

**TOPICS IN INORGANIC AND ORGANOMETALLIC CHEMISTRY
CHEM/ENCH 423 (Fall 2023)**

Course instructors:

PART I:

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Course website: this course is supported by an OnQ site associated with course registration. See <https://onq.queensu.ca>

Intended Student Learning Outcomes:

- (1) The students will be able to apply the principles of organometallic chemistry to analyze and identify the structure(s), stability and reactivity of organometallic compounds.
- (2) The students will be able to explain and anticipate the toxicity of metal ions and coordination complexes, and propose safe practices.
- (3) The students will be able to identify features of metal ions that dictate their ligand affinity and kinetic properties.
- (4) The students will be able to identify and describe the properties of common ligands used in coordination complexes.
- (5) The students will identify and classify common reactions of organotransition metal complexes that occur at the metal centre.

Course outline: See end of this document.

Textbooks : None required ! We'll work off research articles primarily.

Grading Scheme

1 assignment on Part I material	7 %	
4 Feed-back fruits activities on Part I material	8 %	
Midterm examination on Part I material	25 %	
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3 quizzes on Part II material (best 2 scores out of 3)	2 × 10 %	
Final examination on Part II material	25 %	Scheduled by the exams office
Literature presentation (groups of 2)	15 %	Tentatively weeks 11 and 12

Land Acknowledgement: Let us acknowledge that Queen’s University occupies traditional Anishinaabe and Haudenosaunee territory. To acknowledge this traditional territory is to recognize its longer history, one predating the establishment of the earliest European colonies. It is also to acknowledge this territory’s significance for the Indigenous Peoples who lived, and continue to live, upon it and whose practices and spiritualities are tied to the land and continue to develop in relationship to the territory and its other inhabitants today. Indigenous communities in Kingston/Katarokwi continue to reflect the area’s Anishinaabe and Haudenosaunee roots. There is also a significant Métis community and First Peoples from other Nations across Turtle Island present here today. To read more about the history of the land, see the [Queen’s Encyclopedia](#) and to learn more about land acknowledgements, see the [Office of Indigenous Initiatives](#).

Equity, Diversity, and Inclusivity Statement: Queen’s University recognizes that the values of equity and diversity are vital to and in harmony with its educational mission and standards of excellence. It acknowledges that direct, indirect, and systemic discrimination exists within our institutional structures, policies, and practices and in our community. These take many forms and work to differentially advantage and disadvantage persons across social identities such as race, ethnicity, disability, gender identity, sexual orientation, faith, and socioeconomic status, among other examples. In this class I will work to promote an anti-discriminatory, anti-racist and accountable environment where everyone feels welcome. Every member of this class is asked to show respect for every other member.

Grading Method: All components of this course will receive numerical percentage marks. The final grade you receive for the course will be derived by converting your numerical course average to a letter grade according to Queen’s Official Grade Conversion Scale:

Queen’s Official Grade Conversion Scale

Grade	Numerical Course Average (Range)
A+	90-100
A	85-89
A-	80-84
B+	77-79
B	73-76
B-	70-72
C+	67-69
C	63-66
C-	60-62
D+	57-59
D	53-56
D-	50-52
F	49 and below

Calculator Policy: As noted in Academic Regulation 9.2, Calculators acceptable for use during quizzes, tests and examinations are intended to support the basic calculating functions required by most Arts and Science courses. For this purpose, the use of the **Casio 991** series calculator is permitted and is the **only approved calculator for Arts and Science students**. This calculator sells for around

\$25 at the Queen's Campus Bookstore, Staples and other popular suppliers of school and office supplies.

Accommodations Statement: Queen's University is committed to working with students with disabilities to remove barriers to their academic goals. Queen's Student Accessibility Services (QSAS), students with disabilities, instructors, and faculty staff work together to provide and implement academic accommodations designed to allow students with disabilities equitable access to all course material (including in-class as well as exams). If you are a student currently experiencing barriers to your academics due to disability related reasons, and you would like to understand whether academic accommodations could support the removal of those barriers, please visit the [QSAS website](#) to learn more about academic accommodations or start the registration process with QSAS by clicking *Access Ventus* button at [Ventus | Accessibility Services | Queen's \(queensu.ca\)](#)

VENTUS is an online portal that connects students, instructors, Queen's Student Accessibility Services, the Exam's Office and other support services in the process to request, assess, and implement academic accommodations.

To learn more go to: <https://www.queensu.ca/ventus-support/students/visual-guide-ventus-students>

Academic Considerations for Students in Extenuating Circumstances: Academic Consideration is a process for the University community to provide a compassionate response to assist students experiencing unforeseen, short-term extenuating circumstances that may impact or impede a student's ability to complete their academics. This may include but is not limited to,

- Short term Physical or Mental Illness or Injury (stomach flu, anxiety/depression, mononucleosis, concussion, broken bones, surgery, medical treatments, etc.)
- Traumatic Event/Confidential (Bereavement, serious injury, illness or required treatment for a significant other/family member or a traumatic event such as divorce, sexual assault, social injustice, etc.)
- Requirements by Law or Public Health Authorities (court dates, jury duty, requirements to isolate, etc.)
- Significant Event (varsity athletic event, distinguished event, serving in the Reserve Forces, etc.)

Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances. For more information, please see the [Senate Policy on Academic Consideration for Students in Extenuating Circumstances](#).

Each Faculty has developed a protocol to provide a consistent and equitable approach in dealing with requests for academic consideration for students facing extenuating circumstances. For more information, undergraduate students in the Faculty of Arts and Sciences should consult the Faculty's webpage on [Academic Consideration in Extenuating Circumstances](#) and submit a request via the [Academic Consideration Request Portal](#). Students in other Faculties and Schools who are enrolled in this course should refer to the protocol for their home Faculty.

Students are encouraged to submit requests as soon as the need becomes apparent and to contact their instructor and/or course coordinator as soon as possible once academic consideration has been granted. Any delay in contact may limit the options available for academic consideration.

For more information on the Academic Consideration process, what is and is not an extenuating circumstance, and to submit an Academic Consideration request, please see the Faculty of Arts and Science's [Academic Consideration website](#). ASO courses include links to information on **Academic**

Consideration on your **Course Homepage** in onQ. Please see the Teaching Team page for contact information for your instructor and TA(s), where relevant.

Academic Integrity: Queen’s University is dedicated to creating a scholarly community free to explore a range of ideas, to build and advance knowledge, and to share the ideas and knowledge that emerge from a range of intellectual pursuits. Queen’s students, faculty, administrators and staff therefore all have responsibilities for supporting and upholding the fundamental values of academic integrity. Academic integrity is constituted by the five core fundamental values of honesty, trust, fairness, respect and responsibility and by the quality of courage. These values and qualities are central to the building, nurturing and sustaining of an academic community in which all members of the community will thrive. Adherence to the values expressed through academic integrity forms a foundation for the "freedom of inquiry and exchange of ideas" essential to the intellectual life of the University.

The following statements from “The Fundamental Values of Academic Integrity” (2nd edition), developed by the International Center for Academic Integrity (ICAI), contextualize these values and qualities:

1. **Honesty** Academic communities of integrity advance the quest for truth and knowledge through intellectual and personal honesty in learning, teaching, research, and service.
2. **Trust** Academic communities of integrity both foster and rely upon climates of mutual trust. Climates of trust encourage and support the free exchange of ideas which in turn allows scholarly inquiry to reach its fullest potential.
3. **Fairness** Academic communities of integrity establish clear and transparent expectations, standards, and practices to support fairness in the interactions of students, faculty, and administrators.
4. **Respect** Academic communities of integrity value the interactive, cooperative, participatory nature of learning. They honor, value, and consider diverse opinions and ideas.
5. **Responsibility** Academic communities of integrity rest upon foundations of personal accountability coupled with the willingness of individuals and groups to lead by example, uphold mutually agreed-upon standards, and take action when they encounter wrongdoing.
6. **Courage** To develop and sustain communities of integrity, it takes more than simply believing in the fundamental values. Translating the values from talking points into action -- standing up for them in the face of pressure and adversity — requires determination, commitment, and courage.

Students are responsible for familiarizing themselves with and adhering to the Senate [regulations](#) concerning academic integrity, along with [Faculty or School](#) specific information. Departures from academic integrity include, but are not limited to, plagiarism, use of unauthorized materials, facilitation, forgery and falsification. Actions which contravene the regulation on academic integrity carry sanctions that can range from a warning, to loss of grades on an assignment, to failure of a course, to requirement to withdraw from the university.

Syllabus statements for Generative Artificial Intelligence (AI) Tools: Not permitted. Using generative AI writing tools such as ChatGPT in your submitted work is not permitted in this class. This type of use constitutes a Departure from Academic Integrity. Original work, completed wholly by you, is expected to be submitted in this course. The use of an artificial intelligence tool like ChatGPT is not permitted.

Queen’s [Student Academic Success Services](#) (SASS) offers a self-directed, online academic integrity module which we encourage all students to take which will help with:

- Understanding the nature of the academic integrity departure

- Understanding the expectations of and role of sources in scholarly writing
- Integrating sources into your writing (paraphrasing, quoting, summarizing)
- Understanding when and how to cite your sources
- Managing your time effectively to avoid the need for shortcuts
- Taking effective notes to ensure accuracy of source material and correct attribution

Turnitin Statement: This course makes use of Turnitin, a third-party application that helps maintain standards of excellence in academic integrity. Normally, students will be required to submit their course assignments through onQ to Turnitin. In doing so, students' work will be included as source documents in the Turnitin reference database, where they will be used solely for the purpose of detecting plagiarized text in this course. Data from submissions is also collected and analyzed by Turnitin for detecting Artificial Intelligence ([AI-generated text](#)). These results are not reported to your instructor at this time but could be in the future. Turnitin is a suite of tools that provide instructors with information about the authenticity of submitted work and facilitates the process of grading. The similarity report generated after an assignment file is submitted produces a similarity score for each assignment. A similarity score is the percentage of writing that is similar to content found on the internet or the Turnitin extensive database of content. Turnitin does not determine if an instance of plagiarism has occurred. Instead, it gives instructors the information they need to determine the authenticity of work as a part of a larger process.

Please read Turnitin's [Privacy Policy](#), [Acceptable Use Policy](#) and [End-User License Agreement](#), which govern users' relationship with Turnitin. Also, please note that Turnitin uses cookies and other tracking technologies; however, in its service contract with Queen's Turnitin has agreed that neither Turnitin nor its third-party partners will use data collected through cookies or other tracking technologies for marketing or advertising purposes.

For further information about how you can exercise control over cookies, see [Turnitin's Privacy Policy](#).

Turnitin may provide other services that are not connected to the purpose for which Queen's University has engaged Turnitin. Your independent use of Turnitin's other services is subject solely to Turnitin's Terms of Service and Privacy Policy, and Queen's University has no liability for any independent interaction you choose to have with Turnitin.

Portions of this document have been adapted, with permission, from the University of Toronto Centre for Teaching Support and Innovation tip sheet "[Turnitin: An Electronic Resource to Deter Plagiarism](#)".

Copyright of Course Materials: Course materials created by the course instructor, including all slides, presentations, handouts, tests, exams, and other similar course materials, are the intellectual property of the instructor. It is a departure from academic integrity to distribute, publicly post, sell or otherwise disseminate an instructor's course materials or to provide an instructor's course materials to anyone else for distribution, posting, sale or other means of dissemination, without the instructor's express consent. A student who engages in such conduct may be subject to penalty for a departure from academic integrity and may also face adverse legal consequences for infringement of intellectual property rights.

Class attendance: Presence and participation in class contribute to the knowledge and skills that you will develop throughout this course. You are expected to attend class regularly, participate in class

conversations and learning activities. These types of activities provide active engagement, promote a deeper understanding of the course content, and contribute to success in this course.

Timing of Final Examination: Once the exam schedule has been finalized, the exam date will be posted on your SOLUS account. The exam dates for each term are listed on the Faculty of Arts and Science webpage under "[Important Dates](#)." Student exam schedules for the Fall Term are posted on SOLUS immediately prior to Thanksgiving and on the Friday before Reading Week for the Winter Term. Students should **delay finalizing any travel plans until after the examination schedule has been posted**. Exams will not be moved or deferred to accommodate employment, travel/holiday plans or flight reservations. For information regarding what is considered extenuating circumstances and qualifications for Academic Consideration, please visit the [Faculty of Arts and Science's Academic Consideration webpage](#).

Course Outline (tentative):

Note that you are responsible for, and will be tested on, in-class and recorded material (including required videos). If you miss a class, please make an effort to get copies of the notes from that day.

PART I (Dr. Petitjean)

Introduction: Classification; Electronegativity; Metals/Main group.

Chapter 1: Main Group Organometallics

1.1 Alkali Metals

Focus on organolithium compounds (synthesis, properties, applications)

1.2 Alkaline-Earth metals

Focus on organomagnesium compounds (synthesis, properties, applications)

1.3 Organometallic Compounds of Zn, Cd, Hg

Synthesis, properties, toxicity, applications

Chapter 2: Coordination as a tool for the Assembly of Complex Systems and Molecular Machines [Time permitting]

2.1 Review of properties of metal ions.

2.2 Application to Self-assembly

Pseudo 1D, 2D and 3D architectures

2.3 Application to Molecular Machines

Stimulus-responsive coordination complexes

Chapter 3: Incursion into Bio-active Coordination Complexes

3.1 Anti-cancer Drugs

Platinum-based drugs, ruthenium arenes

3.2 Nucleic acid recognition and repair

Ru, Rh, mismatch repair

3.3 Dr. Turro's and Dr. Sessler's journeys

Feed-back fruit activities

PART II (Dr. Lee)

Chapter 4: Bonding in Transition Metal Organometallic Complexes

4.1 Complexes obeying 18 electron rule and exceptions

Review of electron counting

4.2 Types and properties of common ligands

Carbonyls, phosphines, π -ligands, carbenes, carbynes, hydrides, dihydrogen, alkane and alkyl complexes

Chapter 5: Organometallic Reactions I

5.1 Ligand substitution

5.2 Oxidative addition

5.3 Reductive elimination

Chapter 6: Organometallic Reactions II

6.1 Insertion and elimination

6.2 Addition and abstraction

6.3 Carbon-carbon coupling

Proposed list of presentation topics: To be announced during week 1. Half of the topics will be related to Part I material, and the other half to Part II themes. To Be Announced (1st week of classes).

Topic #	
# 1	
# 2	
# 2	
# 3	
# 4	
# 5	
# 6	
# 7	
# 8	
# 9	
# 10	
# 11	
# 12	
# 13	
# 14	
# 15	
# 16	

Each topic presentation includes 15 minutes of speech including 3-5 minutes of questions (both will be assessed). It is anticipated that 3 groups will present per class session of 50 minutes. All presentations will take place in the last two weeks of classes (weeks 11 and 12).