**Division of Applied Science & Management**
**School of Science**
**Winter, 2017**

# COURSE OUTLINE

# CHEM 211

# Organic Chemistry II

**45 HOURS**
**3 CREDITS**

PREPARED BY: Ernie Prokopchuk, Instructor DATE: November 17, 2016

APPROVED BY: Margaret Dumkee, Dean DATE: November 18, 2016

APPROVED BY ACADEMIC COUNCIL: (date)

RENEWED BY ACADEMIC COUNCIL: (date)

**Division of Applied Science & Management**
**CHEM 211**
**Credit Course**
**Winter, 2017**

# CHEM 211 ORGANIC CHEMISTRY II

**INSTRUCTOR:** Ernie Prokopchuk, PhD

**OFFICE HOURS:** Wed 10 am – 1 pm
**Open door policy is in effect*

**OFFICE LOCATION:** A2513

**CLASSROOM:** A2603

**E-MAIL:** eprokopchuk@yukoncollege.yk.ca

**TIME:** Tues & Thurs 1:00 – 2:30 (class)
Friday 1:00 – 4:00 (lab)

**TELEPHONE:** (867) 668-8865

**DATES:** January 5 – April 21, 2017

## 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.

## EQUIVALENCY OR TRANSFERABILITY

See the http://bctransferguide.ca/ for a complete list of transfers in British Columbia and http://alis.alberta.ca/ps/tsp/ta/tbi/onlinesearch.html for a complete list of transfers in 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:

Classes are a blend of lecture and tutorial allowing for an opportunity to practice solving calculation-based problems related to the material being covered in class.

Classes will be recorded with the intent to provide students with a way to revisit material covered in class. This may be helpful while studying or to review a topic covered in class. This will provide greater flexibility to students who are unable to make classes due to work commitments (or any other reason for absence that comes up).

Links to these videos will be posted online but the videos will only be viewable by people with the password which will only be provided to students enrolled in the class. Portions of the videos may be used for professional development purposes, meaning that they may be shown to staff and faculty within the College for the purposes of workshops and demonstrations, and possibly to instructors outside of the College as part of a conference presentation.

Most students in the class will not be visible on the videos, but voices may be heard during class discussions. Seats that are visible will be indicated on the first day of class.

Material is regularly posted on the course LMS, Moodle. This material will include links to lecture capture videos, assignments, course announcements, links to content on LibreText (chem.libretexts.org), 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 College email address. It is essential that you regularly check this email account, or set it up to automatically forward to your preferred email account.

Labs are a mandatory component of the course. In order to receive a passing grade in the lab, a student must complete the experiments and submit the required reports. If a lab period is missed, the report for that experiment cannot be submitted unless arrangements are made with the instructor. Expectations for the labs are outlined in the lab manual.

## ASSESSMENTS

### Assignments

There will be at least 5 assignments due on an approximately bi-weekly basis. Assignments as a whole are worth 10% of the final grade which is determined based on the total mark obtained on all assignments. Assignments will involve a number of questions or problems related to the course material. You will have at least one week to complete each assignment. Late assignments will be penalized 5% for each day late. Late assignments will not be accepted (receiving a mark of 0) once graded assignments have been returned to the class, which usually happens at the next class.

### Tests

There will be two term tests (February 2 and March 9, 2017) held during scheduled class time. Each test is worth 15% of the final grade. The final examination, worth 30% of the final grade, will take place during Final Exam period (April 10 – April 21). The exam date will be announced as soon as it is known.

**Laboratory component**

As a whole, the laboratory component is worth 30% of the final grade. This will be based on lab performance (10%), pre-lab questions (10%), and lab reports (80%) The specific evaluation criteria for the lab are detailed in the lab manual.

**EVALUATION**

| | |
|---|---|
| Assignments | 10% |
| Term Test 1 | 15% |
| Term Test 2 | 15% |
| Final Exam | 30% |
| Laboratory | 30% |
| Total | 100% |

Students must pass (get at least 50%) both the laboratory and the lecture component in order to pass the course.

**REQUIRED TEXTBOOKS AND MATERIALS**

As a step to making education more affordable, we will be using LibreText as our textbook. Some copies of traditional textbooks will be placed on reserve in the library. If you wish to purchase a textbook for your own reference, I can suggest some good options.

Laboratory Manual for Chemistry 211 (available at the first lab session)

**ACADEMIC AND STUDENT CONDUCT**

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

Information on academic standing and student rights and responsibilities can be found in the Academic Regulations:
https://www.yukoncollege.yk.ca/downloads/Yukon_College_2016-17_Academic_Calendar_and_Regulations.pdf

**PLAGIARISM**

Plagiarism is a serious academic offence. Plagiarism occurs when students present the words of someone else as their own. Plagiarism can be the deliberate use of a whole piece of another person's writing, but more frequently it occurs when students fail to acknowledge and document sources from which they have taken material. Whenever the words, research or ideas of others are directly quoted or paraphrased, they must be documented according to an accepted manuscript style (e.g., APA, CSE, MLA, etc.). Resubmitting a paper 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 College.

**YUKON FIRST NATIONS CORE COMPETENCY**

Yukon College 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 College program, you will be required to achieve core competency in knowledge of Yukon First Nations. For details, please see www.yukoncollege.yk.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 College Academic Regulations (available on the Yukon College website). It is the student's responsibility to seek these accommodations. If a student requires an academic accommodation, he/she should contact the Learning Assistance Centre (LAC) at (867) 668-8785 or lassist@yukoncollege.yk.ca.

**TOPIC OUTLINE**

| **Week** | **Unit** | **Topic** |
|---|---|---|
| 0.5-2 | 9 | Nuclear Magnetic Resonance Spectroscopy<br>- how NMR works – the theory<br>- interpretation of HNMR spectra<br>   - shielding and deshielding of protons<br>   - chemical shifts<br>   - spin-spin coupling and splitting patterns<br>   - HNMR spectra and rate processes<br>- interpretation of CNMR<br>Mass Spectrometry<br>- how MS works – the theory<br>- the mass spectrum<br>- determination of molecular formulas and weights<br>- fragmentation |
| 2,3 | 13 | Conjugated unsaturated systems |

| | | |
|---|---|---|
| | | - allylic substitution<br>- allyl radicals<br>- allyl cations<br>- 1,3-butadiene<br>- UV-vis spectroscopy<br>- 1,4-addition<br>- Diels-Alder reaction |
| 4,5 | 14,15 | Aromatic compounds<br>- benzene<br>    - nomenclature<br>    - stability<br>- Huckel's Rule<br>- heterocyclic aromatic compounds<br>- spectroscopy<br>Reactions<br>- electrophilic substitution reactions<br>    - halogenation<br>    - nitration<br>    - sulfonation<br>    - Friedel-Crafts alkylation and acylation<br>        - Clemmensen and Wolff-Kishner reductions<br>- substituent effects<br>- alkenylbenzenes<br>- nucleophilic substitutions |
| 6 | 16 | Aldehydes and Ketones<br>- nomenclature<br>- properties<br>- synthesis<br>- nucleophilic addition to the carbonyl group<br>    - addition of alcohols<br>    - addition of amines<br>    - addition of HCN<br>    - addition of Ylides<br>- oxidation<br>- analysis and spectroscopy |
| 7 | 17 | carboxylic acids and their derivatives<br>- nomenclature and properties<br>- preparation<br>- acyl substitution<br>- acyl chlorides<br>- carboxylic acid anhydrides<br>- esters<br>- amides |

| | | |
|---|---|---|
| | | - decarboxylation of carboxylic acids<br>- tests for acyl |
| 8,9 | 18, 19 | Enols and enolates<br>- acidity of carbonyl compounds<br>- keto and enol tautomers<br>- reactions involving enols and enolates<br>    - synthesis of methyl ketones<br>    - synthesis of substituted acetic acids<br>    - synthesis of enamines<br>    - the Claisen condensation<br>    - acylation of ketone enolates<br>    - aldol reactions<br>    - addition to a,b-unsaturated aldehydes and ketones<br>    - the Mannich reaction |
| 10 | 20 | Amines<br>- nomenclature<br>- structure and properties<br>- basicity<br>- preparation<br>- reactions<br>    - with nitrous acid<br>    - replacement reactions of arenediazonium salts<br>    - coupling reactions with arenediazonium salts<br>    - reactions with sulfonyl chlorides<br>    - synthesis of sulfa drugs<br>- analysis<br>- eliminations involving ammonium compounds |
| 11 | 21 | Phenols and aryl halides<br>- structure and nomenclature<br>- physical properties<br>- synthesis<br>- reactions<br>    - phenols as acids<br>    - other O-H group reactions<br>    - cleavage of alkyl aryl ethers<br>    - reaction of the benzene ring<br>    - Claisen rearrangement<br>- Quinones<br>- Aryl halides and nucleophilic aromatic substitution<br>- spectroscopic analysis |
| 12, 12.5 | 22 | Carbohydrates<br>- classification |

| | | |
|---|---|---|
| | | - mutarotation<br>- reactions<br>    - glycoside formation<br>    - oxidation<br>    - reduction<br>- synthesis and degradation<br>- disaccharides<br>- polysaccharides |

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