Chemistry 3371F – Transition Metal Chemistry (2020 Course Outline)

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, or the former Chemistry 251.

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.

Instructor: Professor Joe B. Gilroy
MSA 3201
joe.gilroy@uwo.ca
(e-mail messages must be from your @uwo.ca account, please use OWL forum for questions about course material)

Office hours: W 12:30–1:20 (via Zoom) or by appointment

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

Course Schedule: Lectures
M, W, F; via Zoom (NS 145 available for use); 11:30–12:20

*Note – All of the remote learning sessions for this course will be recorded and posted to a private Microsoft Stream group for viewing.

Laboratory (one of)
T, W, Th; 1:30–5:20 pm (or online-only section)

In-person labs are held in ChB 080 (lower ground floor). The schedule for the experiments and their due dates is given on page 4 of this handout.

Required Text:
Inorganic Chemistry, 5th Edition (Miessler, Fischer, and Tarr) & Chapter 20 Inorganic Chemistry, 4th Edition (Housecroft and Sharpe). The latter will be posted to our OWL course page. NOTE: this is the textbook that 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!
Required Materials:

**Technical Requirements:** Stable internet connection, device with working microphone and webcam (laptop recommended), ability to create .pdf copies of quizzes/exams/reports for submission.

**Lab Manual:** Chemistry 3371F Laboratory Experiments 2020 Edition. This is required and can be purchased from the UWO Campus Bookstore. *Note – there is an online version of the lab manual for those registered in lab section 098. Everyone else is required to purchase the hard copy version.

**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.

**Evaluation:**

- Final Exam (3 hours; cumulative) 40%
- December examination period – date tba
- Quizzes (x 5) 30%
  (6% each – tentatively Sept. 18, Oct. 2, Oct. 16, Nov. 13, Nov. 27)
- Laboratory Component 20%
  (Total 109 marks, see lab manual for details)
- 5 minute oral presentation (recorded) 10%

*Note - Grading will be conducted by TAs and/or Dr. Gilroy.

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

*Note - In order to pass Chem 3371F it is necessary to obtain a passing grade in the laboratory component and the combined marks from the quizzes, oral presentation, and final examination. Additionally, all three laboratory experiments and reports must be completed in order to obtain a passing grade in Chem 3371F.

**Problem Sets:** Several problem sets will be assigned during the term. Solutions will be posted to OWL.

**Course Attendance:** Course attendance is mandatory for Chem 3371F. Information missed during unexcused absences will not be the grounds for academic appeal.
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 2020–2021:

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

1. 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 (3–4 lectures)
   (g) Interpretation of electronic spectra (3–4 lectures)
   (h) Mechanisms of substitution (2–3 lectures)
   (i) Organometallic chemistry (4–5 lectures)

2. Laboratory Experiments
The laboratory 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 14, 2020 (sections 023, 033, 043) or September 21, 2020 (sections 024, 034, 098).

A lab report must be submitted for each experiment. This will either be in the form of a formal, written report or data sheet format. 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: Ben Katzman (bkatzman@uwo.ca), Alex Watson (awatso92@uwo.ca), and Mansha Nayyar (mnayyar2@uwo.ca)

In order to maintain consistency across the entire course, please use the OWL Forum to ask questions about the lecture and lab portions of the course prior to contacting Dr. Gilroy or the TAs.

3. **Submission of course work**

Course work (quizzes/tests/lab reports/etc.) must be submitted via Gradescope (integrated into our OWL page) as .pdf files unless otherwise directed. Documents can be scanned to .pdf format or converted using your mobile phone (https://www.gradescope.com/help#help-center-item-student-scanning). As document conversion will sometimes be necessary with short timelines, please familiarize yourself with these technologies well in advance to deadlines.

4. **Chemistry 3371 late policy**

Late lab reports and oral presentations will receive a penalty of 20% per day, with the weekend counting as one day. Late quizzes will not be accepted. Academic Considerations will only be given to students who get the required approval (see details below).

5. **Laboratory Schedule**, **Note**

<table>
<thead>
<tr>
<th>Week of....</th>
<th>Sections 023, 033, 043</th>
<th>Sections 024, 034</th>
<th>Section 098</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept. 14</td>
<td>Exp. 1: Linkage Isomers</td>
<td>No Lab</td>
<td>No Lab</td>
</tr>
<tr>
<td>Sept. 21</td>
<td>No Lab</td>
<td>Exp. 1: Linkage Isomers</td>
<td>Exp. 1: Linkage Isomers</td>
</tr>
<tr>
<td>Sept 28</td>
<td>Exp. 3: Ligand Field Strengths</td>
<td>Exp. 1 Formal Reports Due</td>
<td>No Lab</td>
</tr>
<tr>
<td>Oct. 5</td>
<td>No Lab</td>
<td>Exp. 3: Ligand Field Strengths</td>
<td>Exp. 1 Formal Reports Due</td>
</tr>
<tr>
<td>Oct. 12</td>
<td>Exp. 5: Ferrocene, Week 1</td>
<td>No Lab</td>
<td>Exp. 5: Ferrocene, Week 1</td>
</tr>
<tr>
<td>Oct. 19</td>
<td>No Lab</td>
<td>Exp. 5: Ferrocene, Week 1</td>
<td>Exp. 3 Data Sheets Due</td>
</tr>
<tr>
<td>Oct. 26</td>
<td>Exp. 5: Ferrocene, Week 2</td>
<td>No Lab</td>
<td>Exp. 5: Ferrocene, Week 2</td>
</tr>
<tr>
<td>Nov. 2</td>
<td>Reading Week</td>
<td>Reading Week</td>
<td>Reading Week</td>
</tr>
<tr>
<td>Nov. 9</td>
<td>No Lab</td>
<td>Exp. 5: Ferrocene, Week 2</td>
<td>Exp. 5: Ferrocene, Week 2</td>
</tr>
<tr>
<td>Nov. 16</td>
<td>No Lab</td>
<td>Exp. 5: Ferrocene, Week 2</td>
<td>Exp. 5: Ferrocene, Week 2</td>
</tr>
<tr>
<td>Nov. 23</td>
<td>No Lab</td>
<td>Exp. 5: Ferrocene, Week 2</td>
<td>Exp. 5: Ferrocene, Week 2</td>
</tr>
</tbody>
</table>

**Note** - Formal Reports must be submitted as .pdf via Gradescope before the beginning of your lab section.

**Note** - Data Sheets must be submitted as .pdf via Gradescope before the beginning of your lab section.

Dec. 9 is last day of classes
6. Short Formal Presentation
Should be prepared using PowerPoint/Keynote or similar. Presentations should be 5 minutes maximum and uploaded to OWL. Best practices will be discussed during our lectures.

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 \(\Delta/\Lambda\) complexes, cis-platin, \(K_2Cr_2O_7\) in breathalysers, FLP chemistry, MO diagrams for tbo 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 Friday, Oct. 30). A 20% per day penalty on the presentation will apply for every day late on topic submission/approval.

Accommodation and Accessibility:

Accommodation Policies

Students with disabilities work with Accessible Education (formerly SSD) which provides recommendations for accommodation based on medical documentation or psychological and cognitive testing. The Academic Accommodation for Students with Disabilities policy can be found at: https://www.uwo.ca/univsec/pdf/academic_policies/appeals/AcademicAccommodation_disabilities.pdf

Academic Consideration for Student Absence

Students will have up to two (2) opportunities during the regular academic year to use an on-line portal to self-report an absence during the semester, provided the following conditions are met: the absence is no more than 48 hours in duration, and the assessment for which consideration is being sought is worth 30% or less of the student’s final grade. Students are expected to contact their instructors within 24 hours of the end of the period of the self-reported absence, unless noted on the syllabus. Students are not able to use the self-reporting option in the following circumstances:

- for exams scheduled by the Office of the Registrar (e.g., December and April exams)
- absence of a duration greater than 48 hours,
- assessments worth more than 30% of the student’s final grade,
- if a student has already used the self-reporting portal twice during the academic year

If the conditions for a Self-Reported Absence are not met, students will need to provide a Student Medical Certificate if the absence is medical, or provide appropriate documentation if there are
compassionate grounds for the absence in question. Students are encouraged to contact their Faculty academic counselling office to obtain more information about the relevant documentation. 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.

For policy on Academic Consideration for Student Absences - Undergraduate Students in First Entry Programs, see:

https://www.uwo.ca/univsec/pdf/academic_policies/appeals/Academic_Consideration_for_absences.pdf

and for the Student Medical Certificate (SMC), see:

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

**Religious Accommodation**

Students should consult the University’s list of recognized religious holidays, and should give reasonable notice in writing, prior to the holiday, to the Instructor and an Academic Counsellor if their course requirements will be affected by a religious observance. Additional information is given in the Western Multicultural Calendar: https://multiculturalcalendar.com/ecal/index.php?s=c-univwo

You may also be eligible to write the Special Exam if you are in a “Multiple Exam Situation” (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

**Specifics for Chem 3371**

**Quizzes:** If a quiz is missed for valid reasons (see process for seeking academic consideration above) the weighting of the quiz will be transferred to the final examination. If a quiz cannot be written at the scheduled time, please contact Dr. Gilroy immediately.

**Final Exam:** If you miss the Final Exam, please contact your faculty’s Academic Counselling Office as soon as you are able to do so. They will assess your eligibility to write the Special Exam (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” (see http://www.registrar.uwo.ca/examinations/exam_schedule.html).

**Academic Policies:**

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

In accordance with policy, http://www.uwo.ca/its/identity/activatenonstudent.html, 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.
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 interactions, 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.

Lecture Recording

All of the remote learning sessions for this course will be recorded. The data captured during these recordings may include your image, voice recordings, chat logs and personal identifiers (name displayed on the screen). The recordings will be used for educational purposes related to this course, including evaluations. The recordings may be disclosed to other individuals participating in the course for their private or group study purposes. Please contact the instructor if you have any concerns related to session recordings.

Participants in this course are not permitted to record the sessions, except where recording is an approved accommodation, or the participant has the prior written permission of the instructor.

Academic Offences

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.

All required reports may be subject to submission for textual similarity review to the commercial plagiarism detection software under license to the University for the detection of plagiarism. All reports submitted for such checking will be included as source documents in the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between Western University and Turnitin.com (http://www.turnitin.com).

Test Proctoring

Tests and examinations in this course may be conducted using Zoom and/or a remote proctoring service, such as Proctortrack.

If Zoom is used for exam invigilation, you will be required to keep your camera on for the entire session, hold up your student card for identification purposes, and share your screen with the invigilator if asked to do so at any time during the exam.

Proctortrack will require you to provide personal information (including some biometric data). The session will be recorded. By taking this course, you are consenting to the use of this software.
More information about remote proctoring is available in the Online Proctoring Guidelines at the following link: https://www.uwo.ca/univsec/pdf/onlineproctorguidelines.pdf

Completion of this course will require you to have a reliable internet connection and a device that meets the system and technical requirements for both Zoom and Proctortrack. Information about the system and technical requirements are available at the following links: https://www.proctortrack.com/tech-requirements/  https://support.zoom.us/hc/en-us

*Note - Zoom servers are located outside Canada. If you would prefer to use only your first name or a nickname to login to Zoom, please provide this information to the instructor in advance of the test or examination.

Statements concerning online etiquette:

Some components of this course will involve online interactions. To ensure the best experience for both you and your classmates, please honour the following rules of etiquette:

• “arrive” to class on time.
• use your computer and/or laptop if possible (as opposed to a cell phone or tablet).
• ensure that you are in a private location (if possible) to protect the confidentiality of discussions in the event that a class discussion deals with sensitive or personal material.
• to minimize background noise, mute your microphone for the entire class until you are invited to speak, unless directed otherwise.
• In order to give us optimum bandwidth and web quality, turn off your video camera for the entire class unless you are invited to speak.
• Please be prepared to turn your video camera off at the instructor’s request if the internet connection becomes unstable.
• Unless invited by your instructor, do not share your screen in the meeting.

The course instructor will act as moderator for the class and will deal with any questions from participants (generally via the chat feature). To participate please consider the following:

• If you wish to speak, use the “raise hand“ function and wait for the instructor to acknowledge you before beginning your comment or question.
• Please remember to unmute your microphone and turn on your video camera before speaking.
• Self-identify when speaking.
• Please remember to mute your mic and turn off your video camera after speaking (unless directed otherwise).

General considerations of “netiquette”:

• Keep in mind the different cultural and linguistic backgrounds of the students in the course.
• Be courteous toward the instructor, your colleagues, and authors whose work you are discussing.
• Be respectful of the diversity of viewpoints that you will encounter in the class and in your readings. The exchange of diverse ideas and opinions is part of the scholarly environment. “Flaming” is never appropriate.

• Be professional and scholarly in all online postings. Use proper grammar and spelling. Cite the ideas of others appropriately.

Note that disruptive behaviour of any type during online classes, including inappropriate use of the chat function, is unacceptable. Students found guilty of Zoom-bombing a class or of other serious online offenses may be subject to disciplinary measures under the Code of Student Conduct.