

**Faculty of Science Course Syllabus**  
**Department of Chemistry**  
**CHEM 3103.03**  
**Intermediate Inorganic Chemistry**  
**Fall 2019**

<b>Instructor(s):</b>	Dr. Laura Turculet (lectures)	laura.turculet@dal.ca	(CHEM 414)
	Dr. Marc Whalen (lab)	marc.whalen@dal.ca	(CHEM 110)
<b>Lectures:</b>	MWF 9:35 - 10:25 am	(CHEM 223)	
<b>Laboratories:</b>	4 hours per week	(CHEM 118P)	
<b>Office Hours (LT):</b>	Mon, Fri 10:30 - 11:00 am	(CHEM 414)	
	Mon 2:30 - 3:30 pm	(CHEM 414)	
<b>Office Hours (MW):</b>	Tues 10:00 - 11:00 am	(CHEM 110)	
	Thurs 10:00 - 11:00 am	(CHEM 110)	

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### Course Description

Modern bonding theories are developed using symmetry concepts. These are applied to understanding the molecular structure, reactivity, and spectroscopic properties of inorganic compounds, including coordination (transition metal) compounds and organometallic complexes. The compounds prepared in the laboratory introduce more advanced synthetic procedures for the preparation of inorganic compounds.

### Course Prerequisites

CHEM 2101.03 Introductory Inorganic Chemistry

### Course Objectives/Learning Outcomes

- Understand basic trends in structure and reactivity of transition metal and organometallic complexes
- Acquire a symmetry-based approach to understanding modern bonding models and spectroscopic properties
- Learn advanced synthetic procedures in the laboratory
- Through laboratory application, become familiar with some advanced characterization techniques for structure determination in solution and in the solid state (infrared and Raman spectroscopy, multinuclear magnetic resonance spectroscopy, magnetic susceptibility, visible spectroscopy)
- Obtain an introductory knowledge of the catalysis of organic reactions using organometallic complexes

### Course Materials

- Inorganic Chemistry, 5th Ed. Miessler, Fischer and Tarr Pearson, 2014 (Dalhousie Bookstore)
- Chemistry 3103 Laboratory Manual, 2019 (Dalhousie Bookstore)
- Brightspace course website; NOTE: separate sites for lecture and lab components

## Course Assessment

Component	Weight (% of final grade)	Date
<b>Laboratory</b> <sup>1</sup>	25	4 h per week, starting Sept. 11 & 13
<b>Tests</b> (in class)	15	Wed, Oct. 2
	15	Wed, Oct. 23
	15	Wed, Nov. 20
<b>Final exam</b> (3 hours)	30	<i>to be scheduled by Registrar</i>

<sup>1</sup>See Lab Manual for more details; for laboratory report due dates, see **CHEM 3103 Laboratory Schedule**, below

### Conversion of numerical grades to Final Letter Grades follows the Dalhousie Common Grade Scale

A+ (90-100)	B+ (77-79)	C+ (65-69)	D (50-54)
A (85-89)	B (73-76)	C (60-64)	F (<50)
A- (80-84)	B- (70-72)	C- (55-59)	

## Other Course Requirements

**Chemistry Safety Module and Quiz:** Chemicals and laboratory equipment can pose serious hazards if they are not treated with an appropriate amount of caution. As a chemistry student, part of your training involves understanding the hazards that are present within a chemistry laboratory and learning the measures that must be taken in order to maximize the safety for you and your peers. You are **REQUIRED** to read the Chemistry Safety Module in your 3103 Lab Manual and complete the online safety quizzes, with perfect marks, by **September 22, 2019 at 11:30 pm**. Students who do not successfully complete this requirement will not be allowed to perform experiments in any Dalhousie undergraduate laboratory until the module is completed. If a lab session is missed due to an incomplete safety module, the instructor is not obligated to provide a make-up session.

## Course Policies

**Class announcements:** The instructors will post announcements on the lecture/lab Brightspace sites when possible. However, anything stated or announced in lecture is considered to be common knowledge. If you want to be informed on all topics, come to lecture.

**Meeting with the instructors outside of office hours:** Please note that outside of office hours, meeting with the instructors is by appointment only. If you wish to set up a meeting, please email the instructor(s), clearly indicating the reason you wish to meet as well as your availability.

**Short-term absence policy:** As of January 1, 2018, the university has adopted a **new policy** regarding short-term absences, as detailed here : [https://www.dal.ca/dept/university\\_secretariat/policies/academic/misled-or-late-academic-requirements-due-to-student-absence.html](https://www.dal.ca/dept/university_secretariat/policies/academic/misled-or-late-academic-requirements-due-to-student-absence.html). In accordance with the new policy, students will no longer submit a sick note or medical certificate in case of a missed academic requirement due to **short-term absence** (defined as “absence of three (3) consecutive days or fewer due to minor physical or mental health conditions, or other extenuating circumstances such as caregiving duties; immediate family illness, injury or death; involvement in an accident; legal proceedings or being a victim of a crime, domestic or intimate partner violence”). Instead, they will:

- (1) notify the instructor by email within 24 h of the missed academic deadline or test

(2) submit a **Student Declaration of Absence (SDA)** form on-line through the **CHEM3103 lab website** within three (3) calendar days following the last day of absence (NOTE: SDA forms for **both** lab and lecture academic requirements will be **submitted via the lab website**).

Students can use the SDA form **twice** in this course. The submission of the SDA form **does not provide an automatic exemption** from any academic requirements that were missed or late during an absence. Once the form is submitted, course policies will apply regarding procedures for making up the missed academic requirement (see below).

- **Missed term test:** If you miss a term test for any reason, **no make-up will be offered**. Once the SDA form is submitted, the instructor will transfer the points from the missed term test to the final exam.
- **Missed laboratory session:** You are expected to attend the laboratory sessions scheduled for the lab section in which you are registered (see below). Students cannot attend a different laboratory session unless prior arrangements have been made with the instructor. After submittal of the SDA form for a short-term absence, it is at the discretion of the instructor as to whether or not the lab can be performed at another time. The **Laboratory Schedule** has space for the makeup of only one laboratory experiment.
- **Late submittal of a graded laboratory report sheet:** For each weekday after the posted due date, 10% will be deducted. A submitted SDA form will excuse one day late past the last day of short-term absence (unless alternate arrangements are made with the instructor).

If you miss the **final exam** for any other reason, as per Dalhousie policy, the SDA form does not apply. You must contact Dr. Turculet by email (laura.turculet@dal.ca) within 24 h of the missed exam for further instructions. Appropriate documentation (e.g., medical certificate indicating dates and duration of illness and a description of the impact it had on your ability to fulfill academic requirements) must be submitted to Dr. Turculet within three (3) calendar days of the missed final exam if you wish to write a make-up. If no appropriate notification and documentation for the absence is provided within the timeframe described above, no make-up will be allowed and you will earn a mark of "zero" for the missed exam component.

Please note that if you are more than 30 minutes late to write a test or exam, it will be considered a missed test/exam.

**Attending your lab section:** You are registered for one of the lab sections below. You must attend the lab section for which you have registered.

**Lab Sections:** **Section B01** - Wednesday, 1:35-5:25 pm, CHEM 118P (1<sup>st</sup> lab Sept 11)

**Section B03** - Friday, 1:35 - 5:25 pm, CHEM 118P (1<sup>st</sup> lab Sept 13)

**Registering for a different lab section:** Students can change laboratory sections online until 5pm, Friday September 6 (end of 1<sup>st</sup> week of classes).

**Attending a lab day other than the one you are registered for:** You are expected to attend the laboratory sessions scheduled for the lab section in which you are registered (see **Laboratory Schedule** below). Students cannot attend a different laboratory session unless prior arrangements have been made with the instructor. In case of illness or other circumstances that affect your ability to attend lab, please consult the **Short-term absence policy** (above), and submit a **Student Declaration of Absence (SDA)** form through the lab website within (3) calendar days following the last day of absence. It is at the discretion of the instructor as to whether or not the lab can be performed at another time. The **Laboratory Schedule** has space for the makeup of only one laboratory experiment.

**Personal protective equipment in the laboratory:** No student will be allowed to work in the lab without approved safety glasses, closed toe shoes, and a properly fitting cotton lab coat (sleeves cannot be rolled up). Lab coats and glasses can be purchased in the Dalhousie Bookstore.

**Lab preparation:** For safety reasons, students are expected to come to the lab having completed adequate preparation in advance according to the guidelines stated in the laboratory manual. For this reason students will write a quiz at the beginning of each lab session. The instructor reserves the right to ask any student to leave the laboratory if they are deemed unprepared to conduct the lab in a safe and efficient manner. No make-up session will be provided in these cases.

**End of each lab day:** All labs end strictly at the times posted above. Organized students have ample time to complete experiments and perform clean-up in the allotted time. Students will receive a 10% deduction per minute late leaving lab.

**Laboratory exemptions:** If you have taken this course before, you may apply for a lab exemption. To do so, contact Dr. Whalen by email prior to the first day of lab (Sept. 11). Dr. Whalen will then seek documentation within the department proving that you passed the lab component previously. Lab exemptions are at the discretion of the instructor and must be applied for. The student should not assume that such an exemption will be granted without applying.

**CHEM 3103 Course Content** (subject to modification)

Week	Date	Lecture	Topic/Chapter of textbook
1	Sept 4	1	Class syllabus and intro
	6	2	Transition Metal Coordination Chemistry - Ligands, Structures / Ch. 9, 6.6, 4
2	9	3	Transition Metal Coordination Chemistry - Ligands, Structures / Ch. 9, 6.6, 4
	11	4	Transition Metal Coordination Chemistry - Ligands, Structures / Ch. 9, 6.6, 4
	13	5	Characterization of TM Complexes - Vibrational Spectroscopy / Ch 4.4.2, 13.8.1
3	16	6	Characterization of TM Complexes - Vibrational Spectroscopy / Ch 4.4.2, 13.8.1
	18	7	Characterization of TM Complexes - Vibrational Spectroscopy / Ch 4.4.2, 13.8.1
	20	8	Coordination Chemistry - Bonding / Ch. 10
4	23	9	Coordination Chemistry - Bonding / Ch. 10
	25	10	Coordination Chemistry - Bonding / Ch. 10
	27	11	Coordination Chemistry - Bonding / Ch. 10
5	30	12	Coordination Chemistry - Bonding / Ch. 10
	Oct 2		<b>Term Test 1</b>
	4	13	Coordination Chemistry - Electronic Spectra / Ch. 11
6	7	14	Coordination Chemistry - Electronic Spectra / Ch. 11
	9	15	Coordination Chemistry - Electronic Spectra / Ch. 11
	11	16	Coordination Chemistry - Electronic Spectra / Ch. 11
7	14		<b>Thanksgiving</b>
	16	17	Coordination Chemistry - Electronic Spectra / Ch. 11
	18	18	Coordination Chemistry - Reactions & Mechanisms / Ch. 12
8	21	19	Coordination Chemistry - Reactions & Mechanisms / Ch. 12
	23		<b>Term Test 2</b>
	25	20	Coordination Chemistry - Reactions & Mechanisms / Ch. 12
9	28	21	Organometallic Chemistry - Ligand Classes & Bonding / Ch. 13
	30	22	Organometallic Chemistry - Ligand Classes & Bonding / Ch. 13
	Nov 1	23	Organometallic Chemistry - Ligand Classes & Bonding / Ch. 13
10	4	24	Organometallic Chemistry - Ligand Classes & Bonding / Ch. 13
	6	25	Organometallic Chemistry - Ligand Classes & Bonding / Ch. 13
	8	26	
11	11		<b>Remembrance Day</b>
	13		<b>Fall Study Break</b>
	15		<b>Fall Study Break</b>
12	18	27	Organometallic Chemistry - Ligand Classes & Bonding / Ch. 13
	20		<b>Term Test 3</b>
	22	28	Organometallic Reactions / Ch 14
13	25	29	Organometallic Reactions / Ch 14
	27	30	Organometallic Chemistry - Catalysis / Ch 14
	29	31	Organometallic Chemistry - Catalysis / Ch 14
14	Dec 2	32	Organometallic Chemistry - Catalysis / Ch 14
	3	33	MONDAY SCHEDULE Last class - Q&A

**CHEM 3103 Laboratory Schedule** (subject to modification)

<b>Lab Report Sheets Due Dates</b>	
See below (must be handed in during your normal laboratory period)	
<b>Lab Make Ups</b>	
The schedule allows for only one laboratory make up per section. See below.	
Week 1 (Sept. 4-6)	<ul style="list-style-type: none"> <li>No labs</li> </ul>
Week 2 (Sept. 11, 13)	<ul style="list-style-type: none"> <li>Locker Check-in and safety maps.</li> <li><b>Experiment 1:</b> Synthesis and Characterization of Geometric Isomers of <math>[\text{Mo}(\text{CO})_4(\text{L})_2]</math></li> </ul>
Week 3 (Sept. 18, 20)	<ul style="list-style-type: none"> <li><b>Experiment 1:</b> continued</li> </ul>
Week 4 (Sept. 25, 27)	<ul style="list-style-type: none"> <li><b>Experiment 2:</b> Complexes of <math>\pi</math>-Bonding Ligands</li> <li>Pass in Experiment 1 Report Sheets in lab</li> </ul>
Week 5 (Oct. 2, 4)	<ul style="list-style-type: none"> <li><b>Experiment 3:</b> A Complex Containing a Cr-Cr Quadruple Bond</li> <li>Pass in Experiment 2 Report Sheets</li> </ul>
Week 6 (Oct. 9-11)	<ul style="list-style-type: none"> <li><b>Experiment 4:</b> Visible Spectra of Octahedral Cr(III) Complexes</li> <li>Pass in Experiment 3 Report Sheets in lab</li> </ul>
Week 7 (Oct. 16, 18)	<ul style="list-style-type: none"> <li><b>Experiment 4:</b> continued</li> <li>NMR processing tutorial in CHEM 122 (4:30 – 5:30)</li> </ul>
Week 8 (Oct. 23, 25)	<ul style="list-style-type: none"> <li><b>Experiment 5:</b> Geometric Variability of Four-Coordinate Ni(II) Complexes</li> <li>Pass in Experiment 4 Report Sheets in lab</li> <li>Introduce presentation topics to the groups</li> <li>NMR (4:30 – 5:30)</li> </ul>
Week 9 (Oct. 30, Nov 1)	<ul style="list-style-type: none"> <li><b>Experiment 5:</b> continued (magnetic susceptibility, UV/vis)</li> <li>NMR if needed (4:30 – 5:30)</li> </ul>
Week 10 (Nov. 6, 8)	<ul style="list-style-type: none"> <li><b>Experiment 6:</b> Synthesis and Spectroscopic Characterization of Some Complexes of Ruthenium</li> <li>1<sup>st</sup> Draft Experiment 5 group presentations due</li> <li>NMR (4:30 – 5:30)</li> </ul>
Week 11 (Nov. 13, 15)	<ul style="list-style-type: none"> <li>No labs (week of study break)</li> </ul>
Week 12 (Nov. 20, 22)	<ul style="list-style-type: none"> <li><b>Experiment 5 Group Presentations</b></li> <li>Pass in Experiment 6 Report Sheets</li> <li>Locker Check-out.</li> </ul>
Week 13 (Nov. 27, 29)	<ul style="list-style-type: none"> <li>Lab Make Up</li> <li>Pass in Experiment 5 Report Sheets</li> </ul>

## University Policies and Statements

**This course is governed by the academic rules and regulations set forth in the University Calendar and by Senate**

### **Academic Integrity**

At Dalhousie University, we are guided in all of our work by the values of academic integrity: honesty, trust, fairness, responsibility and respect (The Center for Academic Integrity, Duke University, 1999). As a student, you are required to demonstrate these values in all of the work you do. The University provides policies and procedures that every member of the university community is required to follow to ensure academic integrity.

**Information:** [https://www.dal.ca/dept/university\\_secretariat/academic-integrity.html](https://www.dal.ca/dept/university_secretariat/academic-integrity.html)

### **Accessibility**

The Advising and Access Services Centre is Dalhousie's centre of expertise for student accessibility and accommodation. The advising team works with students who request accommodation as a result of a disability, religious obligation, or any barrier related to any other characteristic protected under Human Rights legislation (Canada and Nova Scotia).

**Information:** [https://www.dal.ca/campus\\_life/academic-support/accessibility.html](https://www.dal.ca/campus_life/academic-support/accessibility.html)

### **Student Code of Conduct**

Everyone at Dalhousie is expected to treat others with dignity and respect. The Code of Student Conduct allows Dalhousie to take disciplinary action if students don't follow this community expectation. When appropriate, violations of the code can be resolved in a reasonable and informal manner—perhaps through a restorative justice process. If an informal resolution can't be reached, or would be inappropriate, procedures exist for formal dispute resolution.

**Code:** [https://www.dal.ca/dept/university\\_secretariat/policies/student-life/code-of-student-conduct.html](https://www.dal.ca/dept/university_secretariat/policies/student-life/code-of-student-conduct.html)

### **Diversity and Inclusion – Culture of Respect**

Every person at Dalhousie has a right to be respected and safe. We believe inclusiveness is fundamental to education. We stand for equality. Dalhousie is strengthened in our diversity. We are a respectful and inclusive community. We are committed to being a place where everyone feels welcome and supported, which is why our Strategic Direction prioritizes fostering a culture of diversity and inclusiveness

**Statement:** <http://www.dal.ca/cultureofrespect.html>

### **Recognition of Mi'kmaq Territory**

Dalhousie University would like to acknowledge that the University is on Traditional Mi'kmaq Territory. The Elders in Residence program provides students with access to First Nations elders for guidance, counsel and support. Visit or e-mail the Indigenous Student Centre (1321 Edward St) ([elders@dal.ca](mailto:elders@dal.ca)).

**Information:** [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

**Important Dates** in the Academic Year (including add/drop dates)

[https://www.dal.ca/academics/important\\_dates.html](https://www.dal.ca/academics/important_dates.html)

### **University Grading Practices**

[https://www.dal.ca/dept/university\\_secretariat/policies/academic/grading-practices-policy.html](https://www.dal.ca/dept/university_secretariat/policies/academic/grading-practices-policy.html)

## Student Resources and Support

### Advising

**General Advising:** [https://www.dal.ca/campus\\_life/academic-support/advising.html](https://www.dal.ca/campus_life/academic-support/advising.html)

**Science Program Advisors:** <https://www.dal.ca/faculty/science/current-students/academic-advising.html>

**Indigenous Student Centre:** [https://www.dal.ca/campus\\_life/communities/indigenous.html](https://www.dal.ca/campus_life/communities/indigenous.html)

**Black Advising Centre:** [https://www.dal.ca/campus\\_life/communities/black-student-advising.html](https://www.dal.ca/campus_life/communities/black-student-advising.html)

**International Centre:** [https://www.dal.ca/campus\\_life/international-centre/current-students.html](https://www.dal.ca/campus_life/international-centre/current-students.html)

### Academic supports

**Library:** <https://libraries.dal.ca/>

**Writing Centre:** [https://www.dal.ca/campus\\_life/academic-support/writing-and-study-skills.html](https://www.dal.ca/campus_life/academic-support/writing-and-study-skills.html)

**Studying for Success:** [https://www.dal.ca/campus\\_life/academic-support/study-skills-and-tutoring.html](https://www.dal.ca/campus_life/academic-support/study-skills-and-tutoring.html)

**Copyright Office:** <https://libraries.dal.ca/services/copyright-office.html>

**Fair Dealing Guidelines:** <https://libraries.dal.ca/services/copyright-office/fair-dealing.html>

### Other supports and services

**Student Health & Wellness Centre:** [https://www.dal.ca/campus\\_life/health-and-wellness/services-support/student-health-and-wellness.html](https://www.dal.ca/campus_life/health-and-wellness/services-support/student-health-and-wellness.html)

**Student Advocacy:** <https://dsu.ca/dsas>

**Ombudsperson:** [https://www.dal.ca/campus\\_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html](https://www.dal.ca/campus_life/safety-respect/student-rights-and-responsibilities/where-to-get-help/ombudsperson.html)

### Safety

**Research Lab Safety:** [https://www.dal.ca/content/dam/dalhousie/pdf/dept/safety/lab\\_policy\\_manual\\_2007.pdf](https://www.dal.ca/content/dam/dalhousie/pdf/dept/safety/lab_policy_manual_2007.pdf)

**Biosafety:** <https://www.dal.ca/dept/safety/programs-services/biosafety.html>

**Chemical Safety:** <https://www.dal.ca/dept/safety/programs-services/chemical-safety.html>

**Radiation Safety:** <https://www.dal.ca/dept/safety/programs-services/radiation-safety.html>

**Scent-Free Program:** <https://www.dal.ca/dept/safety/programs-services/occupational-safety/scent-free.html>