Western Science

Department of Chemistry
Molecular Energy Conversion
CHEM-9531 (Winter 2027)
Prof. Marcus W. Drover (Pronouns: he/him)

Course Introduction and Overview:

This course exposes students to the use of organometallic chemistry for clean energy conversion. The content will be broken up into four major sub-sections regarding Earth's hydrogen, carbon, nitrogen, and oxygen cycles. Topics of interest will include (but are not limited to): i) assessing the energy challenge; ii) nuclear energy; iii) hydrogen as an energy carrier in fuel cells; iv) recent developments in CO_2 hydrogenation; v) assessing global need for ammonia formation and utilization; and vi) homogeneous water oxidation. In each of these areas, students are expected to develop a basic understanding of the factors that govern chemical reactivity to propose new catalysts from scratch. Emphasis will be placed on honing students' writing skills, mastering careful literature evaluation, and providing strong oral presentations.

Contact Information:

Course Instructor:	**Prof. Dr. Marcus W. Drover** Location: Chemistry, MSA 3205 Phone: 519-661-2111 ext. 86334 Email: marcus.drover@uwo.ca (Only send e-mail from UWO)
Course Webpage	OWL (https://owl.uwo.ca/portal)
Student Hours:	By appointment only. • Please e-mail, for instance, three (3), times convenient to you and we can arrange a mutually suitable time.
Lecture/ Tutorial times & location:	**Lectures**: 1:30-4pm MSA 3204

Important Dates:

Jan. 8: Class 1 - *First Class*
Jan. 15: Class 2 -
Jan. 22: Class 3 -
Jan. 29: Class 4 -
Feb. 5: Class 5 -
Feb. 12: Class 6 -

Student Assessment:

CHEM-9531 comprises one lecture per week. There will be **3 assignments** due Jan. 22nd, Feb 5th, and Feb. 22nd.

1. Class Participation	20%
2. **Assignments** [3]	30%
** Due: Jan. 22nd, Feb 5th, and Feb. 22nd.	
3. Research Proposal	
Written Paper	25%
Presentation	15%
Peer Review	10%
Total	**100%**

**Note: this course has no mid-terms or final examination

Assignments will include a range of questions of varying complexity and depth to ensure students understand the basic principles and develop the skills necessary to use these principles.

Notes on participation:

What follows are some general rules to increase participation marks along with a quick guide to assist you in understanding how the participation mark will be assessed.

General Rule #1: Be kind and courteous (to me and your classmates). Self-explanatory.

General Rule #2: Be present. You should bear in mind that effective in-class discussions (whether in smaller group discussions or in the larger class), requires preparation and attendance. I do not take attendance (you are all adults), though to participate you need to be there so a prolonged, unexplained absence won't help you increase your participation mark.

General Rule #3: Be excited! Be intellectually curious! Throughout the year I will give students opportunities to take the lead on readings during class discussion. Challenge ideas you do not agree with by offering your position that is supported with facts from the course materials

Dominating class discussion does not result in a higher participation mark. Find a balance. Do not feel the compulsion to speak in every class thinking this gets you a higher mark. However, speaking every class is fine so long as you are contributing and leaving room for others. Contribute to class discussion as you are willing and able. This includes asking questions about areas you do not understand or setting out a dilemma with the materials you may be experiencing.

Course content: (not all might be covered and this may vary, there is no text for this course).

Part 0: A [brief] review of coordination and organometallic chemistry

Part I: The Energy Challenge
1. Unsustainable growth on planet Earth
2. Energy & climate crisis

Part II: Oil, natural gas, & coal
1. What are oil, natural gas, & coal?
2. Notes on gas exploitation

3. Coal production & reserves
4. The fossil-fuel legacy
5. CO_2 as a contributor to global warming
6. Pollution & human health

Part III: Nuclear energy
1. Solar energy basics
2. Solar energy conversion
3. Solar cells
4. Artificial photosynthesis
5. Other renewables: hydroelectric, wind, ocean, & geothermal energy

Part IV: Hydrogen
1. Properties & industrial uses of hydrogen
2. Hydrogen as an energy carrier in fuel cells
a. Hydrogen oxidation
b. Proton (H^+) reduction
3. Hydrogen storage mediums
a. Amine-borane dehydrogenation
b. End uses of hydrogen fuels
4. Hydrogenases
5. Hydrogen-powered vehicles
a. The hydrogen economy

Part V: Carbon
1. Recent developments in CO_2 hydrogenation to formate & methanol
2. Nature's CO_2 reductases
3. Formic acid dehydrogenation
4. Hydrogenation of formate, carbonate, & ureas to methanol
5. Biomass as a commodity feedstock for *C*-based fuels

Part VI: Nitrogen
1. The nitrogen economy
2. Dinitrogen reduction reaction (N_2RR)
a. by nitrogenases
b. by synthetic homogeneous catalysts
c. by synthetic heterogeneous catalysts
3. Ammonia oxidation

Part VII: Oxygen
1. Properties & industrial uses of O_2/H_2O
2. Photosystem II
3. Homogeneous water oxidation
4. O_2 Reduction

A friendly reminder: *It is extremely important, as with any course, to keep up with the required reading. One can become lost very quickly, and the pace of this course, combined with the fact that many of the topics discussed rely heavily on a firm knowledge of the prior materials, will leave you feeling behind and frustrated!*

All course material will be posted to OWL: http://owl.uwo.ca. If students need assistance with the course OWL site, they can seek support on the OWL Help page. Alternatively, they can contact the Western Technology Services Helpdesk. They can be contacted by phone at 519-661-3800 or ext. 83800.

Late Policy for Chem 9531: All work is subject to a late policy of 10% per day, including weekends. Work more than three days late will not receive any credit. Late policies will be waived provided students have a valid reason that is supported by the academic counsellors from their home faculty.

Student Absences: Students who are unable to meet their academic responsibilities due to medical or compassionate reasons may submit a request for academic consideration. For each missed piece of work, regardless of its weight in the total course grade, you must apply for such consideration by providing valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration.

Accommodation for students with disabilities: Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. In cases where a student misses a piece of work for reasons related to the disability on file with Accessible Education, the student should request accommodation by contacting Accessible Education instead of the Academic Counselling Office

For further information, please consult the University's medical illness policy at https://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf.

The Student Medical Certificate is available at https://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf.

Students should also note that individual instructors are not permitted to receive documentation directly from a student, whether in support of an application for consideration on medical grounds, or for other reasons. All documentation required for absences that are not covered by the Self-Reported Absence Policy must be submitted to the Academic Counselling office of a student's Home Faculty.

Specific to Chem 9531:

Assignments – If an assignment is not handed in for a valid reason (see process for seeking academic consideration above) the weighting will be redistributed equally to the other assignments.

Accommodation Policies:

Students with disabilities are encouraged to contact Accessible Education, which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The policy on Academic Accommodation for Students with Disabilities can be found at:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic Accommodation_disabilities.pdf

Academic Policies:

The website for Registration Services is http://www.registrar.uwo.ca

In accordance with policy, https://www.uwo.ca/univsec/pdf/policies_procedures/section1/mapp113.pdf, the centrally administered e-mail account provided to students will be considered the individual's official university

e-mail address. It is the responsibility of the account holder to ensure that e-mail received from the University at their official university address is attended to in a timely manner.

Scholastic offences are taken seriously, and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, at the following Web site:

http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf.

Support Services:

Please visit the Science & Basic Medical Sciences Academic Counselling webpage for information on adding/dropping courses, academic considerations for absences, appeals, exam conflicts, and many other academic related matters: https://www.uwo.ca/sci/counselling/.

Students who are in emotional/mental distress should refer to Mental Health@Western (https://uwo.ca/health/) for a complete list of options about how to obtain help.

Western is committed to reducing incidents of gender-based and sexual violence and providing compassionate support to anyone who has gone through these traumatic events. If you have experienced sexual or gender-based violence (either recently or in the past), you will find information about support services for survivors, including emergency contacts at https://www.uwo.ca/health/student_support/survivor_support/get-help.html. To connect with a case manager or set up an appointment, please contact support@uwo.ca.

Please contact the course instructor if you require lecture or printed material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Accessible Education at http://academicsupport.uwo.ca/accessible_education/index.html if you have any questions regarding accommodations.

Learning-skills counsellors at the Student Development Centre (https://learning.uwo.ca) are ready to help you improve your learning skills. They offer presentations on strategies for improving time management, multiple-choice exam preparation/writing, textbook reading, and more. Individual support is offered throughout the Fall/Winter terms in the drop-in Learning Help Centre, and year-round through individual counselling.

Additional student-run support services are offered by the USC, https://westernusc.ca/services/.

Statement on Equity, Diversity, and Inclusivity:

Western University and I are committed to a community and learning environment that embraces equity, diversity, and inclusivity including gender and gender-identity, sexuality, ethnicity, religion, culture, and national origins. This commitment is underscored by Western University being a signatory to the Dimensions Program and Charter. Our community and learning are enhanced and enriched when diverse perspectives and experiences are recognized and respected, and all can contribute. In this class I hold that each student has the right to be addressed "in accordance with their personal identity" (*e.g.,* name, personal pro-nouns).[1] Please let me know how you wish to be addressed and how I can help to support you during this class, and I will do my best to do so.

[1]University of Michigan, Center for Research on Teaching and Learning.