CHEM 4725/8725
Organometallic Chemistry

Spring 2016

Lecture Time and Location:
11:15 am - 12:30 pm Tuesdays and Thursdays
111 Smith Hall

Instructor: Prof. Ian A. Tonks
568A Kolthoff Hall
Phone: 612.624.4705
itonks@umn.edu
Office Hour: 5-6pm Mon

Teaching Assistant: Adam Pearce
664 Kolthoff Hall
pearc131@umn.edu
Office Hour:

Website: On Moodle

Prerequisites:
A basic background in organic chemistry and inorganic chemistry is required (for example, CHEM 2301-02 and CHEM 4701). Some background in physical organic chemistry or kinetics is helpful, but not required.

Recommended Text:

Note: Two copies of this text are available as desk copies in IAT's office. This book is an excellent and thorough resource on organometallics.

Course Objectives:

- Understand the basic principles that govern the electronics, structure and bonding in inorganic and organometallic complexes.
- Explore the fundamental and experimental aspects of elementary organometallic transformations.
- Apply elementary organometallic reactions in the context of catalysis and new reactivity.
- Use this background to predict the reactivity pattern of organometallic complexes.
- Have a background to apply organometallics to other fields: organic synthesis, polymerization, bioinorganic chemistry, etc.
Grading:

Homework: 100 points
Midterm: 100 points
Review Paper: 100 points
Final Exam: 200 points

Total: 500 points

Homework: During the first three weeks of class, homework will be assigned weekly, and afterward will be assigned every 2 weeks; they will be due before the start of class on the assigned day. A full list of assigned dates and due dates are posted in the course outline. Solutions for problem sets will be posted online by the following class session. At the end of the semester, all homework assignments will be averaged and assigned a percentage of 100 points. For example, if your average on problem sets was 91%, you would receive 91% of 100 or 91 points.

Collaboration is permitted on homework assignments, but each collaborator is expected to work all problems and turn in individual answers.

Midterm: There will be one midterm held during class time. The exam will cover reading assignments, lecture topics, and problem sets. The date for the exam is listed in the course outline.

CHEM 8725: Graduate students enrolled in the class will be required to write a short perspective/review article on a topic of modern organometallic chemistry. The rubric for this article will be made available shortly after the midterm exam.

Final Exam: The final exam will be a comprehensive examination. Expect to need to fill out an empty transition metal series!

Late Policy:

Late assignments up to 1 day late will be assessed a 50% penalty; up to 2 days 75%; and more than 2 days will receive no credit.

Missed Exams:

You may be excused from taking an exam due to jury duty, subpoenas, military service, religious holidays, and participation in school sports events only if the instructor is notified two weeks in advance, and the required documentation is provided.

You may also be excused in case of illness (as verified by a doctor's note) or death in the immediate family (be prepared to verify) if the instructor is notified within 24 hours after the exam.
If a midterm exam is missed and supporting documentation is provided, the missed exam score will be replaced by a scaled score of the final exam. No make-up exams will be given. An unexcused absence from the midterm or final will result in a score of zero for that exam.

**Students with Disabilities:**

Students with disabilities that could affect their ability to meet course requirements should discuss with the Office of Disability Services. If special accommodations are needed (for example, extended exam times), the student is responsible for making these arrangements through the ODS in advance.

**Course Videotaping:**

As part of an ongoing research project on teaching methods sponsored through the Cottrell Scholars Collaborative, lectures may be periodically videotaped. Student privacy will be maintained. Students uncomfortable with being videotaped can opt out by talking with Prof. Tonks.
**Course Outline:**

This course outline is a rough sketch of the material to be covered in class. The final material will be determined by time, class discussion and evaluation of the class’ progress.

<table>
<thead>
<tr>
<th>Week Of...</th>
<th>Topics to be Covered</th>
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<tbody>
<tr>
<td>January 19</td>
<td>Introduction, Lewis Dot Structures, Properties of the Transition Elements, a Brief History of Organometallics</td>
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<tr>
<td>Tuesday Jan 19</td>
<td>Problem Set 1 Assigned</td>
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<td>January 26</td>
<td>Electron Counting Formalisms, Structure and Bonding in Organometallic Complexes</td>
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<tr>
<td>Tuesday Jan 26</td>
<td>Problem Set 1 Due</td>
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<td>Problem Set 2 Assigned</td>
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<td>February 2</td>
<td>Structure and Bonding in Organometallic Complexes, CO Complexes of Transition Metals</td>
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<td>Tuesday Feb 2</td>
<td>Problem Set 2 Due</td>
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<td>Problem Set 3 Assigned</td>
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<td>February 9</td>
<td>Overview of Elementary Organometallic Transformations, Ligand Substitution Reactions</td>
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<td>Tuesday Feb 9</td>
<td>Problem Set 3 Due</td>
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<td>Problem Set 4 Assigned</td>
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<td>February 16</td>
<td>Polar Oxidative Addition Reactions, Regular Oxidative Addition Reactions</td>
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<td>February 23</td>
<td>Reductive Elimination Reactions, Sigma Complexes and Sigma Bond Metathesis, Migratory Insertion Reactions</td>
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<tr>
<td>Tuesday Feb 23</td>
<td>Problem Set 4 Due</td>
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<td>Problem Set 5 Assigned</td>
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<td>March 1</td>
<td>Migratory Insertion Cont’d, Elimination Reactions</td>
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<td>Tuesday Mar 1</td>
<td><strong>Midterm Exam</strong></td>
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<td>March 8</td>
<td>Nucleophilic Attack on Ligands, Fundamentals of Catalysis</td>
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<td>Tuesday Mar 8</td>
<td>Problem Set 5 Due</td>
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<td>Problem Set 6 Assigned</td>
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<td>March 15</td>
<td><strong>Spring Break</strong></td>
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March 22  Reactions of Olefins – Hydrogenation and Hydroformylation Catalysis
March 29  Metallocene Chemistry, Olefin Polymerization Catalysis
          Tuesday Mar 29  Problem Set 6 Due
          Problem Set 7 Assigned
April 5    Carbenes and Olefin Metathesis
April 12   Olefin Oxidation and the Wacker Process
          Tuesday Apr 12  Problem Set 7 Due
          Problem Set 8 Assigned
April 19   C-H Activation, Thanksgiving
April 26   Basics of Cross Coupling Chemistry
          Tuesday Apr 26  Problem Set 8 Due
May 3      Main Group Organometallics
          Thursday May 5  Review Paper Due
May 10     Final Exam: Tuesday May 10th 8:00 am – 10:00 am