

Chemistry 4000: Applications of Modern Organic and Organometallic Chemistry December 2022

Professors: Dr. P. G. Hayes and Special Guest Lecturer Dr. F. Arteaga Arteaga

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Course Description: This is a condensed course that will be attended by short-term visiting students from Hokkaido University, as well as students from the University of Lethbridge. It will take place over 11 days (December 12-22, 2022). Days 1-6 and 8-11 will each have one or two classes (see below for details). Days 6 and 10 will also have laboratory components. Day 5 will consist of research presentations by Drs. Hayes and Arteaga Arteaga. Student presentations will take place on Day 11.

Course Subject: This course aims to connect the foundations of organic and organometallic chemistry with modern research topics. Students will gain an overall view of advanced organic and organometallic chemistry, with a focus on synthesis, chemical structure and reaction chemistry. Students will identify the connection between organic chemistry and related areas, such as biochemistry, environmental science, medicine, etc. The learned concepts will be reinforced by current research topics, such as chirality in pharmaceuticals, photodynamic therapy, ligand design and homogenous catalysis.

Lectures: All lectures will take place in SA8003. See below for the time of lectures on each day.

Attendance Policy: Attendance of all classes is mandatory.

Email: Due to the complex nature of the subject, it is not possible to properly answer questions about course material *via* email. Thus, all such inquiries should be made in person. Only emails of an administrative nature (*e.g.* exam absence, appointment set-up, *etc.*) will receive responses. Grades will not be given out by email

Credit Hours: 3.0

Pre-requisites: Chemistry 3840: Inorganic Chemistry II (University of Lethbridge students only)

Special Needs Students: Feel free to inform Dr. Hayes of any documented disabilities in order to have a productive learning experience.

Course Content and Schedule (may be subject to change; all times are Mountain Standard Time):

Day 1 Monday, December 12

- Lecture 1: 10:00 – 11:30 am; Lecture 2: 2:00 – 3:30 pm
- Structure and reactivity, the fundamentals of organic chemistry

Day 2 Tuesday, December 13

- Lecture 1: 1:00 – 2:30 pm; Lecture 2: 4:00 – 5:30 pm
- The disconnection approach, a tool for the synthesis of elaborate molecules
- Reaction chemistry of carbonyl-containing compounds

Day 3 Wednesday, December 14

- Lecture 1: 8:30 – 10:00 am; Lecture 2: 11:00 – 12:30 pm
- Asymmetric synthesis, principles for the preparation of drugs and bioactive molecules

Day 4 Thursday, December 15

- Lecture 1: 8:30 – 10:00 am; Lecture 2: 11:00 – 12:30 pm
- Photoresponsive molecules

Day 5 Friday, December 16

- Lecture 1: 5:00 – 7:00 pm
- Research seminars by Drs. Hayes and Arteaga Arteaga

Day 6 Saturday, December 17

- Lecture 1: 10:00 – 11:30 am; Lecture 2: 2:00 – 3:30 pm
- Lab Session 1 (4:00 – 7:00 pm)
- Introduction to organometallic chemistry

Day 7 Sunday, December 18

- Study day

Day 8 Monday, December 19

- Lecture 1: 8:30 – 10:00 am; Lecture 2: 11:00 – 12:30 pm
- Structure and bonding in transition metal organometallic complexes

Day 9 Tuesday, December 20

- Lecture 1: 10:00 – 11:30 am; Lecture 2: 2:00 – 3:30 pm
- Common reactions of transition metal organometallic complexes

Day 10 Wednesday, December 21

- Lecture 1: 10:00 – 11:30 am; Lecture 2: 2:00 – 3:30 pm
- Transition metal complexes in industrially important homogeneous catalysis
- Lab Session 2 (4:00 – 7:00 pm)

Day 11 Thursday, December 22

- Lecture 1: 10:00 – 12:00 pm; Lecture 2: 2:00 – 4:00 pm
- Student Presentations

Evaluation Mechanisms:

- Daily Quizzes (60%).
- Participation (15%)
- Presentation (25%)

Add/Drop Deadline: December 13, 2022 (9:00 am) by email to Dr. Hayes

Useful References:

- G. O. Spessard, G. L. Miessler, *Organometallic Chemistry 3rd Ed.*, Oxford University Press, 2016. ISBN: 9780199342679, [QD411.S65 2015].
- R. H. Crabtree, *The Organometallic Chemistry of the Transition Metals, 7th Ed.*, Wiley-Interscience, 2019. ISBN: 9781119465881, [QD411.8.T73 C73 2019].
- J. Hartwig, *Organometallic Chemistry: From Bonding to Catalysis*, University Science Books, USA, 2010. ISBN: 9781891389535, [QD411.8.T73 H37 2010].
- C. Elschenboich, *Organometallics, 3rd Ed.*, Wiley-VCH, Weinheim, 2006. ISBN: 3527293906, [QD411.E4413].
- M. Bochmann, *Oxford Primer No. 12: Organometallics 1 – Complexes with Transition Metal-Carbon σ -Bonds*, Oxford University Press, Toronto, 2002. ISBN: 0198557507, [QD411.8.T63 B63].
- M. Bochmann, *Oxford Primer No. 13: Organometallics 2 – Complexes with Transition Metal-Carbon π -Bonds*, Oxford University Press, Toronto, 2001. ISBN: 0198558139, [QD411.8.T73 B632].
- J. P. Collman, L. S. Hegedus, J. R. Norton, R. G. Finke, *Principles and Applications of Organotransition Metal Chemistry*, University Science Books, Mill Valley, California, 1987. ISBN: 0935702512, [QD411.C64].
- William Ogilvie, Nathan Ackroyd, C. Scott Browning, Ghislain Deslongchamps, Felix Lee and Effie Sauer, *Organic Chemistry: Mechanistic Patterns*, Nelson Education Ltd., Toronto, 2018. ISBN: 978-0-17-650026-9, [QD251.3.Q45 2017].
- Thomas N. Sorrell, *Organic Chemistry, 2nd Ed.*, University Science Books, Sausalito, 2006. ISBN: 1-891389-38-6, [QD251.3.S67 2005].

Additional Useful Materials:

- It is highly recommended that students obtain a molecular model kit. These kits are permitted for all assignments and exams. Model kits can be purchased from the Chemistry and Biochemistry Undergraduate Society (Contact Dr. Patenaude in SA8456; ~\$30.00). In addition, the University Book Store sells a more expensive, alternate model kit (~\$80.00).

Calculator Policy:

- While calculations are not the primary focus of this course, you may still need a simple calculator. You will be informed prior to each exam whether or not you should bring your calculator. You are not allowed to store/download text to your calculator – graphing calculators are not permitted. Any calculators found to be in violation of this policy during a test will be confiscated along with the test paper; this is cheating and will be dealt with as such. **CALCULATORS WITH WIRELESS COMMUNICATION CAPABILITIES ARE STRICTLY FORBIDDEN.**

Conversion of Overall Percentage Grade to Letter Grade

The normal overall percentage grade to letter grade conversion will take place according to the following table:

A+	91.00% – 100%
A	85.00% – 90.99%
A–	80.00% – 84.99%
B+	76.67% – 79.99%
B	73.34% – 76.66%
B–	70.00% – 73.33%
C+	66.67% – 69.99%
C	63.34% – 66.66%
C–	60.00% – 63.33%
D+	57.00% – 59.99%
<u>D</u>	<u>50.00% – 56.99%</u>
F	0% – 49.99%

However, it should be noted that Prof. Hayes reserves the right to adjust the conversion table when there are multiple students who have overall percentage grades close to one another (*i.e.* when overall percentage grades for students are within 0.33% of each other) and those grades span the intended percentage to letter grade cut-off.

For example, if the following overall percentage grades were obtained:

80.97%	78.62%
80.25%	78.45%
80.13%	78.11%
79.89%	
79.75%	

the overall percentage to letter grade conversion for the bottom end of A– might be lowered from 80.00% to 79.75%.

Similarly, if the following overall percentage grades were obtained:

71.59%	70.32%
71.28%	70.19%
71.00%	70.01%
	69.73%
	69.55%
	69.42%
	69.16%
	68.91%
	68.65%

the overall percentage to letter grade conversion for the bottom end of B– might be raised to 71.00%.

The purpose of maintaining such flexibility in overall percentage grade to letter grade conversion is to provide the professor with an ability to accommodate for “natural breaks” in overall percentage grade distributions that correspond to a meaningful difference in course performance. In the event

that the actual overall percentage grade to letter grade conversion deviates from the provided table, that deviation will be limited to a maximum of $\pm 3.00\%$.

Plagiarism & Cheating:

If caught cheating on any component of Chemistry 4000 you be assigned a grade of F for the course. A letter describing the offense will be placed in your student file. Two such letters is grounds for expulsion from the university.

STUDENTS WHO CHEAT, CHEAT THEIR FELLOW STUDENTS BY DEVALUING THEIR HARD WORK, EARNED GRADES AND DEGREE. If you see someone cheating during an exam, inform the proctor in the following way: 1) Write a message on your exam paper indicating what is happening and where. 2) Raise your hand and the proctor will come over -- point out your note. The proctor will take it from there. It is often pointless to report cheating after the event.

What is plagiarism? Plagiarism is defined as the taking of someone's thoughts, writings or inventions and using them as one's own.

When writing your research proposal or completing an assignment, you must read up on the topic, get the necessary information and then present it **IN YOUR OWN WORDS**. If you use a sequence of text verbatim (*i.e.* exactly) from someone else's work, **THAT IS A QUOTE** and must be cited (to give proper credit to the author). If you use an idea or data from someone else's work, then that work must be cited specifically as a reference, and/or in your paper's bibliography. Beware of information that is found on the web -- it is rarely primary source information and is generally not acceptable (*e.g.* Wikipedia!)

IF, IN THE COURSE OF WRITING A REPORT, YOU EXECUTE A CUT AND PASTE FROM A WEBSITE OR OTHER SOURCE (without a citation) YOU HAVE COMMITTED PLAGIARISM.

It is important to point out that there is a difference between working out answers to an assignment or a lab report with a friend and plagiarism. If, after conferring with others, what you write down is based on your own understanding of the material and **is in your own words**, then that is acceptable. If, however, you look at a friend's answer to a question, and then simply write (essentially) the same thing on your assignment (a mental cut and paste), then you have committed plagiarism (even if a few words, structures, etc. were changed). Similarly, **IF TWO OR MORE STUDENTS TURN IN IDENTICAL REPORTS/ASSIGNMENTS, THAT IS PLAGIARISM.** Accordingly, you must take care when you share work that you have completed with other students. If they take your material and plagiarize it, you are all subject to disciplinary action. If you have completed a course and loaned marked material from it to someone who is currently taking it, you will be called upon to explain your actions if this material is plagiarized. This also applies to taking marked course material and making it generally available as in a website.

PLAGIARISM IS CHEATING and is subject to discipline as described in the university policy. If you are unclear about any aspect of the student discipline policy for academic offences, refer to https://uleth.sharepoint.com/sites/Policy/Policies/Forms/AllItems.aspx?id=%2Fsites%2FPolicy%2FPolicies%2FStudent_Disc_Academic_Undergraduate_Policy_May_1_2019_EdRev_March_8_2022%2Epdf&parent=%2Fsites%2FPolicy%2FPolicies.