CAMOSUN COLLEGE	***School of Arts & Science*** ***CHEMISTRY AND GEOSCIENCE DEPARTMENT*** **CHEM 231-01A, 01B, 01C** **Organic Chemistry 2** **2014W**

COURSE OUTLINE

The Approved Course Description is available on the web @ _____

Ω *Please note: this outline will be electronically stored for five (5) years only.*
It is strongly recommended students keep this outline for your records.

1. Instructor Information

(a)	Instructor:	Dr. Nasr Khalifa		
(b)	Office Hours:	T, W, Th 9:30am-10:30am and 11:30am-12:30pm		
(c)	Location:	F348C		
(d)	Phone:	250-370-3201	Alternative Phone:	
(e)	Email:	khalifa@camosun.bc.ca		
(f)	Website:	http://faculty.camosun.ca/nasrkhalifa		

Course 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 synthesis of various organic compounds.

Credits: 4

Mode and Hours of Delivery: 3 hours of lectures and 3 hours of labs.
Duration: 15 weeks, estimated out-of-class: at least 5 hours per week.

Pre-requisites: ***Chem121 and Chem230***

Prior Learning Assessment Available: **Yes**

2. Intended Learning Outcomes

(No changes are to be made to this section, unless the Approved Course Description has been forwarded through EDCO for approval.)

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" Eighth Edition, by John McMurry
(b)	Other	"Organic Chemistry Experiments for Chemistry 230 and 231" by Nasr Khalifa and Rin Raap (2012) *****Both texts are REQUIRED*****

4. Course Content and Schedule

Detailed Course Outline:

1. Review: Alcohols, Ethers and Epoxides: (Chapter 17.1-17.8, Chapter 18.1-18.3, 18.5-18.7)

-Classification and nomenclature, physical properties: boiling points, solubility in water, preparation of alcohols: hydration of alkenes, oxymercuration and demercuration, hydroboration of alkenes, nucleophilic substitution reactions **(Chapter 11)**, acidity and basicity of alcohols, reactions of alkoxide ions, mesylates and tosylates, protecting groups and use in synthesis, substitution reactions of alcohols: reactivity of alcohols toward hydrogen halides, S_N1 vs S_N2, other reagents to convert alcohols to alkyl halides, elimination reactions of alcohols, oxidation reactions of alcohols, chromium (VI) reagents, potassium permanganate, selective oxidation
-Nomenclature of ethers and epoxides, physical properties of ethers and crown ethers, preparation of ethers: preparation of diethyl ether, Williamson ether synthesis, acid-catalysed Markovnikov addition to alkenes, cyclic ethers, preparation of epoxides, substitution reactions of ethers, substitution reactions of epoxides: mechanism of base-catalysed and acid-catalysed cleavage, anti-hydroxylation of alkenes via epoxides
-Synthetic applications

2. Aldehydes and Ketones: (Chapter 19)

-Nomenclature, physical properties
-Preparation of aldehydes and ketones
-Nucleophilic addition reactions, reversible and irreversible addition reactions; hydrates, hemiacetals, acetals, thioacetals
-Reduction of carbonyl compounds: sodium borohydride, lithium aluminum hydride, catalytic hydrogenation
-Chemical tests for primary and secondary alcohols
-Reactions with ammonia and amines, imines, the Wolff-Kishner reaction
-Raney Nickel reduction, Clemmensen reduction
-Wittig reaction
-Oxidation: using Mn and Cr oxidizing reagents, Baeyer-Villiger oxidation
-Organometallic compounds; Grignard reagents, alkyllithium reagents, sodium alkynides
-Synthetic methodolgy and applications

3. The Chemistry of Benzene and Its Derivatives: (Chapters 15, 16)

-Nomenclature
-Aromaticity, stability of benzene, Huckel's rule
-Aromatic ions
-Resonance and inductive effects of substituents: acidity of phenols, basicity of anilines
-Electrophilic aromatic substitution: electrophiles, first substitution, nitration, halogenation, sulfonation, mechanism of electrophilic aromatic substitution reactions
-Friedel-Crafts alkylation and acylation
-Second substitution, reactivity, orientation
-Third substitution, reinforcement and opposition

-Nucleophilic aromatic substitution reactions, diazonium salts
-Synthetic applications

4. Spectroscopy: (Chapter 13)

-Electromagnetic spectrum
-Nuclear magnetic resonance spectroscopy, ^{1}H NMR, ^{13}C NMR
-Structure elucidation using IR, UV/VIS, MS, and NMR spectra of alkylhalides, alcohols, alkenes, alkynes, carbonyl compounds, carboxylic acids, aromatic compounds, amines, nitriles

5. Carboxylic Acids and Their Derivatives: (Chapters 20, 21.1-21.7)

-Nomenclature of carboxylic acids
-Physical properties
-Effect of structure on the acidity
-Preparation of carboxylic acids: oxidation of primary alcohols and aldehydes, oxidation of alkenes, oxidation of alkylbenzenes, hydrolysis of nitriles and cyanohydrins, Grignard method
-Reactions of carboxylic acids: reduction, reaction with bases, esterification
-Polyfunctional carboxylic acids: diprotic acids, anhydrides from diprotic acids, β-keto acids, β-diacids
-Derivatives of carboxylic acids: types, reactivity
-Acid halides: nomenclature, preparation, hydrolysis, reactions with nucleophiles
-Anhydrides: nomenclature, preparation, hydrolysis, reactions with nucleophiles,
-Esters: nomenclature, preparation, acid-catalysed and base-catalysed hydrolysis, trans- esterification, reduction, reactions with nucleophiles, as protecting groups
-Polyesters, hydroxycarboxylic acids
-Lactones: preparation, biological examples
-Amides: nomenclature, preparation, acidity and basicity, representative reactions; hydrolysis, reduction, dehydration, the peptide bond
-Nitriles: nomenclature, preparation, representative reactions; hydrolysis, reduction

6. The Chemistry of Enolate Ions: (Chapters 22, 23)

-Acidity of α-hydrogens of carbonyl compounds
-Keto-enol tautomerization
-Reactions via enols and enolate ions: racemization, halogenation, haloform reaction, Hell-Volhard-Zelinski reaction.
-Aldol condensation: dehydration of product, synthetic applications, crossed aldol condensation, intramolecular aldol condensation, Robinson annelation.
-Ester condensation: Claisen condensation, crossed Claisen condensation, Dieckmann condensation
-Additions to α,β-unsaturated carbonyl compounds: 1,4- vs 1,2-additions, addition of organocopper reagents, Michael addition
-Direct alkylation of active hydrogen compounds
-Synthetic applications

7. The Chemistry of Amines: (Chapter 24)

-Nomenclature, physical properties, preparation, basicity, biologically active amines
-Nitrosation reactions, Sandmeyer reaction
-Azo compounds; synthesis, as dyes

8. Carbohydrates: (Chapter 25)

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

Chem231 Laboratory Schedule: (Winter 2014)
(subject to change)

Week of Jan. 6-10:	No Labs. Review problem set
Week of Jan. 13-17:	Exp. 10, elimination reactions
Week of Jan. 20-24:	Exp. 13, oxidation reactions
Week of Jan. 27-31:	**Test #1 (2.5 hrs)**
Week of Feb. 3-7:	Spectroscopy (assignment worth 2 labs)
Week of Feb. 11-14:	No Labs (reading break, Feb. 13, 14)
Week of Feb. 17-21:	Exp. 11, Grignard reaction
Week of Feb. 24-28:	**Test # 2 (2.5 hrs)**
Week of Mar. 3-7:	Exp. 12, Diels-Alder reaction
Week of Mar. 10-14:	Exp. 14, reduction reactions **(spectroscopy assignment due)**
Week of Mar. 17-21:	Exp. 17, Wittig reaction
Week of Mar. 24-28:	**Test # 3 (2.5 hrs)**
Week of Mar. 31-Apr. 4:	Exp. 20, esters
Week of Apr. 7-11:	No Labs. Lecture/Review

Lab experiments	**30%**
Test # 1, January 29 or 30 (2.5 hrs)	**10%**
Test # 2, February 26 or 27 (2.5 hrs)	**10%**
Test # 3, March 26 or 27 (2.5 hrs)	**10%**
Final Examination (April, 3 hrs)	**40%**

	100%

*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.
*Office hours are posted on the door. You can, however, drop by the office any time. You will not be wasting my time if you come for help. I'm here to help you learn.

5. Basis of Student Assessment (Weighting)

(Should be linked directly to learning outcomes.)

(a)	Assignments	Lab Experiments	30%
(b)	Quizzes		
(c)	Exams	Test # 1, January 29 or 30 (2.5 hrs) Test # 2, February 26 or 27 (2.5 hrs) Test # 3, March 26 or 27 (2.5 hrs) Final Examination (April, 3 hrs)	10% 10% 10% 40% --------- 100%
(d)	Other (eg, Attendance, Project, Group Work)		

6. Grading System

(No changes are to be made to this section, unless the Approved Course Description has been forwarded through EDCO for approval.)

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	Minimum level of achievement for which credit is granted; a course with a "D" grade cannot be used as a prerequisite.	1
0-49	F	Minimum level has not been achieved.	0

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 **camosun.ca** or 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.

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 E-1.5 at **camosun.ca** for information on conversion to final grades, and for additional information on student record and transcript notations.

7. Recommended Materials or Services to Assist Students to Succeed Throughout the Course:

LEARNING SUPPORT AND SERVICES FOR STUDENTS

There are a variety of services available for students to assist them throughout their learning. This information is available in the College calendar, at Student Services or the College web site at http://camosun.ca.

STUDENT CONDUCT POLICY

There is a Student Conduct Policy **which includes plagiarism**.
It is the student's responsibility to become familiar with the content of this policy. The policy is available in each School Administration Office, at Student Services and on the College web site in the Policy Section.
http://camosun.ca/about/policies/policies.html

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, 2012 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 written in **ink, including all calculations**. The report does not have to be typed. If 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 (see below).
* 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 10. For every day the report is late, you lose 1 (one) mark.
* Make sure to **staple** the pages of your report together, including any **rough data sheets**. You lose 1 (one) mark if the pages of your report are not stapled together.