COURSE OUTLINE

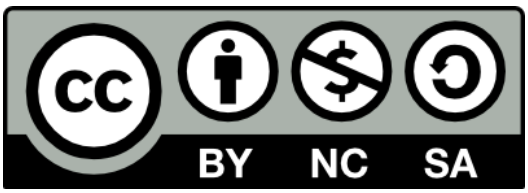
CHEM 211
Organic Chemistry II

3 CREDITS

PREPARED BY: Ernie Prokopchuk, PhD
DATE: November 2, 2020

APPROVED BY: Joel Cubley, Chair, School of Science
DATE: November 6, 2020

Division of Applied Science and Management
CHEM 211
Organic Chemistry II
3 Credits
Winter, 2021



CHEM 211 - Organic Chemistry II

INSTRUCTOR: Ernie Prokopchuk
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OFFICE HOURS: online on demand
CLASSROOM: online and A2803 (lab)
TIME: Wednesday 6:00 – 7:30 pm (online)
Monday 5:30 – 8:30 (lab)
DATES: January 4 – April 12, 2021

COURSE DESCRIPTION

Building upon the concepts of functional group, syntheses design and reaction mechanisms introduced in the first term, students investigate the structure and reactions of aldehydes and ketones, carboxylic acids and their derivatives, dienes and conjugated systems, benzene and its derivatives, amines, and organometallic compounds. Students are introduced to the essential instrumental techniques of infrared spectroscopy, nuclear magnetic resonance spectroscopy, and mass spectrometry with an emphasis on interpretation and structure elucidation. The mandatory labs further develop the students' hands-on skills including some of the instrumental methods covered in class.

PREREQUISITES

CHEM 210

Students are expected to come to this course with an understanding of the concepts covered in CHEM 210. Reactions and mechanisms from CHEM 210 may be used in this course but they will not be reviewed during this course.

RELATED COURSE REQUIREMENTS

For 2021 the lecture component of the course will be offered online. As such a computer or other suitable device is required, as is access to an internet connection.

EQUIVALENCY OR TRANSFERABILITY

See the website http://bctransferguide.ca/ for a complete list of transfers within British Columbia.
See the website http://alis.alberta.ca/ps/tsp/ta/tbi/onlinesearch.html for information on transfers within Alberta.

LEARNING OUTCOMES

After completing this course, students will be able to

- interpret spectroscopic data to determine the structure of simple organic Molecules

- recognize common classes of organic molecules and be familiar with their physical and chemical properties

- accurately predict the outcomes of common reactions involving carbonyl compounds, carboxylic acid and its derivatives, aromatic compounds, amines, and organometallic compounds

- use electron arrows to describe reaction mechanisms for common reactions involving carbonyl compounds, carboxylic acid and its derivatives, aromatic compounds, amines, and organometallic compounds

- design multistep organic syntheses using reactions that students know

- carry out common organic laboratory procedures using standard organic laboratory equipment

COURSE FORMAT

Lectures: Three hours per week. **For 2021, these three hours are divided into 1.5 hours of synchronous online sessions, and the remaining 1.5 hours of content will be posted online as a form of asynchronous instruction.*

Labs: Three hours per week. ** For 2021, labs will be held face to face as usual.*

Course material is delivered through a mix of asynchronous modes, such as posted videos and readings, and synchronous methods, such as Zoom or other web conferencing platforms.

Material is regularly posted on Moodle, the course LMS. This material will include assignments, course announcements, links to content on LibreTexts (https://chem.libretexts.org/) and other online resources, suggested practice problems, an exact copy of everything written on the screen during class, and other useful or interesting material related to the course. Please be aware that any notifications generated by Moodle are sent to your Yukon University email address. It is essential that you regularly check this email account or set it up to automatically forward to your preferred email account.

Class sessions are recorded and posted on the course website that can only be accessed by students enrolled in the course and a limited number of technical staff and faculty at the university. Occasionally some of these recordings may be used for training purposes. Usually student voices are not captured in the video, but if this is a concern, please let me know and we will take steps to address these concerns. Sessions done by Zoom may include people's voices and faces. Students will not be required to use video cameras if they do not wish to appear on screen. If there are any other concerns, please let me know and they will be addressed. Video recordings must not be a barrier for student participation.

Weekly in-person labs provide students with hands-on experience of standard laboratory techniques as well as providing examples of some of the reactions discussed in class. Lab expectations are outlined in the lab manual.

ASSESSMENTS:

Attendance

While lecture attendance is not graded, it is strongly recommended. There is a strong correlation between regular attendance and academic performance.

Assignments

There will be at least 5 assignments due on an approximately bi-weekly basis worth a total of 10% of the final grade. Assignments will consist of various questions or problems related to the course material. Students will have at least one week to complete each assignment. Late assignments will receive a mark of 0 after graded assignments have been returned to the class.

Tests and Examinations

There will be two term tests (February 3, 2021 and March 10, 2021) worth 15% each. The final examination is currently scheduled to occur in-person (9:00 – 12:00 on Wednesday, April 21, 2021) and is worth 30%. Any change to these dates or method of examination, will be communicated to the class as far in advance as possible.

Laboratory component

Labs will take place in-person in the chemistry lab (A2803) with COVID-19 safe-distancing protocols in effect. The labs are a mandatory component of the course. Unless excused by the instructor, absence from a lab will result in a mark of zero for that lab. In order to receive a passing grade in the lab, a student must attend lab sessions and complete the experiments. If a lab period is missed, the report cannot be submitted unless arrangements are made with the instructor. Expectations for the labs are detailed in the lab manual.

EVALUATION:

Assignments	10
Midterm Test 1	15
Midterm Test 2	15
Final Exam	30
Lab	30
Total	**100%**

REQUIRED TEXTBOOKS AND MATERIAL

As a step to making education more affordable, we will be using LibreTexts as our textbook. Traditional textbooks will be placed on reserve in the library.

The Laboratory Manual for Chemistry 210 will be provided.

ACADEMIC AND STUDENT CONDUCT

Information on academic standing and student rights and responsibilities can be found in the current Academic Regulations that are posted on the Student Services/ Admissions & Registration web page.

PLAGIARISM

Plagiarism is a serious academic offence. Plagiarism occurs when a student submits work for credit that includes the words, ideas, or data of others, without citing the source from which the material is taken. Plagiarism can be the deliberate use of a whole piece of work, but more frequently it occurs when students fail to acknowledge and document sources from which they have taken material according to an accepted manuscript style (e.g., APA, CSE, MLA, etc.). Students may use sources which are public domain or licensed under Creative Commons; however, academic documentation standards must still be followed. Except with explicit permission of the instructor, resubmitting work which has previously received credit is also considered plagiarism. Students who plagiarize material for assignments will receive a mark of zero (F) on the assignment and may fail the course. Plagiarism may also result in dismissal from a program of study or the University.

YUKON FIRST NATIONS CORE COMPETENCY

Yukon University recognizes that a greater understanding and awareness of Yukon First Nations history, culture and journey towards self-determination will help to build positive relationships among all Yukon citizens. As a result, to graduate from ANY Yukon University program, you will be required to achieve core competency in knowledge of Yukon First Nations. For details, please see www.yukonu.ca/yfnccr.

ACADEMIC ACCOMMODATION

Reasonable accommodations are available for students requiring an academic accommodation to fully participate in this class. These accommodations are available for students with a documented disability, chronic condition or any other grounds specified in section 8.0 of the Yukon University Academic Regulations (available on the Yukon University website). It is the student's responsibility to seek these accommodations. If a student requires an academic accommodation, they should contact the Learning Assistance Centre (LAC): lac@yukonu.ca.

TOPIC OUTLINE

Week	Unit	Topic

1, 2	10	Nuclear Magnetic Resonance Spectroscopy
		- how NMR works – the theory
		- interpretation of HNMR spectra
		  - shielding and deshielding of protons
		  - chemical shifts
		  - spin-spin coupling and splitting patterns
		  - HNMR spectra and rate processes
		- interpretation of CNMR

2	11	Mass Spectrometry - how MS works – the theory - the mass spectrum - determination of molecular formulas and weights - fragmentation
3	12	Conjugated unsaturated systems - allylic substitution - allyl radicals - allyl cations - 1,3-butadiene - UV-vis spectroscopy - 1,4-addition - Diels-Alder reaction

4	13	Aromatic compounds
		- benzene
		  - nomenclature
		  - stability
		- Huckel's Rule
		- heterocyclic aromatic compounds
		- spectroscopy

4, 5	14	Reactions
		- electrophilic substitution reactions
		  - halogenation
		  - nitration
		  - sulfonation
		  - Friedel-Crafts alkylation and acylation
		  - Clemmensen and Wolff-Kishner reductions
		- substituent effects
		- alkenylbenzenes
		- nucleophilic substitutions

6, 7	15	Aldehydes and Ketones
		- nomenclature
		- properties
		- synthesis
		- nucleophilic addition to the carbonyl group
		  - addition of alcohols
		  - addition of amines
		  - addition of HCN
		  - addition of Ylides
		- oxidation
		- analysis and spectroscopy

8, 9	16	carboxylic acids and their derivatives - nomenclature and properties - preparation - acyl substitution

		- acyl chlorides - carboxylic acid anhydrides - esters - amides - decarboxylation of carboxylic acids - tests for acyl

10, 11	17, 18	Enols and enolates
		- acidity of carbonyl compounds
		- keto and enol tautomers
		- reactions involving enols and enolates
		  - synthesis of methyl ketones
		  - synthesis of substituted acetic acids
		  - synthesis of enamines
		  - the Claisen condensation
		  - acylation of ketone enolates
		  - aldol reactions
		  - addition to α,β-unsaturated aldehydes and ketones
		  - the Mannich reaction

12	19	Amines
		- nomenclature
		- structure and properties
		- basicity
		- preparation
		- reactions
		  - with nitrous acid
		  - replacement reactions of arenediazonium salts
		  - coupling reactions with arenediazonium salts
		  - reactions with sulfonyl chlorides
		  - synthesis of sulfa drugs
		- analysis
		- eliminations involving ammonium compounds

13	20	Phenols and aryl ethers - structure and physical properties

		- synthesis
		- reactions
		  - phenols as acids
		  - other O-H group reactions
		  - cleavage of alkyl aryl ethers
		  - Claisen rearrangement
		- Quinones

*Specific dates of topic coverage may be subject to change. Some topics may not be covered depending on time constraints.