TOPICS IN INORGANIC AND ORGANOMETALLIC CHEMISTRY
Chem/Ench 423 (Winter 2022)

Lectures: Microsoft Teams platform

PART I (Dr Petitjean)
All asynchronous

PART II:
Mondays 10:30-11:20 am
Wednesdays 9:30-9:20 am
Fridays 8:30-9:30 am

Course instructors:

PART I:
Dr Anne Petitjean
Chernoff Hall, room 410
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PART II:
Dr Peng Wang
Chernoff Hall, room 303
wang.peng@queensu.ca

Office Hours: *Petitjean* Wednesdays 1:30-2:30 pm (Zoom), and by appointment (Zoom/Teams).
Wang Wednesdays 1:30-2:30 pm, and by appointment.

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

Intended Student Learning Outcomes for 2022:

(1) The students will be able to apply the principles of organometallic chemistry to analyze and identify the stability and reactivity of organometallic compounds.
(2) The students will be able to design synthetic methods based on cross-coupling reactions for organic compounds.
(3) The students will be able to explain and anticipate the toxicity of metal ions and coordination ligands.
(4) The students will understand the electronic structures of inorganic compounds and be able to describe materials in terms of electrical conductivity as well as optical properties.
(5) The students will be able to describe binary phase diagrams and predict the formation and stability of inorganic compounds.
(6) The students will be able to apply the principle of chemical interactions in describing and predicting suitable materials for a number of optical and opto-electronic applications.
(7) The students will be able to conduct a critical review and assessment on a topic in current literature and research trend related to organometallics and communicate effectively the finding in the form of oral presentations to the class.

Course outline: See end of this document.

Textbooks (useful but **not** required):
- '*Organometallics, A Concise Introduction*' by Ch. Elschenbroich, A. Salzer [on reserve]
- '*The Organometallic Chemistry of the Transition Metals*', by Robert Crabtree
- '*Inorganic Chemistry in Biology*' by P. and R. Wilkin [not available online]
- '*Principles of Bio-Inorganic Chemistry*', by S. Lipard and J. M. Berg [available online; library]
- '*Advanced Inorganic Chemistry*', by F. A. Cotton
- '*Physical Properties of Materials*', by Mary Anne White

Grading Scheme

1 assignment in **Part I**	5.5 %
3 Feed-back fruits activities in **Part I**	6 %

Midterm examination (onQ)	31%	Tentatively Thursday February 17th, 2022 (7-9 pm, but should only take less than 2 h).
1 assignments in **Part II**	7.5 %	
Final examination on **Part II**	35%	Scheduled by the exams office
Literature presentation (groups of 2)	15%	Tentatively scheduled in weeks 11 and 12

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

Academic Integrity:

The following statement on academic integrity builds on a definition approved by Senate and is designed to make students aware of the importance of the concept and the potential consequences of departing from the core values of academic integrity. It is highly recommended that this statement be included on all course syllabi. Instructors may also consider including this statement with each assignment.

Queen's students, faculty, administrators and staff all have responsibilities for upholding the fundamental values of academic integrity; honesty, trust, fairness, respect, responsibility and courage (see www.academicintegrity.org). These values 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 (see the Senate Report on Principles and Priorities http://www.queensu.ca/secretariat/policies/senate/report-principles-and-priorities).

Students are responsible for familiarizing themselves with the regulations concerning academic integrity and for ensuring that their assignments and their behaviour conform to the principles of academic integrity. Information on academic integrity is available in the Arts and Science Calendar (see Academic Regulation 1 http://www.queensu.ca/artsci/academic-calendars/regulations/academic-

regulations/regulation-1), on the Arts and Science website (see https://www.queensu.ca/artsci/students-at-queens/academic-integrity), and from the instructor of this course. Departures from academic integrity include plagiarism, use of unauthorized materials, facilitation, forgery and falsification, and are antithetical to the development of an academic community at Queen's. Given the seriousness of these matters, actions which contravene the regulation on academic integrity carry sanctions that can range from a warning or the loss of grades on an assignment to the failure of a course to a requirement to withdraw from the university.

Turnitin Statement: Queen's University has partnered with the third-party application Turnitin to help maintain our standards of excellence in academic integrity. Turnitin is a suite of tools that provide instructors with information about the authenticity of submitted work and facilitates the process of grading. Submitted files are compared against an extensive database of content, and Turnitin produces a similarity report and a similarity score for each assignment. A similarity score is the percentage of a document that is similar to content held within the database. 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.

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.

Accessibility Statement

Queen's is committed to an inclusive campus community with accessible goods, services, and facilities that respect the dignity and independence of persons with disabilities. Course materials are available in an accessible format or with appropriate communication supports upon request.

Please contact **Meredith Richards in the Department of Chemistry** in one of the following ways:

Email: ugadm@chem.queensu.ca
Phone: 613-533-6000 extension 75518
In person: Chernoff 200

Accommodations Statement

Queen's University is committed to achieving full accessibility for people with disabilities. Part of this commitment includes arranging academic accommodations for students with disabilities to ensure they have an equitable opportunity to participate in all of their academic activities. The Senate Policy for Accommodations for Students with Disabilities was approved at Senate in November 2016 (see https://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/senateandtrustees/ACADACCOMMPOLICY2016.pdf). If you are a student with a disability and think you may need academic accommodations, you are strongly encouraged to contact the Queen's Student Accessibility Services (QSAS) and register as early as possible. For more information, including important deadlines, please visit the QSAS website at: http://www.queensu.ca/studentwellness/accessibility-services/

Academic Considerations for Students in Extenuating Circumstances

Queen's University is committed to providing academic consideration to students experiencing extenuating circumstances that are beyond their control and are interfering with their ability to complete academic requirements related to a course for a short period of time. The Senate Policy on Academic Consideration for Students in Extenuating Circumstances is available at http://www.queensu.ca/secretariat/sites/webpublish.queensu.ca.uslcwww/files/files/policies/senateandtrustees/Academic%20Considerations%20for%20Extenuating%20Circumstances%20Policy%20Final.pdf
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. Arts and Science undergraduate students can find the Faculty of Arts and Science protocol and the portal where a request can be submitted at: http://www.queensu.ca/artsci/accommodations. Students in other Faculties and Schools who are enrolled in this course should refer to the protocol for their home Faculty. If you need to request academic consideration for this course, you will be required to provide the name and email address of the instructor/coordinator. Please use the following:
Instructors' Name: Dr Petitjean and Dr Peng. Instructors' email addresses: See above

Course Outline (tentative):
Note that you are responsible for, and will be tested on, ***in-class/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: ASYNCHRONOUS (recorded videos)

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: Incursion into Bio-active Coordination Complexes

2.1 Anti-cancer Drugs
Platinum-based drugs, ruthenium arenes)
2.2 Nucleic acid recognition and repair
Ru, Rh, mismatch repair
2.3 Dr Turro's and Dr Sessler's journeys
Feed-back fruit activities

Chapter 3: Organometallic Compounds of the Transition Metals

3.1 Introduction
18 valence electron rule, elementary steps
3.2 σ-Donor ligands
e.g., M-Alkyl, M-aryl
Application to bio-inorganic catalysis (Vit B_{12})
3.3 σ-Donor and π-Acceptor Ligands
e.g., CO
3.4 σ and π-Donors, π-Acceptor Ligands
e.g., Olefins, Cp, arenes

PART II

Chapter 4: Bonding and Band Theory

a) Inorganic complexes and solid-state compounds
b) Band theory for large ordered materials
c) Electrical conductivity

Chapter 5: Phase Stability and Solid-state Compounds

a) Liquid–Solid Binary Phase Diagrams
b) Compound Formation
c) The Lever Principle

Chapter 6: Metal, Semiconductors and Insulators

a) Band structure of semiconductors
b) Color in Metals and Semiconductors
c) Color centers and scintillators
d) Opto-electronics, Photovoltaics

Proposed list of presentation topics (dates and location TBA)

Topic #	
# 1	Sonogashira cross-coupling reactions
# 2	Copper-catalyzed azide-alkyne cycloaddition (a member of the 'Click' reactions)
# 3	C-H activation in catalysis by transition metals
# 4	Negishi cross-coupling reactions
# 5	Beneficial health effects of carbon monoxide (as a biological effector); use of coordination complexes to detect and deliver CO.
# 6	UV Nonlinear Optical Materials
# 7	Thermoelectric Materials
# 8	High Temperature Superconductors
# 9	Next generation semiconductors
# 10	Scintillators and Phosphors

Each topic presentation includes 10-15 minutes of speech and 3-5 minutes of questions (both will be assessed). It is anticipated that 3 groups will present per class session of 50 minutes. Topics 1-5 deal with organometallic and bio-inorganic chemistry, and topics 6-10 focus on solid-state inorganic materials. All presentations will take place in the last two weeks of classes (weeks 11 and 12).