Chemistry 3371F - Transition Metal Chemistry (Fall 2022 Course Outline)

1. Course Information

Description: The study of the effects of the electronic structure of transition metals on their properties, including coordination chemistry, electronic spectra, magnetic properties, and reactions. Introduction to organometallic chemistry. The laboratory experiments aim to illustrate and amplify concepts discussed in the lectures.

Course prerequisite: Chemistry 2271 and 2281.

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you may be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from a course for failing to have the necessary prerequisites. Please see http://www.registrar.uwo.ca for details.

2. Instructor Information

Instructor: Professor Joe B. Gilroy
MSA 3201
joe.gilroy@uwo.ca
(e-mail messages *must* be from your @uwo.ca account)

Office hours: By appointment (via Zoom)

Course Web Page: OWL (https://owl.uwo.ca/portal)

Course Schedule:

Lectures
M, W, F; VAC 100; 9:30–10:20 am (in person unless otherwise stated)

Laboratory (one of)
T, W; 1:30pm – 5:20 pm, Th; 8:30 am – 12:20 pm

Labs are held in ChB 080 (lower ground floor). The general schedule for the experiments is given on page 3 of this handout.

3. Course Syllabus, Schedule, Delivery Mode

Course-Based Learning Outcomes:

Upon completion of Chem 3371F, students will be able to....

(i) apply their understanding of inorganic nomenclature to describe a range of transition metal complexes.
(ii) use their knowledge of common structural properties of coordination compounds (such as coordination numbers, stereochemistry, isomerism) to rationalize factors influencing the stability and reactivity of transition metal complexes.
(iii) interpret and predict the physical and chemical properties of transition metal complexes in terms of their electronic structure and the bonding theories typically used to describe them.
(iv) use their knowledge of structure and bonding properties of transition metal organometallic complexes to predict and rationalize their properties and reactivity.
(v) conduct laboratory experiments safely and evaluate the potential impact transition metal chemistry may have on society, health, and the environment.
(vi) prepare logical, organized, and concise written reports describing their experimental results in the areas of the synthesis and characterization of transition metal complexes.

Chemistry 3371F Syllabus Fall 2022:

The topics likely to be covered are outlined in the section below. The order of presentation and the number of lectures devoted to each are approximate.

i. Tentative Course Outline

(a) Periodic Table, electronic configurations, d-block elements: the open d-shell (1–2 lectures)
(b) Coordination Chemistry: nomenclature, terms, and examples (2–3 lectures)
(c) Coordination numbers, stereochemistry, and isomerism (3–4 lectures)
(d) Formation equilibria for complexes (1–2 lectures)
(e) Crystal field theory: spectral properties (4–5 lectures)
(f) Ligand field theory and Molecular Orbital theory of complexes (5–6 lectures)
(g) More of spectroscopic properties (1–2 lectures)
(h) Mechanisms of substitution (2–3 lectures)
(i) Organometallic chemistry (6–7 lectures)

ii. Laboratory Experiments

The laboratory component of the course is intended to augment the lecture course by providing experimental examples to illustrate general principles. It is also intended to teach experimental techniques that are commonly used in inorganic chemistry. Labs begin the week of September 19, 2022.

A lab report must be submitted for each experiment (details are provided in the 3371F lab manual). This will either be in the form of a formal, written report or data sheet format. You will be given your individual schedule during the first week of classes (not everyone performs the same experiment the same week). Important pre-lab information is available on the course OWL page for most experiments.

To help you find the hazards/safety information for the reagents that you will be using in the lab the following online resources will help you:

http://www.uwo.ca/hr/safety/topics/msds.html

Laboratory Teaching Assistants: Erin Cotterill (ecotteri@uwo.ca), Shaun Milkovich (smilkov7@uwo.ca), and Alex Watson (awatso92@uwo.ca).

In order to maintain consistency across the entire course, please contact Alex (lead TA) with lab-related questions prior to contacting Dr. Gilroy or the other TAs. *All correspondence to TAs must be from your @uwo.ca email account.*

iii. Laboratory Schedule*

Week of…	
Sept 19	Experiments 1 & 2
Sept 26	Experiments 1 & 2
Oct 3	Experiments 1 & 2
Oct 10	Experiments 3 & 4
Oct 17	**LAB REPORTS DUE: Expt. 1 (Formal Report) & Expt. 2 (Data Sheet)**
Oct 17	Experiments 3 & 4
Oct 24	Experiments 5a & 6
Oct 31	Reading Week – No Labs
Nov 7	Experiments 5a, 5b & 6
Nov 7	**LAB REPORTS DUE: Expt. 3 (Data Sheet) & Expt. 4 (Data Sheet)**
Nov 14	Experiments 5b & 6
Nov 21	Oral Presentations
Nov 28	**LAB REPORTS DUE: Expt. 5 (Formal Report) & Expt. 6 (Data Sheet)**

*Note - Formal Reports and data sheets must be submitted electronically via Gradescope before the beginning of your lab section the week that they are due.

iv. Short Formal Presentation

Must be PowerPoint/Keynote or similar. Everyone will have a 10-minute slot. Presentations should be 5–7 minutes max. You will be interrupted and cut off after 7 minutes. Your presentation will be followed by questions from the TAs and/or Dr. Gilroy. Scheduling details and presentation tips will be communicated via OWL in early November.

Topic choices include but are not limited to:

Metal-metal quintuple bonds, photonic ink, ferredoxins, redox active ligands, coordination polymers, side chain cobaltocenium polymers, complexes with CN>6, non 18-electron complexes (*e.g.*, 14, 16, 17, 19 electrons), IR of nitrile vs. isonitrile complexes, agostic interactions, ^{1}H NMR spectroscopy of Pt hydride complexes, linkage isomers, cool example of Δ/Λ complexes, cis-platin, $K_2Cr_2O_7$ in breathalysers, FLP chemistry, MO diagrams for tbp complexes with good examples…or anything you chose, **but this must be approved by Dr. Gilroy.**

***Topics must be submitted and approved by Dr. Gilroy before the start of reading week (*i.e.*, by the end of the day on Sunday, Oct. 30). A 10% per day penalty on the presentation will apply for every day late on topic submission/approval.**

v. Important Dates

Classes begin: Sept 8, 2022
Reading Week: Oct 31 – Nov 6, 2022
Classes end: December 8, 2022

vi. Contingency Plan for an In-person Class Pivoting to 100% Online Learning

In the event of a COVID-19 resurgence during the course that necessitates the course delivery moving away from face-to-face interaction, all remaining course content will be delivered entirely online, either synchronously (*i.e.*, at the times indicated in the timetable) or asynchronously (*e.g.*, posted on OWL for students to view at their convenience). The grading scheme will not change. Any remaining assessments will also be conducted online as determined by the course instructor. In the event that online learning is required, a stable v1 (2021.09.03) internet connection with working microphone and webcam will be required.

4. Required Course Materials

Course Text: Inorganic Chemistry, 5th Edition (Miessler, Fischer, and Tarr). NOTE: this is the textbook you used in Chem 2271 and 2281. If you require a copy, this book is available for purchase at the UWO Campus Bookstore. Second hand copies are also generally available and don't forget to check the library!

Lab Manual: Chemistry 3371F Laboratory Manual Fall 2022 Edition. This is required and can be purchased from the UWO Campus Bookstore.

Safety glasses are required at all times when working in the laboratory. The UWO Undergraduate Chemistry Society sells these at the beginning of term should you require a pair. Students who normally wear prescription glasses must wear safety glasses or goggles over their regular glasses. A lab coat is also required.

A **Hayden-McNeil Organic Chemistry Laboratory Notebook with Carbon Copy** is required for recording all data and observations in the laboratory. This can be used for more than one (not concurrent) course.

5. Methods of Evaluation

Term Test #1	Wed. Oct. 5, 2022	10%
*Term Test #2	Wed. Nov 9, 2022	15%

*NOTE: Although the focus of this test will be primarily on material following the first term test, you should consider it cumulative.

Final Exam (3 hours; cumulative) (December examination period – date and time to be set by the Registrar)	36%
Quizzes ($\times$ 3) (3% each – will be announced the lecture prior)	9%
Laboratory Component (Total 250 marks, see lab manual for details)	25%
5ish minute oral presentation (graded by TAs and/or Dr. Gilroy)	5%

By taking this course you agree to abide by the applicable rules and policies detailed below.

Policy on Late Submissions: Laboratory reports handed in late will receive a penalty of 10% per day, with the weekend counting as two days. Academic considerations will only be given to students who get the required approval from the academic counsellors in the Faculty of Science. Graded reports will be returned no sooner than 7 days after the due date. No late lab report submissions can be accepted after the graded reports have been returned, whether you received a deadline extension or not. If your academic accommodation for a missed lab report extends beyond the date that graded reports are returned, you will have to apply for a grade of INC and submit the missed lab report the next time the course is offered. Alternatively, you may choose to accept a mark of ZERO for the missed work.

Course Attendance: Course attendance is mandatory for Chem 3371F. Information missed during unexcused absences will not be the grounds for academic appeal.

Evaluated Materials: All work submitted for a grade in this course must be your personal work (or yours and a team member as appropriate), use of answers obtained externally is prohibited.

The labs and assignments are essential components of this course. You must attend and complete at least 4 out of the 6 labs, write at least one of the two midterm tests, and write the final exam to pass this course. In addition, you must achieve a grade of at least 50% for both the laboratory component and the combined marks for the term tests, quizzes, oral presentation, and final examination. Students who fail to meet any

of these requirements, whether excused or not, will receive a final grade of not greater than 40%, even if the calculated grade is higher. Exception: Students who, for medical or compassionate reasons, have been granted Incomplete Standing (INC grade) by the Dean's Office will be required to complete the missed work the next time the course is offered.

Problem Sets: Several problem sets will be assigned during the term. No marks are assigned to these problem sets.

6. Missed Work

If you miss ANY component of the evaluation, regardless of its weight, due to illness or other serious circumstances and wish to be excused, you must provide valid medical or supporting documentation to the Academic Counselling Office of your Faculty of Registration as soon as possible. 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.

Quizzes and Lab Reports: If a quiz or lab report is missed for valid reasons, the weighting of the quiz or lab report will be transferred to the corresponding portion of the course (*i.e.*, the total for quizzes or labs).

Presentation: If the presentation is missed for valid reasons, the weighting will be transferred to the final examination.

Midterm Tests: If a midterm test is missed for valid reasons, the weighting of the test will be transferred to the final examination. For those students who cannot write the midterm test on the date indicated because of religious or class conflicts, please contact Dr. Gilroy immediately.

Final Exam: If you miss the Final Exam, please contact the Academic Counselling office of your Faculty of Registration as soon as you are able to do so. They will assess your eligibility to write the Special Examination (the name given by the University to a makeup Final Exam). You may also be eligible to write the Special Exam if you are in a "Multiple Exam Situation" (*e.g.*, more than 2 exams in 23-hour period, more than 3 exams in a 47-hour period).

7. Accommodation and Accessibility

Religious Accommodation: When a course requirement conflicts with a religious holiday that requires an absence from the University or prohibits certain activities, students should request accommodation for their absence in writing at least two weeks prior to the holiday to the course instructor and/or the

Academic Counselling office of their Faculty of Registration. Please consult University's list of recognized religious holidays (updated annually) at

https://multiculturalcalendar.com/ecal/index.php?s=c-univwo.

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%20Accommodation_disabilities.pdf.

8. Academic Policies

The website for Registrarial 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 his/her official university address is attended to in a timely manner.

Permitted aids for quizzes, tests and exams: Students will always be allowed to use model kits, point group flow chart, a basic scientific calculator, and a periodic table. Any other information students require will be provided by Dr. Gilroy.

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

9. 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/.