

Department of Chemistry Online Course Syllabus Template

CHM 338: Intermediate Inorganic Chemistry

I TEACHING TEAM



COURSE INSTRUCTOR

Name: Professor Douglas Stephan

Email: dstephan@chem.utoronto.ca or douglas.stephan@utoronto.ca

Availability for online student hours: 1:00-5:30 pm (M-F) see:

<https://outlook.office365.com/owa/calendar/DouglasStephan@utoronto.onmicrosoft.com/bookings/>



LABORATORY INSTRUCTOR

Name: Professor John De Backere

Email: john.debackere@utoronto.ca

Office: Lash Miller Labs, Room 221

In-Person Student hours: **Thursdays, 1:00-2:00 pm**

*** Online student meetings available by appointment*

II COURSE OVERVIEW

COURSE DESCRIPTION:

This course will cover the following topics:

- **Coordination Chemistry:** bonding, electronic spectra, magnetic properties, reactivity trends, and reaction mechanisms.
- **Organometallics:** M-C and M-H compounds, synthesis and reactivity.
- **Catalysis:** Hydrogenation and various other industrial processes, mechanisms of action and applications.

STUDENT LEARNING OUTCOMES:

To give the student a clear understanding of the basics of the properties and chemistry of transition metals and main-group compounds and their application in catalysis. By the end of this course, you will be able to:

- predict trends across the periodic table and general properties of transition metals, including concepts of oxidation states, coordination numbers and the geometry of complexes
- distinguish between both classical and non-classical ligands; recognizing the implications of both ligand steric and electronic effects
- explain the interactions between metals and various ligands using a molecular orbital theory approach

- correlate crystal field theory and UV-Vis absorption, the spectrochemical series, Jahn-Teller distortions and high and low spin transition metal compounds
- understand the fundamental principles of multinuclear NMR, EPR and magnetism and be proficient in interpreting the spectra or measurements
- recognize and understand the reactions and operative mechanisms of various catalysts for several important organic transformations

PREREQUISITE COURSE:

The prerequisite for this course is a minimum grade of 63% in CHM 238Y (recently split into CHM236H1 + CHM237H1).

III HOW THE COURSE IS ORGANIZED

In addition to the live in-person lectures summary videos of the material will be made available on-line after the lectures.

Students are expected to attend prior and use the video for review purposes. Each Friday (most weeks) will be short on-line tutorial quizzes, designed to encourage help students stay up to date with the material. One practical in-person lab session occurs every week on either Thursday or Friday (*tentative lab due dates provided in table below but subject to change – please refer to the Quercus PRA site for up-to-date details*) with accompanying lab reports.

COURSE SCHEDULE & RELEVANT SESSIONAL DATES:

LECTURE DATES	UNIT	SUBJECT
Sept 11/13	Introduction to the Transition metals Laboratory Begins	1.The periodic table 2. Basic terms
Sept 18/20	Ligand and coordination chemistry	3. classical ligands 4. non-classical ligands 5. Ligand Properties 6. isomers and chirality
Sept 25/27	Survey of the Transition metals.	7. first row of transition metals 8. heavy metals
Oct 2/4	Bonding theories and Absorption Spectroscopy Laboratory Expt. #1 Due	9. crystal field theory 10. CFT-part 2 11. molecular orbital theory 12. multiple electron systems 13. Other Absorptions
Oct 9	THANKSGIVING	
Oct 11 Oct 16/18	MIDTERM Magnetism and spectroscopy	14. Magnetism 15. EPR spectroscopy 16. NMR spectroscopy-basics

	Laboratory Expt. #2 Due	
OCT 23		17. NMR spectroscopy-special 18. Metal Carbonyl preparation
Oct 25	Species with Metal-Carbon σ -bonds.	19. Metal-Carbon bonds
Oct 30/Nov 1	Species with Metal-Carbon π -bonds, Metal-Hydrides and metal-small molecule interactions Laboratory Expt. #3 Due	20. Metal-olefins 21. Metal-alkynes 22. Metal-Allyl species 23. Cyclopentadienyls etc. 24. Metal Hydrides 25. Interactions with small molecules
Nov 6/8	READING WEEK	
Nov 13/14	Reactions of Organometallics and Hydrogenation Catalysis Laboratory Expt. #4 Due	26. substitution reactions 27. Oxidative Addition 28. Reductive elimination 29. Insertion 30. Hydrogenation catalysis 31. Wilkinson's catalyst 32. P3RhCOH 33. Schrock's catalyst
Nov 20	Other Catalysis	34. Asymmetric reductions 35. Hydrosilylation 36. Monsanto acetic acid 37. Hydroformylation 38. Polymerization 39. Metathesis 40. Fischer Tropsch
Nov 22	MIDTERM	
Nov 27/29 Dec 4/6	Frustrated Lewis pairs Laboratory Expt. #5 Due Laboratory Expt. #6 Due	41. The concept 42. Hydrogenation 43. Activation of small molecules

LABORATORY OBJECTIVES:

Upon completing the experiments of this course, you will be able to:

- safely synthesize and characterize a variety of inorganic compounds using standard and more advanced laboratory techniques and spectroscopic methods;
- apply the fundamental principles learned in lecture to explain the properties and aspects of the inorganic systems investigated;
- work both independently and collaboratively with integrity and accountability to interpret data and clearly/concisely communicate results using proper scientific writing through lab reports or oral presentations; thinking critically to recognize the limitations, assumptions, errors, and uncertainties that may arise in experimental work
- use the scientific literature to prepare for, understand, and evaluate experimental procedures and results.

See your Quercus CHM338H1 PRA0X0X webpage for more information.

IV EVALUATION/GRADING SCHEME

Tutorial Quiz	5% (on line quiz)
Mid-terms	30% (Oct 11, Nov 22)
Laboratory	35% (7 % each, lowest/missed lab dropped)
Final Exam	30% (Date to be determined)

The midterms will 50 minutes, to be written during regularly scheduled class time and normally be weighted 10% and 20% for the first and second midterms; this will be adjusted to 15% each if that is to the student's advantage.

**** NOTE: A passing grade must be obtained in both the laboratory and on the final exam to pass the course.**

V COURSE POLICIES

If you are absent from your studies due to illness or other reasons and unable to complete course work (e.g., a term test or an assignment) then a piece of written documentation is required. The following four items are the recognized forms of documentation:

1. Absence Declaration via ACORN (please note the circumstances under which an absence declaration can and cannot be submitted)
2. U of T Verification of Illness or Injury Form
3. College Registrar's letter
4. Letter of Academic Accommodation from Accessibility Services

Students who complete the ACORN Absence Declaration form must additionally contact me/the course coordinator/the course administrator to discuss their situation within five business days of the missed piece of work. This is essential action for any consideration to be granted.

For extended absences and for absences due to non-medical reasons, make sure to contact your College Registrar's Office. They can help you decide between a request for an extension or other types of academic consideration.

If you suspect or know that you have a disability that is affecting your studies, learn about the services and supports available through Accessibility Services. A disability can be physical disability, sensory disability, a learning disability, mental health disorder or a short-term disability like an injury. If you are not sure whether you have a disability, you can confidentially contact Accessibility Services with your questions.

- Students may use artificial intelligence tools for creating an outline for an assignment, but the final submitted assignment must be original work produced by the individual student alone.
- Students may not use artificial intelligence tools for taking tests, writing research papers, creating computer code, or completing major course assignments. However, these tools may be useful when gathering information from across sources and assimilating it for understanding.
- Students may not use artificial intelligence tools for taking tests in this course, but students may use generative AI tools for other assignments.
- Students may use the following, and only these, generative artificial intelligence tools in completing their assignments for this course: No other generative AI technologies are allowed to be used for assessments in this course. If you have any question about the use of AI applications for course work, please speak with the instructor.
- I will make every effort to respond to email within 24 h on weekdays (Douglas.stephan@utoronto.ca).
- Office hours: I will be available M-F (1-5:30 pm); barring other commitments. Please use the link below to arrange a TEAMS meeting using the booking webpage: <https://outlook.office365.com/owa/calendar/DouglasStephan@utoronto.onmicrosoft.com/bookings/>
- *The University of Toronto is committed to equity, human rights, and respect for diversity. All members of the learning environment in this course should strive to create an atmosphere of mutual respect where all members of our community can express themselves, engage with each other, and respect one another's differences. U of T does not condone discrimination or harassment against any persons or communities."*
- Privacy language and appropriate use of course materials: <https://teaching.utoronto.ca/ed-tech/audio-video/sample-statements/>
- The Deadlines for tutorial quizzed posted on Quercus are also posted on the course webpage. Late submissions will not be accepted.
- The midterm will be during class time (50 min). Students are expected to answer these questions without aid or notes. If you are absent for a medically documented reason, there will be no make up exam, rather your average will be calculated with increase weight on the final assessment.

VI TECHNOLOGY REQUIREMENTS

Specific guidance from the U of T Vice-Provost, Students regarding student technology requirements is available here:

<https://www.viceprovoststudents.utoronto.ca/covid-19/tech-requirements-online-learning/>

Advice for students more broadly regarding online learning is available here:

<https://onlinelearning.utoronto.ca/getting-ready-for-online/>

This course requires the use of computers, and of course sometimes things can go wrong when using them. You are responsible for ensuring that you maintain regular backup copies of your files, use antivirus software (if using your own computer), and schedule enough time when completing an assignment to allow for delays due to technical difficulties. Computer viruses, crashed hard drives, broken printers, lost or corrupted files, incompatible file formats, and similar mishaps are common issues when using technology, and are not acceptable grounds for a deadline extension.

VII INSTITUTIONAL POLICIES AND SUPPORT

ACADEMIC INTEGRITY

On Academic Integrity:

Academic integrity is essential to the pursuit of learning and scholarship in a university, and to ensuring that a degree from the University of Toronto is a strong signal of each student's individual academic achievement. As a result, the University treats cases of cheating and plagiarism very seriously. The University of Toronto's Code of Behaviour on Academic Matters

(<https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019>) outlines the behaviours that constitute academic dishonesty and the processes for addressing academic offences. Potential offences include, but are not limited to:

In papers and assignments:

1. Using someone else's ideas or words without appropriate acknowledgement.
2. Submitting your own work in more than one course without the permission of the instructor.
3. Making up sources or facts.
4. Obtaining or providing unauthorized assistance on any assignment.

On tests and exams:

1. Using or possessing unauthorized aids.
2. Looking at someone else's answers during an exam or test.
3. Misrepresenting your identity.

In academic work:

1. Falsifying institutional documents or grades.

2. Falsifying or altering any documentation required by the University.

All suspected cases of academic dishonesty will be investigated following procedures outlined in the Code of Behaviour on Academic Matters. If you have questions or concerns about what constitutes appropriate academic behaviour or appropriate research and citation methods, you are expected to seek out additional information on academic integrity from your instructor or from other institutional resources (see <https://www.academicintegrity.utoronto.ca/>).

USE OF PLAGIARISM DETECTION TOOL

Normally, students will be required to submit their course essays to the University's plagiarism detection tool for a review of textual similarity and detection of possible plagiarism. In doing so, students will allow their essays to be included as source documents in the tool's reference database, where they will be used solely for the purpose of detecting plagiarism. The terms that apply to the University's use of this tool are described on the Centre for Teaching Support & Innovation web site (<https://uoft.me/pdt-faq>)

COPYRIGHT

Course videos and materials belong to your instructor, the University, and/or other source depending on the specific facts of each situation and are protected by copyright. In this course, you are permitted to download session videos and materials for your own academic use, but you should not copy, share, or use them for any other purpose without the explicit permission of the instructor. More information regarding this is available here: <https://teaching.utoronto.ca/ed-tech/audio-video/copyright-considerations/>

ACCESSIBILITY NEEDS

Students with diverse learning styles and needs are welcome in this course. The University of Toronto is committed to accessibility: if you require accommodations for a disability, or have any other accessibility concerns about the course, please contact [Accessibility Services](#) as soon as possible.

ADDITIONAL SERVICES and SUPPORT

The following are some important links to help you with academic and/or technical service and support

- General student services and resources at [Student Life](#)
- Full library service through [University of Toronto Libraries](#)
- Resources on conducting online research through [University Libraries Research](#)
- Resources on academic support from the [Academic Success Centre](#)
- Learner support at the [Writing Centre](#)
- Information for [Technical Support/Quercus Support](#)

ACKNOWLEDGEMENT OF TRADITIONAL LANDS

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years, it has been the traditional land of the Huron-Wendat, the Seneca and, most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.