國立中正大學課程大綱

National Chung Cheng University Course Syllabus

2026.01.19 修訂

學年/學期(Academic Year / Semester)	114-2		
課程名稱(Course name)	**Organometallic Chemistry**		
課碼(Course code)	2605328_01	學分數 Credit(s)	3
授課教師(Instructor)	Joyce Shuchun Yu Email: chejyy@ccu.edu.tw tel: +886-5-2720411 ext. 66407		
	☐Professor ■Associate Professor ☐Assistant Professor		
授課方式(teaching methods)	■Lecture ■Student Presentation ■Seminar ☐Lab ☐other		
先修科目(Prerequisite)	This course is designed for graduate students in Chemistry, Chemical Engineering, Materials Science, and related fields (Soil and Water Sciences, Geology, Environmental Science) with a strong interest in organometallic chemistry and its applications. A solid background in undergraduate inorganic and physical chemistry is essential.		
課程介紹與教學目標 (Course Description and Objectives)	**Course Description**–(3 credits): This course provides a comprehensive exploration of organotransition metal chemistry, with a focus on reaction mechanisms, structure-reactivity relationships, and applications in catalysis and organic synthesis. We will begin with the fundamentals of bonding and structure, including the 18-electron rule, and progress to advanced topics such as ligand substitution, oxidative addition, reductive elimination, insertion/elimination reactions, and the role of carbenes in catalysis. Modern characterization techniques for organometallic compounds will be covered. The course will culminate in an examination of catalytic applications of organometallic complexes, including industrial processes and the activation of small molecules. **Objectives**: Upon successful completion of this course, students will be able to: • **Master fundamental principles:** Demonstrate a deep understanding of the principles governing the structure, bonding, and reactivity of organotransition metal compounds. • **Analyze structure and bonding:** Apply knowledge of bonding models (including the 18-electron rule) to predict the stability and reactivity of organometallic complexes. • **Evaluate characterization methods:** Critically evaluate and interpret data from modern characterization techniques used in organometallic chemistry. • **Understand reaction mechanisms:** Describe and explain key organometallic reaction mechanisms, including ligand substitution, oxidative addition, reductive elimination, insertion/elimination reactions, and carbene-mediated reactions. • **Apply knowledge to catalysis:** Apply their understanding of organometallic chemistry to analyze and design catalytic		

	processes, including those relevant to industrial applications and small molecule activation. • **Communicate effectively in English:** Confidently use English to discuss, read, and write about complex topics in organometallic chemistry.
教科書及參考書(Textbooks and References)	**Required Textbook:** Crabtree, Robert H. *The Organometallic Chemistry of the Transition Metals*. 7th ed. New York, NY: John Wiley, 2019. (ISBN: 9781119465881) **Recommended Textbooks:** • Collman, James P., et al. *Principles and Applications of Organotransition Metal Chemistry*. Mill Valley, CA: University Science Books, 1987. • Spessard, Gary O., and Gary L. Miessler. *Organometallic Chemistry*. Upper Saddle River, NJ: Prentice-Hall, 1996.
學習評量與成績配分 (Assessment and Grade scale)	• Midterm Exam……30% (04/14)* • Final Exam……..…….. 30% (06/09)* • Problem Sets and Quizes……..…20% • Oral Presentations……..……...…...20% (06/16) * * Dates are subject to change based on progress. Announcements will be made well in advance.
課程要求 (Course Requirements)	Attendance is required

課程進度(Course Schedule)

Week	Contents
PART-1:	***Introduction to Basic Concept of Organometallic Chemistry***
Week 01	Why Study Organometallic Chemistry? *Organometallic chemistry is a vibrant field with far-reaching impact. Organometallic compounds play crucial roles in a vast array of applications, from cutting-edge research to large-scale industrial processes. They are essential for the synthesis of a wide range of products, including polymers, pharmaceuticals, and fine chemicals. Moreover, organometallic catalysts drive many important reactions, enabling the efficient and sustainable production of countless materials that improve our daily lives.*
Week 02	• Coordination Chemistry and Spartan Molecular Modeling • Werner Complexes • Trans Effect and Trans Influence
Week 03	• Crystal Field and Spartan Molecular Modeling • Ligand Field • Back Bonding • Types of Ligand
PART-2:	***General Properties of Organometallic Complexes***
Week 04	• The 18-Electron Rule • Electron Counting in Reactions • Oxidation State
Week 05	• Coordination Number and Geometry and Spartan Molecular Modeling • Effects of Complexation • Differences between Metals

PART-3:	***Metal Alkyls and Metal Hydrides***
Week 06	• Alkyls and Aryls • Other σ–bonded Ligands • Bond Strengths
Week 07	• Make-up day for university sports day activities • Children's Day, Tomb Sweeping Day (2 days off, Make-up day as announced by the Executive Yuan)
Week 08	***Midterm Exam***
PART-4:	***Carbonyls , Phosphines and Substitution Reactions***
Week 09	• Metal Carbonyls • Metal Phosphines • N-Heterocyclic Carbenes (NHCs)
Week 10	• Dissociative Substitution • Associative Substitution • Redox Effects and Interchange Substitution
Week 11	• Photochemical Substitution • Counterions and Solvents in Substitution
PART-5:	***Fundamental Reaction Types for Organometallics***
Week 12	• π-Complexes • Alkyenes, alkynes, Allyls and Dienes complexes • Cyclopentadiene and Arene Complexes • Isolobal Replacement and metallacycles
Week 13	• Oxidative Addition and Reductive Elimination • Insertion and Elimination • Addition and Abstraction
PART-6:	***Application in Organic Chemistry***
Week 14	• Homogeneous Catalysis and catalytic Cycles • Catalytic Alkene Reactions • Coupling Reactions • Surface and Supported Catalysis
Week 15	• Metathesis • Dimerization, Oligomerization and Polymerization of Alkenes • Activation of CO and CO_2 • CH Activation
PART-7:	***Student Learning Assessment***
Week 16	***Final Exam***
Week 17	***Student Oral Presentation—Assigned Special Topics***
PART-8:	***Invited Seminar***
Week 18	***Title and Speaker: To be announced***