CHEM 334 – Spring 2024
Organometallic Chemistry

Instructor: Professor Patrick Melvin (prmelvin@brynmawr.edu)
Room: Park 278
Time: TTH, 9:55 – 11:15 PM
Office Hours: Wednesday 2 – 3PM, or by appointment
Textbook: "Organometallic Chemistry, 3rd Edition" – Gary Spessard & Gary Miessler
Optional Additional Texts:
"The Organometallic Chemistry of the Transition Metals, 4th Edition" – Robert Crabtree
"Organotransition Metal Chemistry – From Bonding to Catalysis" – John Hartwig

Course Description:

Organometallic chemistry, at the interface between organic and inorganic, has revolutionized how chemists approach synthetic transformations today. Unlike with CHEM 211 / 212, much of the chemistry we will discuss this semester is relatively recent and important discoveries continue to be made in this field using the fundamentals we will learn in class. In this way, we will spend a good portion of the class studying special topics followed by further exploration of the current literature with written and oral presentations to conclude the class.

Commitment to an Inclusive Learning Environment:

As with all of my courses, I will strive to build this course on inclusive, anti-racist principles. For me, this simplifies to two guiding statements:

Each and every one of you ***BELONGS*** in this course and

Each and every one of you can ***SUCCEED*** in this course

Course Structure and Expectations:

This class will be divided into roughly 3 parts. The first few weeks will introduce the fundamentals of organometallic chemistry, from electron counting, types of ligands and mechanistic steps that are the most common in metal-centered chemistry. The middle of the class will be dedicated to studying specific transformations enabled by these fundamental organometallic mechanisms, such as cross-coupling and C-H activation. The last few weeks are reserved for student presentations which will expand into more current literature.

As an upper-level course with a small number of students, I will strive to make this course equal portions discussion / problem-solving as it is lecture. This course will be infinitely more effective, engaging and (hopefully!) fun if you bring your own background, ideas and passions to our daily discussions. My aim is to have each class be a mixture of lecture and organized problem solving, although that will fluctuate depending on the topic.

Learning Goals:

- Build the foundations of organometallic principles, including fundamental mechanisms and spectroscopic techniques
- Predict reaction pathways based on experimental data provided
- Critically analyze mechanisms proposed in the current scientific literature and determine whether these agree with the data collected
- Explore several critical synthetic areas that organometallic chemistry has impacted
- Become comfortable critiquing and discussing organometallic literature

General Course Outline (*subject to change*):

Date (Lecture #)	***Lecture Topic***
	Week 1
Jan. 23 (1)	Syllabus, Intro to Organometallic Chemistry
Jan. 25 (2)	Ligand Types, Electron Counting
	Week 2
Jan. 30 (3)	Electron Counting
Feb. 1 (4)	Crystal Field Theory
	Week 3
Feb. 6 (5)	Ligand Field Theory, Analytical Techniques
Feb. 8 (6)	Finish Analytical Techniques, Ligand Substitution
	Week 4
Feb. 13 (7)	Ligand Substitution
Feb. 15 (8)	Oxidative Addition
	Week 5
Feb. 20 (9)	Finish OA, Reductive Elimination
Feb. 22 (10)	Finish RE, Migratory Insertion
	Week 6
Feb. 27 (11)	Finish Insertion, β-elimination, Transmetalation
Feb. 29 (12)	Begin Cross-Coupling
	Week 7
Mar. 5 (13)	Cross-Coupling Continued
Mar. 7	***Exam 1***
Mar. 8	*Week 8*
Mar. 12	***Spring Break***
Mar. 14	
	Week 9
Mar. 19 (14)	Start C – H Activation
Mar. 21 (15)	C – H Activation Continued
	Week 10
Mar. 26	No Class – ACS Meeting
Mar. 28 (16)	Finish C – H Activation, Concerted Metalation Deprotonation
	Week 11
Apr. 2 (17)	Olefin Polymerization
Apr. 4 (18)	Olefin Polymerization

	Week 12
Apr. 9 (19)	Allylic Substitution
Apr. 11 (20)	Hydroformylation
	Week 13
Apr. 16	**Exam 2**
Apr. 18 (21)	Example Presentation
	Week 14
Apr. 23	Student Presentations
Apr. 25	Student Presentations
	Week 15
Apr. 30	Student Presentations
May 2	Student Presentations

Attendance & Participation:

As this course will rely as much on your participation and input as my lecturing, attendance and engagement in discussions is incredibly important – particularly during problem-solving sessions. Participation will not be a factor in your final grade (see below) but I do think it will add to your overall experience with the course if you remain engaged!

Assessment:

Problem Sets:	*20%*
Two (2) Midterms:	*40%*
Seminar / Reflection:	*10%*
Literature Paper:	*20%*
Literature Presentation:	10%

Problem Sets:

Three (3) problem sets will be assigned throughout the semester, each due in the weeks indicated below. More concrete deadlines will be given when the problem sets are posted. These will be designed to cover question types that are not easily assessed during in-class examinations. You may work together on these problem sets, but *all of your answers must be written independently and in your own words*. In general, I always strive to be flexible with due dates, but you must contact me at least 24 hours before the problem set is due to ask for an extension.

Tentative due dates: February 8, February 29 & April 4

In-class Exams:

We will have two (2) in-person exams, at the conclusion of the first two sections of the course.

Tentative exam dates: Thursday, March 7th & Thursday, April 16th

Seminar Attendance / Reflection:

As students in an upper-level chemistry course, it is important to listen to researchers at the forefront of their fields presenting cutting edge science. You will be required to attend **TWO** seminars throughout the semester and will submit a 1-page reflection on the topic presented. You have a variety of seminar options

to choose from, including (but not limited to!) those presented at Bryn Mawr, Haverford, Swarthmore and the Philadelphia Organic Chemists Club (POCC) at UPenn. If you are curious about whether a seminar would count towards this, please just ask beforehand to confirm. I will be sharing information about upcoming seminars throughout the semester.

Literature Paper / NSF Proposal:

Towards the middle of the semester, a list of current organometallics-related topics will be given and each of you will choose a topic to research. You will then do a deep dive into the primary literature of this area to gather information on the last 15 years of this topic. Your written report will be presented in the style of a National Science Foundation (NSF) research proposal. This will include two portions: a) background and significance of your chosen area and b) proposed research for how this area could be pushed forward (1 – 3 specific aims). More information on this will be provided around Spring Break.

Literature Presentation:

The last three weeks of the semester will be dedicated to student presentations related to the assignment described above. These presentations should be approximately 20 – 30 minutes in length. More specific information will be given towards the end of the semester.

Access and Accommodations:

Bryn Mawr College is committed to providing equal access to students with a documented disability. Students needing academic accommodations for a disability must first register with Access Services. Students can call 610-526-7516 to make an appointment with the Access Services Director, Deb Alder, or email her at dalder@brynmawr.edu to begin this confidential process. Once registered, students should schedule an appointment with me as early in the semester as possible to share the verification form and make appropriate arrangements. Please note that accommodations are not retroactive and require advance notice to implement. Any student who has a disability-related need to tape record this class must first speak with the Access Services Director and to me, the instructor. Because of laws within the State of Pennsylvania, class members need to be aware that this class may be recorded.