Course Syllabus – CHEM 530

Course Information

Course Number: CHEM 530 SP21
Course Name: Organometallic Chemistry
Term: SP 2021
Start Date: 04/06/2021
End Date: 06/25/2021
Credits: 3.0

Meeting Days / Times

Tuesdays and Thursdays, 8:30-10:00am PST / 11:30am-1:00pm EST
(See Calendar in Canvas for the most up-to-date schedule.)

Location

Online via Zoom

Course Managers

Role	Last Name	First Name	Email Address
Instructor	Engle	Keary	keary@scripps.edu
TA	Jankins	Tanner	jankinst@scripps.edu
TA	Tran	Van	tranvan@scripps.edu

Course Description

The goal of this course is to introduce you to the unique properties of transition metals as prolific manipulators of organic molecules (i.e. catalysts for diverse bond-making and bond-breaking processes). We will begin by learning about the nature of the bonds between transition metals and organic ligands and the effects this bonding has on the metal and on the ligand. We will then survey fundamental transformations mediated by metals and will examine their applications to the construction of complex organic molecules and in industrial syntheses of commodity chemicals.

Program Learning Outcomes

By the end of the program, students will have accomplished these objectives:
PLO1: Original Research – graduate students are expected to develop the skills critical for generating high-quality research output. This would include absorbing, recalling, and contextualizing scientific knowledge, evaluating scientific information and data, creating

testable hypotheses and investigating hypotheses, mastering scientific tools and techniques, displaying ethical behavior, and receiving and giving feedback.
PLO2: Communication – graduate students are expected to demonstrate the oral, written, and media skills to effectively communicate the impact of a study or a body of work to the greater scientific community and to the public at large using a number of methods.
PLO3: Critical Thinking – graduate students are expected to develop a self-directed process to analyze information, form opinions or judgments, and use this process to improve the quality of their scientific thoughts, navigate problems, and make informed decisions.
PLO4: Intellectual Curiosity – graduate students are expected to acquire the capacity to build their intellectual curiosity and demonstrate problem solving approaches that serve their professional growth and ability to impact a field.
PLO5: Career and Professional Development – graduate students are expected to develop a variety of transferable skillsets throughout their graduate experience, including management and leadership, inclusiveness, resilience, scientific rigor, collaboration, accountability, time management, teamwork, networking, and career planning.

Course Learning Outcomes

Upon completion of this course students will be able to:
CLO1: Students will have an advanced understanding of the bonding, applications and reactivity of organometallic compounds, specifically within the lens of modern organic synthesis.
CLO2: Students will be able to confidently propose novel uses of transition metals for both methodological and synthetic pursuits.
CLO3: Students will understand the reliance on transition metals in industrial and fine chemical endeavors.

Background Preparation (Prerequisites)

N/A

Course Materials

Required: Hartwig, John (2009). Organotransition Metal Chemistry: From Bonding to Catalysis. ISBN: 978-1891389535.
Useful to Consult: Crabtree, Robert H. (2014). The Organometallic Chemistry of the Transition Metals (6th Edition). ISBN: 978-1118138076. Available online: https://onlinelibrary.wiley.com/doi/book/10.1002/9781118788301.
Useful to Consult: Collman, James P., et al. (1987). Principles and Applications of Organotransition Metal Chemistry.
Useful to Consult: Hegedus, Louis S.; Soderberg, Bjorn G.C. (2010). Transition Metals in the Synthesis of Complex Organic Molecules.

Instructor Policies

There will be 20 lectures, a midterm, and a final exam. After learning the basics, we will begin class sessions with a brief review (7-10 minutes) of the reactivity and practical applications of a useful organometallic reagent (we will give you copies of the original papers). Please do not be shy and feel free to suggest reagents and/or reactions about which you want to learn.

Much of the basic material can be found in the Crabtree and Hegedus books. The Collman book is also useful, so we recommend that you at least get familiar with it.

Attendance Statement

Students are expected to attend all classes. Students who are unable to attend class must seek permission for an excused absence from the course director or teaching assistant. Unapproved absences or late attendance for three or more classes may result in a lower grade or an "incomplete" for the course. If a student has to miss a class, he or she should arrange to get notes from a fellow student and is strongly encouraged to meet with the teaching assistant to obtain the missed material. Missed extra-credit quizzes will not be available for re-taking.

Scientific and Professional Ethics

The work you do in this course must be your own. Feel free to build on, react to, criticize, and analyze the ideas of others but, when you do, make it known whose ideas you are working with. You must explicitly acknowledge when your work builds on someone else's ideas, including ideas of classmates, professors, and authors you read. If you ever have questions about drawing the line between others' work and your own, ask the course professor who will give you clear guidance. Exams must be completed independently. Any collaboration on answers to exams, unless expressly permitted, may result in an automatic failing grade and possible expulsion from the Graduate Program.

Technology Requirements and Support

For issues related to Canvas, please contact the Graduate Office by email at: gradprgm@scripps.edu or by phone at: 858-784-8469.

Course Grading

Grading is in accordance with the academic policies of the Skaggs Graduate School. The breakdown of grading is as follows:

- Homework: 10%
- Wikipedia Project: 15%
- Midterm Exam: 30%
- Final Exam: 40%

- Participation: 5%

Letter Grade	Percent	GPA	Description
A	93-100	4.00	Outstanding achievement. Student performance demonstrates full command of the course subject matter and evinces a high level of originality and/or creativity that far surpasses course expectations.
A-	90-92	3.67	Excellent achievement. Student performance demonstrates thorough knowledge of the course subject matter and exceeds course expectations by completing all requirements in a superior manner.
B+	87-89	3.33	Very good work. Student performance demonstrates above-average comprehension of the course subject matter and exceeds course expectations on all tasks as defined in the course syllabus. There is notable insight and originality.
B	83-86	3.00	Satisfactory work. Student performance meets designated course expectations and demonstrates understanding of the course subject matter at an acceptable level.
B-	80-82	2.67	Marginal work. Student performance demonstrates incomplete understanding of course subject matter. There is limited perception and originality.
C+	77-79	2.33	Unsatisfactory work. Student performance demonstrates incomplete and inadequate understanding of course subject matter. There is severely limited or no perception or originality. Course will not count toward degree.
C	73-76	2.00	Unsatisfactory work. Student performance demonstrates incomplete and inadequate understanding of course subject matter. There is severely limited or no perception or originality. Course will not count toward degree.
P	73-100	0.00	Satisfactory work. Student performance demonstrated complete and adequate understanding of course subject matter. Course will count toward degree.
F	0-72	0.00	Unacceptable work/Failure. Student performance is unacceptably low level of knowledge and understanding of course subject matter. Course will not count toward degree. Student may continue in program only with permission of the Dean.
I		0.00	Incomplete is assigned when work is of passing quality but is incomplete for a pre-approved reason. Once an incomplete grade is assigned, it remains on student's permanent record until a grade is awarded.
W		0.00	Withdrew from the course with Dean's permission beyond the second week of the term.

- All courses will be recorded and maintained in the student's permanent academic record; only courses that apply towards the degree will appear on the academic transcript. Non-credit or audited courses will not appear on the transcript.
- 4 core courses taken for a letter grade (pass = B- or higher for a core course)
- 2 elective courses taken pass/fail (pass = A, B, C for an elective)

Course Schedule:

Date	Details
Tue Apr 6, 2021	Strong Inference and Main Group Organometallics
Thu Apr 8, 2021	Organotransition Metal Complexes: History, Structure, and Bonding I
Tue Apr 13, 2021	Organotransition Metal Complexes: History, Structure, and Bonding II
Thu Apr 15, 2021	Elementary Reactions I
Tue Apr 20, 2021	Elementary Reactions II
Thu Apr 22, 2021	Elementary Reactions III
Tue Apr 27, 2021	Carbenes and Other M-C and M-X Multiple Bonds
Thu Apr 29, 2021	Principles of Catalysis and Ancillary Ligand Design
Tue May 4, 2021	Catalytic Cycloadditions (V. Schmidt, UCSD)
Thu May 6, 2021	Catalytic Hydrogenation
Tue May 11, 2021	Catalytic Carbonylation
Thu May 13, 2021	Assignment Midterm Exam
Tue May 18, 2021	Wacker- and Heck-Type Nucleopalladation
Thu May 20, 2021	Allylic Substitution Chemistry
Tue May 25, 2021	Olefin Metathesis
Thu May 27, 2021	Catalytic Cross-Coupling
Tue Jun 1, 2021	Interfacing Radicals and Cross-Coupling (T. Diao, NYU)
Thu Jun 3, 2021	C-H Activation
Tue Jun 8, 2021	Application, Mechanism, and Catalyst Activation in the Real World (M. Eastgate, BMS)
Thu Jun 10, 2021	Natural and Artificial Metalloenzymes (H. Renata, Scripps Florida)
Tue Jun 15, 2021	Assignment Wikipedia Project
Thu Jun 17, 2021	Photoredox Catalysis in Process Chemistry (D. Schultz, Merck)

Tue Jun 22, 2021	**Frontiers in s- and p-Block Chemistry (R. Gilliard, UVA)**