

نموذج توصيف مقرر
Course Description Form

Name of College\Faculty :

اسم الكلية:

Name of Department:

اسم القسم العلمي:

Course Name	Chemistry of the Organometallic Compounds, (3-0- 3)	اسم المقرر
Course No.	CHEM 440:	رقم المقرر
No. of Credits	(3-0- 3)	عدد الوحدات
Theoretical Hours		عدد الساعات النظرية
Practical Hours		عدد الساعات المحلّية
Course topics		مواضيع المقرر
1. Synthetic method of addition and substitution compounds of hydrides 2. Synthesis, characterization, reactions and applications of groups 1A-III A 3. Organometallic compounds of elements of main Groups IVA 4. Preparation, structure, reaction, bonding and IR studies of the metal carbonyls. 5. Organ transition metal chemistry. AlkyI and alkylidene derivatives. Complexes of alkenes and alkynes 6. Allyl and diene complexes of the transition elements 7. Preparation, characterization and structure of the sandwich compounds (ferrocene). 8. Complexes of arenes		
Text book: (Name, Author , Year , Publisher)		عنوان الكتاب : (الاسم ، المؤلف ، سنة الطبع ، دار النشر)
Principles of Organometallic Chemistry,		
References: (Name , Author , Year . Publisher)		عنوان المرجع : (الاسم ، المؤلف ، سنة الطبع ، دار النشر)
P.Powell, Latest Edn., Chapman & Hall, N.Y. 1988 (2 nd . Edn).		

Prerequisites		متطلبات المقرر			
	Exams		%	40	الاختبارات

Grading	Quizzes		%	5	امتحانات قصيرة	آلية رصد المقرر
	H.W.		%	5	واجبات	
	Project (field study)		%	10	مشاريع (دراسة ميدانية)	
	Final		%	40	الاختبار النهائي	
	100%					

Chapters included:

Chapter	Topic	Sections Included
CH.2	Synthetic method of addition and substitution compounds of the hydrides	4
CH.3	Synthesis, characterization , reactions and applications of groups 1A-IVA	1-12
CH.4	Organometallic compounds of elements of main Groups IVA	1-7
CH.5	Preparation, structure, reaction, bonding and IR studies of the metal carbonyls, Bonding & 18e Vs 16e specie	1-3
ch7	Organotransition metal chemistry. Alkyl and alkylidene derivatives. Complexes of alkenes and alkynes	1-4
ch 8	allyl and diene complexes of the transition elements	1-2
CH.9	Preparation and characterization and structure of the sandwich compounds (ferrocene).	1-6
ch 10	Complexes of arenes	1-3
	Applications of organometallic Complexes (homogeneous catalysis)	

Course objectives					
No.	Course Objectives (Learning Outcomes)	Example(s) of relevant (Topics and activities)	Recommended Level to satisfy the objectives		
			High	Medium	Low
1	Describe the different preparative methods of the different	Synthesis, characterization, reactions			



	organometallic compounds of the main group elements.	and applications of groups 1A-III A			
2	Apply the different spectral tools to study the structure and bonding in these compounds.	Spectroscopic Techniques (NMR, UV-VIS, IR) Used in characterizing Organometallic Chemistry			
3	Illustrate different synthetic methods of the different hydrides of the main group elements.	– Direct reaction of alkali/alkaline earth metals with H_2 (e.g., NaH, CaH_2). – Reduction of halides with $LiAlH_4$ or $NaBH_4$ (e.g., BH_3, AlH_3). – Hydroboration reactions to prepare organoboranes. – Synthesis of ammonia via Haber process; PH_3 from metal phosphides. – Formation of H_2S from metal sulfides. – Preparation of hydrogen halides by direct combination or acidification. – Laboratory synthesis and IR characterization of M–H, B–H, Si–H bonds.			
4	Describe the different preparative methods of the metal carbonyls.	– Direct synthesis of $Ni(CO)_4$ and $Fe(CO)_5$ from metals and CO. – Carbonylation of metal halides with reducing agents. – Reduction of metal oxides in CO atmosphere to form $M(CO)_6$ compounds. – Ligand substitution to generate carbonyl complexes. – Electrochemical synthesis of low-valent metal carbonyls. – Laboratory synthesis and			



		IR characterization of metal carbonyls.			
5	Discuss the different properties and reactions of the metal carbonyls, organometallic and hydrides of the main group elements.	Physical Properties Chemical Properties			
	Apply the different preparative methods for the preparation of the sandwich compounds.	– Direct synthesis: $\text{FeCl}_2 + 2 \text{NaC}_5\text{H}_5 \rightarrow \text{Fe}(\text{C}_5\text{H}_5)_2$ – Reduction method: $\text{CrCl}_3 + 3 \text{NaC}_5\text{H}_5 \rightarrow \text{Cr}(\text{C}_5\text{H}_5)_3$ – Redox condensation: $\text{Mo}(\text{CO})_6 + \text{NaC}_5\text{H}_5 \rightarrow \text{CpMo}(\text{CO})_3$ – Electrophilic substitution / metalation of low-valent metal carbonyls – Laboratory synthesis, IR and NMR characterization, mechanistic studies of $\eta^5\text{-Cp}$ coordination			
	Illustrate the different spectral tools and physical methods to study the bonding structure, bonding and properties of the sandwich compounds.	IR and NMR Analysis: Record ^1H and ^{13}C NMR spectra of ferrocene to observe Cp proton/carbon equivalence. Use IR to check metal–ligand vibrations or CO ligands in substituted metallocenes. Crystallography Study: Examine X-ray data of Cp_2Fe, Cp_2Co to measure M–C bond lengths and ring centroids. Electrochemical Experiment:			



		Determine redox potential of ferrocene/ferrocenium couple using cyclic voltammetry. UV-Vis & Mass Spectrometry: Identify electronic transitions and confirm molecular weight of synthesized sandwich compounds.			
	Discuss the preparation and characterization of the metal alkyls and aryls as well as their different reactions	Synthesis Experiment: Preparation of phenylmagnesium bromide (Grignard reagent). Reaction Demonstration: Addition of Grignard reagent to aldehydes/ketones to form alcohols. Characterization Exercise: Use IR, NMR, and MS to confirm structure. Comparative Study: Compare the reactivity of alkyl vs aryl organometallic compounds.			
	Be able to study the rapid tautomeric process by NMR.	Keto-enol mixture shows a single averaged -OH/-CH signal at high temperature, Carbonyl carbon signal may shift due to fast keto-enol interconversion, Lowering temperature splits averaged peaks into distinct keto and			



		enol signals, Determines kinetics of proton transfer in tautomerism			
	Be able to discuss how to stabilize the unstable ligands.	Fischer carbenes, $\text{Cp}_2\text{Ti}(\text{CH}_3)_2$, Grignard reagents, organolithiums			
	Discuss the uses of the organometallic compounds as catalysts.	Production of aldehydes and alcohols, Polyethylene, polypropylene, Fine chemical synthesis			
Fields					
Skills					
Coordinator (Name and Rank) : prof .Mousa Al-noaimi					
Signature and stamp :					
Date:-8-11-2025	13\ 11 \2025				