Syllabus: Chemistry 16:160:575:01 and 475:01
Prof. Alan Goldman
Spring 2015
180 Rieman Labs 848-445-5232
Office Hrs: Tu, Th. 10:30 -12:00
(and/or by appt.)
Monday, Wednesday 3:20 - 4:40 pm WL-260
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Organometallic Chemistry: a survey of organotransition-metal and related chemistry with an emphasis on structure, reactivity, mechanisms and relevance to catalysis.

Required Text:
Crabtree, Robert H., The Organometallic Chemistry of the Transition Metals; John Wiley & Sons, (6th Ed.; earlier editions have generally same material, but different page numbers)

Suggested additional reading:
For more depth: Hartwig, Organotransition Metal Chemistry; University Science Books:
For background: Yamamoto, Akio; Organotransition Metal Chem; Wiley Interscience (esp. pp 1-40) or most advanced undergraduate inorganic textbook (e.g. Shriver Atkins)

The course will be organized to follow (approximately) along the lines of the text by Crabtree. After each chapter is covered in class, you are expected to read the following chapter before the corresponding class.

Tests: TENTATIVE Date Aprox. % of final grade
Quiz #1 ("electron-counting") Wednesday, Feb. 11 10
Mid-term Wednesday, March 25 35
Quiz #2 ?????
Final Wed,. May 13, 12:00-3:00 PM 55

Attendance is required.
Participation in class will affect your grade (only upwards!)

Homework may be assigned and collected. For your own benefit you are encouraged to do problems such as those found at the end of Crabtree's chapters.

Tests are based on lectures and handouts (not text reading, which is intended to supplement the lectures).

You are responsible for reading the corresponding chapter in “Crabtree” before each class meeting.
**Tentative Course Outline - Chemistry 475/575**
(Each “lecture” may require more or less than one class meeting.)

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<th>Lecture</th>
<th>Chapter in Crabtree Text*</th>
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<td>Fundamentals of Coordination Chemistry, 18-electron rule</td>
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<td>3,4</td>
<td>Metal Alkyls and Metal Hydrides</td>
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<td>5</td>
<td>Bond Dissociation Enthalpies</td>
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<td>6</td>
<td>Metal Carbonyls, Cyanides, Nitrosoyls, etc.</td>
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<td>7</td>
<td>Phosphine Complexes and Substitution</td>
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<td>8</td>
<td>Metal Olefin Complexes</td>
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<td>Homogeneous Catalysis - Hydrogenation</td>
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<td>14,15</td>
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<td>16,17</td>
<td>Metal Carbenes; Polymerization</td>
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<td>18-20</td>
<td>Spectroscopy and Characterization</td>
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<td>21,22</td>
<td>Activation of Small Molecules - Alkanes, CO, CO₂, N₂</td>
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Note: Some “Lectures” may require more than one class-meeting; hence 22 lectures but 28 class meetings.

*Additional readings will be assigned occasionally.

**Also Yamamoto text (on reserve in Chem Library) pp 1-41

**Homework:** (not to be collected; answers in back of book)

1. 1-3, 6-10
2. 1*, 2, 4, 6*, 7, 8*, 9, 10, 11*
   * problem relevant to quiz
3. All. (What is wrong with the answer to 8a? How might it be corrected?)
4. 1-4, 7-12, 13-note that [Ir(CO)₆]³⁺ was reported after book went to press, 14
5. 2-6, 10 (note: answer is incomplete; what is missing?)
6. 1, 2 (answer is completely inadequate; determine the right answer), 4, 7-10, 12
7. 1-4, 6,7,9,10
8. 2, 4-10
9. 2-8,10
10. 1,2,4-10 (10 is particularly tricky)
Syllabus - Chemistry 475/575 (Lectures 1-5)
(Each “lecture” may require more or less than one class meeting.)

Lecture Chapter in Crabtree Text*

1,2 Fundamentals of Coordination Chemistry, 18-electron rule

What is organometallic - and why does organometallic chemistry have its own “principles and practice”? Coordination number, oxidation state. Crystal Field Theory. "Organometallic" ligands are typically high-field. MO Theory.

π-back-bonding. Valence Bond Theory. 18-electron rule: MO diagrams - octahedral complexes - π-bonding. e-counting with metal carbonyls. 16-electron square planar. Other ligands, electron-counting, exceptions to the rule. Isolobal analogy.

3 Metal Alkyls


4 Metal Hydrides


5 Bond Dissociation Enthalpies

Significance; kinetic methods, Halpern equilib. method, typical equilib. methods, Bryndza-Bercaw (BB) relationship: implications, rationale (electronegativity theory), expected departures from BB; predictive power, M-L BDE’s

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