國立中正大學課程大綱

National Chung Cheng University Course Syllabus

學年/學期(Academic Year / Semester)	114-2		
課程名稱(Course name)	**Organometallic Chemistry**		
課碼(Course code)	2708013_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)	☐Lab ☐Seminar ■Student Presentation ■Lecture ☐other		
先修科目(Prerequisite)	This course is intended for graduate students in the areas of Chemical Engineering, Materials Science, Chemistry, Soil and Water Sciences, Geology, and Environmental Science who are strongly interested in materials chemistry. Previous knowledge in physical and inorganic chemistry is recommended.		
課程介紹與教學目標 (Course Description and Objectives)	**Course Description**–(3 credits): This course examines important transformations of organotransition-metal species with an emphasis on basic mechanisms, structure-reactivity relationships, and applications in organic synthesis.The course starts with fundamental molecular properties and gradually develops this into practical applied catalysis. Structure and bonding issues in organometallic compounds are discussed in view of the 18-electron rule. Relevant and modern methods for characterization of organometallic compounds are described. Different reactive ligand types are discussed, including σ-bonded ligands such as alkyl, aryl, og hydride, as well as π-bonded ligands such as carbonyl, alkene, diene, alkyne, cyclopentadienyl, and arene. The properties of important ancillary ligands such as phosphine and N-heterocyclic carbenes are given special attention. Organometallic reaction mechanisms are thoroughly discussed with emphasis on ligand substitution, oxidative addition, reductive elimination, insertion and elimination reactions, nucleophilic and electrophilic addition and abstraction at ligands, and the involvement of carbenes in metathesis and polymerization. The accumulated know-how at this point serves as the foundation for discussions about how organometallic complexes are utilized in homogeneous catalysis and in the activation of small molecules. The application of organometallics in catalysis is highlighted with selected important industrial processes. **Objectives**: Students who successfully complete this course should: ● have a good overview of the fundamental principles of organotransition-metal chemistry and know how chemical properties are affected by metals and ligands.		

	● be able to use knowledge about structure and bonding issues to understand the stability and reactivity of simple organometallic complexes. ● have insight into the use of modern methods to characterize organometallic compounds. ● understand fundamental reaction types and mechanisms and how to combine these to understand efficient catalytic processes ● know important applications of organometallic homogeneous catalysis in the production of large-scale (bulk) and smaller-scale (fine chemicals) production.
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. **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……20% (Week-08) ● Final Exam……..30% (Week-18) ● Problem Sets and Quizes……..…20% ● Oral Presentations……..……...…...20%
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 compounds are widely used both stoichiometrically in research and industrial chemical reactions, as well as in the role of catalysts to increase the rates of such reactions (e.g., as in uses of homogeneous catalysis), where target molecules include polymers, pharmaceuticals, and many other types of practical products.*
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	● Metal Hydrides ● Sigma Complexes
Week 08	***Midterm Exam***
PART-4:	***Carbonyls , Phosphines and Substitution Reactions***
Week 09	● Metal Carbonyls ● Metal Phosphines ● N-Heterocyclic Carbenes (NHCs)
Week 010	● Dissociative Substitution ● Associative Substitution ● Redox Effects and Interchange Substitution
Week 011	● Photochemical Substitution ● Counterions and Solvents in Substitution
PART-5:	***Fundamental Reaction Types for Organometallics***
Week 012	● π-Complexes ● Alkyenes, alkynes, Allyls and Dienes complexes ● Cyclopentadiene and Arene Complexes ● Isolobal Replacement and metallacycles
Week 013	● Oxidative Addition and Reductive Elimination ● Insertion and Elimination ● Addition and Abstraction
PART-6:	***Application in Organic Chemistry***
Week 014	● Homogeneous Catalysis and catalytic Cycles ● Catalytic Alkene Reactions ● Coupling Reactions ● Surface and Supported Catalysis
Week 015	● Metathesis ● Dimerization, Oligomerization and Polymerization of Alkenes ● Activation of CO and CO_2 ● CH Activation
PART-7:	***Student Learning Assessment***
Week 016	***Student Oral Presentation—Assigned Special Topics***
Week 017	***Student Oral Presentation—Assigned Special Topics***
Week 018	***Final Exam***