Course Outline: Chem 521 Organometallics

Course Description: Introduces the chemistry of carbon to transition-metal bonds beginning with rules governing structure and stability; effects of metal and ancillary ligand environment; general mechanistic steps; NMR and IR spectroscopy; fluxional processes. Followed by applications in homogeneous catalysis and stoichiometric organic synthesis. *Prerequisites: Chem 202L and 404.*

Learning Outcomes

- Examine 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
- Demonstrate and predict the reactivity pattern of organometallic complexes
- Have a background to apply organometallics to other fields: organic synthesis, polymerization, bioinorganic chemistry, etc.

Text: Reader will be based on materials from current journals and selected texts, including:

- Modern Organic Synthesis, G. Zweifel and M. Nantz, *Freeman*, 2007.
- Organic Synthesis, M. B. Smith, *Academic Press*, 2011.
- The Art of Writing Reasonable Organic Reaction Mechanisms, R. B. Grossman, *Springer*, 2003.

Other useful references:

- The Logic of Chemical Synthesis, E. J. Corey, X.-M. Cheng, *VCH*, 1995.
- The Organometallic Chemistry of the Transition Metals, R. H. Crabtree, *Wiley*, 2009.
- Transition Metals in the Synthesis of Complex Organic Molecules, L. S. Hegedus and B. C. G. Soderberg, *University Science Books*, 2009.

Attendance: Attendance is mandatory and essential to do well in the class.

Homework: Seven comprehensive problem sets will be given throughout the semester. The problem sets will emphasize the topics covered during the lecture.

Examination: Two mid-term examinations and one final exam will be given.

Quizzes: Four quizzes are anticipated for the semester. The 10-minute quizzes will be based on readings and class notes since the last quiz. Goals in this course include the ability to discuss important aspects of retrosynthesis and synthetic methods.

Grading: The course will be graded based on the following criteria:

Problem Sets:	140	(7 problem sets @ 20 points each)
Quizzes:	100	(4 quizzes @ 25 points each)
Paper	50	
Participation:	30	
Midterm Examinations:	200	(2 exams @ 100 points each)
Final Examination:	200	
Total Possible Points	720	

Topics

Week 1	Introduction in bonding and molecular orbitals
Week 2	Metal-ligand interactions; Basic principles of ligand-field theory; MO theory
Week 3	Metal-centered organometallic reactions
Week 4	Alkene pi complexes, Oxidative additions, reductive eliminations
Week 5-6	Palladium catalyzed cross coupling reactions
Week 7	Heck Reactions
Week 8-9	CO insertion chemistry
Week 10	Alkene and Alkyne insertion chemistry
Week 11	Carbene & carbenoid complexes
Week 12	Cobalt chemistry
Week 13	Metathesis
Week 14-15	Synthetic Analysis and Strategies, Synthetic Efficiency, Total Synthesis

Written term paper. A 10 page paper (1.5 – double spaced, 12 pt. font, ¾" – 1" margins) is due at the end of the semester. The paper should be written as a review of the synthetic steps and methods in a classical example in total synthesis. Emphasis will be on illustrating and describing chemical transformations. The report will be fully references and references should be in the same format as the *Journal of the American Chemical Society*.