



## SCIENCE DEPARTMENT

### COURSE OUTLINE – FALL 2020

#### CH2630 A2: Organic Chemistry II – 3 (3-1-3) UT 105 Hours for 15 Weeks

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**OFFICE HOURS:**

**FALL 2020 DELIVERY:** Mixed Delivery. This course is delivered remotely with some face-to-face/onsite components at the GPRC *Grande Prairie* campus. The CH2630 L1 Labs will be delivered on-site in Chemistry Lab J116 on Wednesday afternoons from 2:30 p.m. to 5:20 p.m. Please note:

- For the remote delivery components: students must have a computer with a webcam and reliable internet connection. Technological support is available through [helpdesk@gprc.ab.ca](mailto:helpdesk@gprc.ab.ca).
- For the onsite components: students must supply their own mask and follow GPRC Campus Access Guidelines and Expectations (<https://www.gprc.ab.ca/doc.php?d=ACCESSGUIDE>). The dates and locations of the onsite components can be found on the Course Calendar.

#### CALENDAR DESCRIPTION:

Reference GPRC Calendar, 2020 – 2021.

**CH2630 3 (3-1-3) UT 105 Hours 15 Weeks Organic Chemistry II** Continuation of the study of structural and chemical properties of the basic functional groups of organic compounds including aromatic compounds, aldehydes, ketones, carboxylic acids and their derivatives and amines. Illustration of these functional groups in natural products such as carbohydrates, amino acids and proteins, nucleic acids and lipids and discussion of the application of spectroscopic methods for structure determination in simple organic molecules. Prerequisites: CH1610 or CH2610 Notes: Credit will be granted for only one of CH1630 or CH2630. Engineering students who take this course will receive 4.5 credits of transfer to U of A. Transfer: UA, UC, UL, AU, AF, CU, CUC, GMU, KUC, Other

**PREREQUISITE(S)/COREQUISITE:** CH1610 or CH 2610

**REQUIRED TEXT/RESOURCE MATERIALS:** There are no, “Required Text/Resource Materials, however:

**Recommended Text/Resource Materials** include:

1. On-Line Resource Material accessible through Search of Organic Chemistry, Topic-by-Topic. Class members are encouraged to access and share good On-Line Resource Sites.

2. Organic Chemistry Textbooks and Supplementary Resource Material are Expensive. Several Organic Textbooks address similar theory with emphasis on Reaction Mechanism within Functional Groups while covering the main Families of Organic Compounds.

Reference to the Solomons et al Textbook and Study Guide are:

3. Solomons, T.W.G., C.B. Fryhle, S.A. Snyder, *Organic Chemistry*, 12th Edition, Wiley, 2016, including access to the WileyPlus web site at:  
<https://edugen.wiley.com/edugen/secure/index.uni> ISBN: 978-1-118-87576-6

Note: The 11<sup>th</sup> Edition is acceptable; namely:

Solomons, T.W.G., C.B. Fryhle, S.A. Snyder, *Organic Chemistry*, 11th Edition, Wiley, 2014, including access to the WileyPlus web site at:  
<https://edugen.wiley.com/edugen/secure/index.uni> ISBN: 978-1-118-13357-6

4. Organic Chemistry, 12e Study Guide / Student Solutions Manual (12th Edition);  
Craig B. Fryhle, Scott A. Snyder, Robert G. Johnson, Jon Antilla, Paperback, 744 Pages.  
Published 2016, ISBN: 978-1-119-07732-9

Note: The 11<sup>th</sup> Edition Solutions Guide to the 11<sup>th</sup> Edition Textbook is:

Study Guide and Solutions Manual, 11<sup>th</sup> Edition, authored by Jon Antilla, University of South Florida, Robert Johnson, Xavier University, Craig Fryhle, Graham Solomons, and Scott Snyder. ISBN: 978-1-118-14790-0 is an Optional Item.

5. A Three Ring Binder to Hold: Sloan, J.P., *Organic Chemistry Experiments, Chemistry 2610/2630*, Grande Prairie Regional College, 2020/2021.
6. Molecular Models are highly recommended, namely: Molecular Model Set for Organic Chemistry, Prentice Hall.

Note: Safety glasses, and lab coats are available at the College Bookstore. *Organic Chemistry Experiments*, by J.P. Sloan, will be given as handouts in advance of each lab period. These are to be inserted in a three-ring binder.

## **DELIVERY MODE(S):**

Organic Chemistry II consists of CH2630 A2, S1 & L1 and is delivered in Lecture, Tutorial and Laboratory Components as stated under: **FALL 2020 DELIVERY.**

## **COURSE OBJECTIVES:**

The objective of Organic Chemistry II is for students to become proficient in their understanding of the theory of Organic Chemistry as outlined in the Calendar Description and in this Course Outline.

## LEARNING OUTCOMES:

The Learning Outcomes of Organic Chemistry II is for students to be aware of their ability to apply their understanding of the theory of Organic Chemistry as presented in the course and as outlined in the Calendar Description and in this course outline. The Learning Outcomes includes the students being able to apply their understanding of Organic Chemistry to related issues and problems in addition to the specific issues and problems directly addressed throughout the course. The learning outcomes of the students are directly related to the grades earned by the students in the course.

## TRANSFERABILITY:

(Ref: Alberta Council of Admissions and Transfers, updated May 31, 2016)

<https://alis.alberta.ca/pdf/transferralberta/transfers/transferagreements.pdf>

CH 2610	Athabasca King's U UofA	CHEM 350 (3) <sup>51</sup> CHEM 3xx (3) <sup>51</sup> CHEM 261 (3) OR AUCHE 250 (3)	Burman U MacEwan UofL	CHEM 241 (3) CHEM 261 (3) CHEM 2500 (3)	Concordia U U of C	CH 261 (3) CHEM 351 (3)
CH 2630	Athabasca King's U UofA	CHEM 360 (3) <sup>52</sup> CHEM 351 (3) CHEM 263 (3) OR AUCHE 252 (3)	Burman U MacEwan UofL	CHEM 242 (3) CHEM 263 (3) CHEM 2600 (3)	Concordia U U of C	CH 263 (3) CHEM 353 (3)

Notes:

- 51. Student will not also receive credit for CHEM 350 at King's.
- 52. Student will not also receive credit for AUCHE 250 at U of A.
- 53. Credit will be given for only 1 of GPRC's CH 1610 or 2610.
- 54. Credit will be given for only 1 of GPRC's CH 1630 or 2630.

## TRANSFERABILITY: ALBERTA TRANSFER CREDIT, continued.

GPRC:	CH 2610 (3)	CH 2630 (3)
U of Alberta:	CHEM 261 (3) or AUCHE 250 (3)	CHEM 263 (3) or AUCHE 252 (3)
U of Calgary:	CHEM 351 (3)	CHEM 353 (3)
U of Lethbridge:	CHEM 2500 (3)	CHEM 2600 (3)
Grant MacEwan U:	CHEM 261 (3)	CHEM 263 (3)
Athabasca U:	CHEM 350 (3)	CHEM 360 (3)
Burman U:	CHEM 241 (3)	CHEM 242 (3)
Concordia U:	CHEM 261 (3)	CHEM 263 (3)
King's UC:	CHEM 3xx (3)	CHEM 351 (3)

**\*Warning:** Although we strive to make the transferability information in this document up-to-date and accurate, **the student has the final responsibility for ensuring the transferability of this course to Alberta Colleges and Universities.** Please consult the Alberta Transfer Guide for more information. You may check to ensure the transferability of this course at Alberta Transfer Guide main page <http://www.transferralberta.ca> or, if you do not want to navigate through few links, at <http://alis.alberta.ca/ps/tsp/ta/tbi/onlineSearch.html?SearchMode=S&step=2>

**\*\* Grade of D or D+ may not be acceptable for transfer to other post-secondary institutions. Students are cautioned that it is their responsibility to contact the receiving institutions to ensure transferability.**

## **EVALUATIONS:**

### Examination Schedule and Composition of the Final Grade:

1.	Midterm Exam # 1, Tuesday October 20 -----	15%
2.	Midterm Exam # 2, Tuesday November 17 -----	20%
2.	Final Exam to be scheduled between December 11 – 19 -----	35%
3.	Laboratory -----	20%
4.	Tutorial Grading Component -----	<u>10%</u>
		100%

Notes:

1. The Mid-Term Exams will be of 1.5 hours duration and the Final Exam will be of 3 hours duration.
2. Between 5 and 15% of exam content is from a combination of weekly assignments, and questions in the organic chemistry textbook by Solomons, Fryhle and Snyder.
3. A pass grade is essential for the Laboratory Component.
4. The Tutorial Grading Component will contribute to 10% of the final grade and will consist of nine assignments with ten questions per assignment.
5. Assistance with assignments is available upon request.

### **GRADING CRITERIA: (The following criteria may be changed to suite the particular course/instructor)**

Please note that most universities will not accept your course for transfer credit **IF** your grade is **less than C-**.

<b>Alpha Grade</b>	<b>4-point Equivalent</b>	<b>Percentage Guidelines</b>		<b>Alpha Grade</b>	<b>4-point Equivalent</b>	<b>Percentage Guidelines</b>
A+	4.0	90-100		C+	2.3	67-69
A	4.0	85-89		C	2.0	63-66
A-	3.7	80-84		C-	1.7	60-62
B+	3.3	77-79		D+	1.3	55-59
B	3.0	73-76		D	1.0	50-54
B-	2.7	70-72		F	0.0	00-49

## COURSE SCHEDULE/TENTATIVE TIMELINE:

The Course Schedule is:

1. Lectures: Days, Time and Remote Delivery: CH2630 A2 M,W 8:30 - 9:50 Remote
2. Laboratory Component: Day, Time and Place: CH2630 L1 W 14:30 - 17:20 in J116
3. Tutorial Component: Day, Remote: CH2630 S1 T 13:00 - 13:50 Remote
4. Office Hours: Individual and group assistance will normally be available by Remote Delivery during regular college business hours outside of formal class lecture, laboratory and tutorial hours.

The Course Schedule consists of Lecture, Laboratory and Tutorial Components. A brief description of these components is as follows:

### Lecture Component:

Continuation of the study of the fundamental principles of the chemistry of carbon compounds as commenced in Chemistry 2610. The study is based on a reaction mechanism approach to the functional group chemistry of arenes, aldehydes, ketones, carboxylic acids, esters, amides, amino acids and carbohydrates. Topics include: structure and bonding; physical properties; acidity and basicity; conformations of molecules; stereochemistry; addition, elimination and substitution reactions; structure-reactivity relationships; aromaticity and aromatic substitution; and spectroscopic methods for structure determination including  $H^1$  and  $C^{13}$  NMR (Nuclear Magnetic Resonance) and IR Infrared Spectroscopy.

A representative selection of molecules found in agricultural, biological, environmental, industrial, medical, and pharmaceutical applications of organic chemistry will be discussed, e.g., molecules found in agrochemicals, fibres, food additives, perfumes, polymers, and prescription drugs.

### Laboratory Component:

Techniques in organic chemistry; preparation of some organic compounds, and; methods of qualitative organic analysis.

### Tutorial Component:

Problem solving and discussion sessions with weekly problem sets. Regular assignments will be given and marked. There will be nine assignments with each assignment consisting of ten questions.

### Tentative Timetable:

The Tentative Timetable follows the Statement on Plagiarism and Cheating.

## STUDENT RESPONSIBILITIES:

Students are responsible for regular attendance in Lecture, Laboratory, and Tutorial Components of the Organic Chemistry II course. They are also responsible for submission of assignments and laboratory reports according to the course policy; and for attending the exams according to the Exam Schedule.

## STATEMENT ON PLAGIARISM AND CHEATING:

Cheating and plagiarism will not be tolerated and there will be penalties. For a more precise definition of plagiarism and its consequences, refer to the Student Conduct section of the College Calendar at <http://www.gprc.ab.ca/programs/calendar/> or the College Policy on Student Misconduct: Plagiarism and Cheating at <https://www.gprc.ab.ca/about/administration/policies>

**\*\*Note:** all Academic and Administrative policies are available on the same page.

## Schedule for Reading, Studying and Practice Problems, Ref 12<sup>th</sup> Edition of Solomons...

References are to T.W.G. Solomons, C.B. Fryhle and S.A. Snyder, Organic Chemistry, **12th Edition, Wiley, 2016.**

### FALL SEMESTER

Weeks of September 2, 7 & 14: Spectroscopic Methods of Structure Determination.

Nuclear Magnetic Resonance (NMR) and Mass Spectroscopy (MS):

Tools for Structure Determination. Read and Study Chapter 9, pages 391 – 447.

Problems/Page #'s:	In-Chapter	9.1 to 9.19
437	End of Chapter	9.20 to 9.43
446	Challenge Problems	9.44 to 9.49
446	Learning Group Problems	1 to 2
Concept Map's:	447	<sup>1</sup> H NMR Spectroscopy.
	446	<sup>13</sup> C NMR Spectroscopy.
	456	<sup>13</sup> C NMR and <sup>1</sup> H NMR Chemical Shift Ranges

Week of Sept 21: Aromatic Compounds. Read and Study Chapter 14, pages 617 – 659.

Problems/Page #'s:	In-Chapter	14.1 to 14.15
651	End of Chapter	14.16 to 14.38
657	Challenge Problems	14.39 to 14.43
658	Learning Group Problems	1 to 5

Concept Map: 659 Aromatic Compounds.

Weeks of Sept 28 & Oct 5: Reactions of Aromatic Compounds.

Read and Study Chapter 15, pages 660 – 710.

Problems/Page #	In-Chapter	15.1 to 15.19
700	End of Chapter	15.20 to 15.56

- 706 Challenge Problems 15.57 to 15.66  
 707 Learning Group Problems 1 to 3

Concept Map's:

- 709 Summary of Mechanisms -Electrophilic Aromatic Substitution.  
 710 Some Synthetic Connections of Benzene and Aryl Derivatives.

Week of October 12-16: Thanksgiving, October 12, and Fall Break October 13-16.

Week of Oct 19 & 26: Aldehydes and Ketones: Nucleophilic Addition to the Carbonyl Carbon. Read and Study Chapter 16, pages 711 – 760.

- Problems/page #'s: In-Chapter 16.1 to 16.21  
 749 End of Chapter 16.22 to 16.55  
 755 Challenge Problems 16.56 to 16.57  
 756 Learning Group Problems a to f.

Summary of Aldehyde and Ketone Addition Reactions: p 756, Section 16.15.

Summary of Mechanisms:

- 757 Acetals, Imines, and Enamines: Common Mechanistic Themes in  
 Their Acid-catalyzed Formation from Aldehydes and Ketones.  
 758-759 Nucleophilic Addition to Aldehydes and Ketones Under Basic Conditions.  
 760 Some Synthetic Connections of Aldehydes, Ketones, and Other Functional Groups.

Week of Nov 2 & 9: Carboxylic Acids and Their Derivatives:  
 Nucleophilic Addition-Elimination at the Acyl Carbon.  
 Read and Study Chapter 17, pages 761 – 810.

- Problems/page #'s: In-Chapter 17.1 to 17.16  
 802 End of Chapter 17.17 to 17.49  
 809 Challenge Problems 17.50 to 17.55  
 810 Learning Group Problems 1 to 4

Summary of Reactions of Carboxylic Acids and Their Derivatives, Page 798, Section 17.12.

Week of Nov 16: Reactions at the  $\alpha$ -Carbon of Carbonyl Compounds: Enols and Enolates.  
 Read and Study Chapter 18, pages 811 – 848.

- Problems/page #'s: In-Chapter 18.1 to 18.14  
 840 End of Chapter 18.15 to 18.37  
 845 Challenge Problem 18.38  
 846 Learning Group Problems 1 to 2

Summary of Reactions of Enolate Chemistry, Page 837, Section 18.10.

- 848 Summary of Mechanisms: Enolates:  $\alpha$ -Substitution.

Condensation and Conjugate Addition Reactions of Carbonyl Compounds:  
More Chemistry of Enolates.  
Read and Study Chapter 19, pages 849 – 889.

Problems/page #'s:	In-Chapter	19.1 to 19.22
878	End of Chapter	19.23 to 19.60
887	Challenge Problem	19.61 to 19.63
887	Learning Group Problems	1 to 2

- 876 Summary of Important Reactions, Page 876, Section 19.9.  
889 Synthetic Connections: Some Synthetic Connections Involving Enolates.  
888 Summary of Mechanisms: Enolate Reactions with Carbonyl Electrophiles.

Week of Nov 23: Amines. Read and Study Chapter 20, pages 890 – 937.

Problems/Page #'s:	In-Chapter	20.1 to 20.18
928	End of Chapter	20.19 to 20.51
935	Challenge Problems	20.52 to 20.56
936	Learning Group Problems	1 to 2

- 924 Summary of Preparation and Reactions of Amines, Page 924, Section 20.13

Week of Nov 30: Carbohydrates and Lipids (Optional). Read Chapters 22 & 23,  
pages 965 - 1010 and 1011 – 1044.

Problems/Page #'s:	In-Chapter 22	22.1 to 22.19
1005	End of Chapter	22.20 to 21.42
1008	Challenge Problems	22.43 to 22.45
1009	Learning Group Problems	1 to 2

- 1010 Summary and Review Tools: A Summary of Reactions Involving Monosaccharide's.

Problem/Page #'s:	In-Chapter 23	23.1 to 23.13
1041	End of Chapter	23.14 to 23.25
1043	Challenge Problems	22.26 to 22.27
1044	Learning Group Problems	1 to 4



Week of Dec 7: Amino Acids & Proteins & Nucleic Acids & Protein Synthesis (Optional) & Review.

Read Chapters 24 & 25: Amino Acids and Proteins & Nucleic Acids and Protein Synthesis.

Chapter 24, read pages 1045 - 1089.

Problems/Page #'s:	In-Chapter	24.1 to 24.16
1088	End of Chapter	24.17 to 24.23
1089	Challenge Problem	24.24
1089	Learning Group Problems	1 to 2

Chapter 25, read pages 1090 -1124.

Problems/Page #'s:	In-Chapter	25.1 to 25.11
1122	End of Chapter	25.12 to 25.16
1124	Learning Group Problem	

## Schedule for Reading, Studying and Practice Problems, Ref 11<sup>th</sup> Edition of Solomons...

References are to T.W.G. Solomons, C.B. Fryhle and S.A. Snyder, Organic Chemistry, **11th Edition, Wiley, 2014.**

### FALL SEMESTER

Weeks of September 1, 7 & 14: Spectroscopic Methods of Structure Determination.

Nuclear Magnetic Resonance (NMR) and Mass Spectroscopy (MS):  
Tools for Structure Determination. Read and Study Chapter 9.

Problems/Page #'s:	In-Chapter	9.1 to 9.21
444	End of Chapter	9.23 to 9.46
455	Challenge Problems	9.47 to 9.52
456	Learning Group Problems	1 to 2

Concept Map's:	455	<sup>1</sup> H NMR Spectroscopy.
	456	<sup>13</sup> C NMR Spectroscopy.
	456	<sup>13</sup> C NMR and <sup>1</sup> H NMR Chemical Shift Ranges

Week of Sept 21: Aromatic Compounds. Read and Study Chapter 14.

Problems/Page #'s:	In-Chapter	14.1 to 14.15
665	End of Chapter	14.16 to 14.39
666	Challenge Problems	14.40 to 14.44
666	Learning Group Problems	1 to 5

Concept Map: Aromatic Compounds.

Weeks of Sept 28 & Oct 5: Reactions of Aromatic Compounds.  
Read and Study Chapter 15.

Problems/Page #	In-Chapter	15.1 to 15.21
713	End of Chapter	15.22 to 15.51
716	Challenge Problems	15.52 to 15.55
717	Learning Group Problems	1 to 3

Concept Map's:

718	Summary of Mechanisms -Electrophilic Aromatic Substitution.
719	Some Synthetic Connections of Benzene and Aryl Derivatives.

Week of October 12-16: Thanksgiving, October 12, and Fall Break October 13-16.

Week of Oct 19 & 26: Aldehydes and Ketones: Nucleophilic Addition to the Carbonyl Carbon. Read and Study Chapter 16.

Problems/page #'s:	In-Chapter	16.1 to 16.21
759	End of Chapter	16.22 to 16.52

- 773 Challenge Problems 16.53 to 16.54  
774 Learning Group Problems a to f.

Summary of Aldehyde and Ketone Addition Reactions: p 756, Section 16.15.

Summary of Mechanisms:

- 767 Acetals, Imines, and Enamines: Common Mechanistic Themes in  
Their Acid-catalyzed Formation from Aldehydes and Ketones.  
768-769 Nucleophilic Addition to Aldehydes and Ketones Under Basic Conditions.  
770 Some Synthetic Connections of Aldehydes, Ketones, and Other Functional Groups.

Week of Nov 2 & 9: Carboxylic Acids and Their Derivatives:  
Nucleophilic Addition-Elimination at the Acyl Carbon

Read and Study Chapter 17.

- Problems/page #'s: In-Chapter 17.1 to 17.17  
813 End of Chapter 17.18 to 17.48  
819 Challenge Problems 17.49 to 17.54  
820 Learning Group Problems 1 to 4

Summary of Reactions of Carboxylic Acids and Their Derivatives, Page 809, Section 17.13.

Week of Nov 16: Reactions at the  $\alpha$ -Carbon of Carbonyl Compounds: Enols and Enolates.  
Read and Study Chapter 18.

- Problems/page #'s: In-Chapter 18.1 to 18.14  
850 End of Chapter 18.15 to 18.34  
854 Challenge Problem 18.35  
855 Learning Group Problems 1 to 2

Summary of Reactions of Enolate Chemistry, Page 847, Section 18.10.

857 Summary of Mechanisms: Enolates:  $\alpha$ -Substitution.

Condensation and Conjugate Addition Reactions of Carbonyl Compounds:  
More Chemistry of Enolates.  
Read and Study Chapter 19.

- Problems/page #'s: In-Chapter 19.1 to 19.22  
887 End of Chapter 19.23 to 19.57  
894 Challenge Problem 19.58 to 19.60  
894 Learning Group Problems 1 to 2

- 884 Summary of Important Reactions, Page 884, Section 19.9.  
896 Synthetic Connections: Some Synthetic Connections Involving Enolates.  
895 857 Summary of Mechanisms: Enolate Reactions with Carbonyl Electrophiles.

Week of Nov 23: Amines. Read and Study Chapter 20.

Problems/Page #'s:	In-Chapter	20.1 to 20.18
936	End of Chapter	20.19 to 20.49
941	Challenge Problems	20.50 to 20.54
942	Learning Group Problems	1 to 2

932 Summary of Preparation and Reactions of Amines, Page 932, Section 20.13

Covered on other Chapters of the 12<sup>th</sup> Edition.

Phenols and Aryl Halides: Nucleophilic Aromatic Substitution.

Read and Study Chapter 21.

Read Special Topics G between page 978 and 979, Pages G-1 to G-16.

Carbon-Carbon Bond-Forming and Other Reactions of Transition Metal Organometallic Compounds.

Problems/Page #'s:	In-Chapter	21.1 to 21.12
970	End of Chapter	21.13 to 21.33
973	Challenge Problems	21.34 to 21.43
975	Learning Group Problems	1 to 2

978 Some Synthetic Connections of Phenols and Related Aromatic Compounds.

Week of Nov 30: Carbohydrates and Lipids (Optional). Read Chapters 22 & 23.

Problems/Page #'s:	In-Chapter 22	22.1 to 22.19
1021	End of Chapter	22.20 to 21.42
1024	Challenge Problems	22.43 to 22.45
1025	Learning Group Problems	1 to 2

1026 Summary and Review Tools: A Summary of Reactions Involving Monosaccharide's.

Problem/Page #'s:	In-Chapter 23	23.1 to 23.11
1055	End of Chapter	23.12 to 23.23
1058	Challenge Problems	22.24 to 22.25
1058	Learning Group Problems	1 to 4

Week of Dec 7: Amino Acids & Proteins & Nucleic Acids & Protein Synthesis (Optional) & Review.

Read Chapters 24 & 25: Amino Acids and Proteins & Nucleic Acids and Protein Synthesis

Chapter 24

Problems/Page #'s:	In-Chapter	24.1 to 24.16
1103	End of Chapter	24.17 to 24.23
1104	Challenge Problem	24.24
1104	Learning Group Problems	1 to 2

Chapter 25

Problems/Page #'s:	In-Chapter	25.1 to 25.11
1137	End of Chapter	25.12 to 25.16
1139	Learning Group Problem	