must be written in passive past tense. For example, the reaction of an alcohol with sodium metal produced sodium alkoxide and hydrogen gas (passive). **Do not** - Alcohol was reacted with sodium producing sodium alkoxide and hydrogen gas. (active). We added sodium metal to the alkoxide to produce sodium alkoxide and hydrogen gas (personalized – active). Use of personalizing report will result in a deduction of marks.
- Make sure include your report in a duo tang folder. The report should be bound together, any loose pages will be unacceptable and you will lose one mark.