



## Subject card

Subject name and code	Organometallic Chemistry , PG_00053214						
Field of study	Chemistry						
Date of commencement of studies	October 2022		Academic year of realisation of subject		2023/2024		
Education level	first-cycle studies		Subject group		Optional subject group Subject group related to scientific research in the field of study		
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	2		Language of instruction		Polish		
Semester of study	3		ECTS credits		3.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Inorganic Chemistry -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Rafał Grubba				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	15.0	45
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	45		5.0		25.0	75
Subject objectives	The aim of the course is to familiarize students with the structure, properties and applications of coordination compounds with particular emphasis on organometallic compounds.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	K6_W03		The student is able to predict the properties of organometallic compounds on the basis of their electronic structure.		[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge		
	[K6_U03] can make detailed documentation of the results of self-conducted experiments and prepare a report describing these results		The student is able to prepare a concise report describing the syntheses of organometallic compounds made.		[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment		
	[K6_U02] can work individually and in a team; he/she can assess the necessary task time and plan and organize individual work and in a small team in a way that ensures the execution of the task within a set deadline		The student is able to independently plan the synthesis of organometallic compounds. In addition, he can cooperate with other students in the implementation of tasks related to the synthesis and identification of organometallic compounds.		[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment		
	K6_W02		The student has knowledge of the structure and chemical properties of organometallic compounds.		[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge		

Subject contents	<b>LECTURE:</b> Coordination unions:- Basic concepts- Nomenclature of complex compounds- Equilibrium in solutions of complex compounds- Isomerism of complex compounds- Crystalline field theory- Color and magnetic properties of the d-block metal complexesOrganometallic compounds:-Phosphines as ligands-N-heterocyclic carbenes as ligands-Metal carbonyls-Alkenes as ligands- Aromatic hydrocarbons as ligands- Organolithium and organomagnesium compounds-Organic boron compounds- Organosilicon compounds-Basics of preparation of organometallic compounds <b>SEMINAR:</b> Importance of organometallic compounds in chemical synthesis, catalysis, material chemistry and medicine:Metal complexes with phosphines (synthesis and catalytic properties);Organophosphorus and organophosphorus compounds (synthesis and use as plant protection products or in medicine);Metal carbonyls (synthesis and catalytic properties; application in medicine);Metal complexes with unstable carbenes (synthesis and catalytic properties);Metal and non-metal complexes with N-heterocyclic carbenes (synthesis and catalytic properties, application in medicine);Cyclopentadienyl metal complexes (synthesis and catalytic properties; application in medicine);Organolithium compounds (synthesis);Organomagnesium compounds (synthesis);Organo-boron compounds (synthesis and catalytic properties);Organoaluminum compounds (synthesis and catalytic properties);Organosilicon compounds (synthesis and application);Nobel Prizes in Organometallic Chemistry;Metal clusters - discussion of selected examples;Organometallic polymers - discussion of selected examples <b>LABORATORY:</b> Synthesis of transition metal compounds containing cyclopentadienyl, olefin, phosphine and carbene ligands.		
Prerequisites and co-requisites	Basic knowledge of general and inorganic chemistry (subjects "General Chemistry" I sem., "Inorganic Chemistry" II sem.).		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lecture - test	60.0%	40.0%
	Seminar - presentation	60.0%	30.0%
	Laboratory - test, report	60.0%	30.0%
Recommended reading	Basic literature	- P. Atkins, L. Jones, Chemia Ogólna, PWN  - A. Bielański, Podstawy Chemii Nieorganicznej, PWN  - B. D. Gupta, A. J. Elias, Basic organometallic chemistry. Concepts, syntheses and applications, Universities Press	
	Supplementary literature	- D. Astruc, Organometallic chemistry and catalysis, Springe	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	<ul style="list-style-type: none"><li>Phosphines and amines are important ligands in coordination chemistry. Give one example each for phosphine and amine. Give their names, the Lewis formula, the shape of the molecule, and the hybridization of the nitrogen and phosphorus atom. Determine whether these compounds are oxidized by air. Write the Lewis formula for the oxidation products. Describe how phosphines and amines bind to transition metal ions (describe the similarities and differences in the nature of the bonds).</li><li>The following pairs of complexes are given. Determine which of the complexes is more stable in a given pair using the Lewis theory of soft and hard acids. Justify your answer. Give names for the listed complexes.  [FeF<sub>6</sub>]<sup>3-</sup> i [FeCl<sub>6</sub>]<sup>3-</sup> [HgI<sub>4</sub>]<sup>2-</sup> i [HgCl<sub>4</sub>]<sup>2-</sup> [Pt(NEt<sub>3</sub>)<sub>4</sub>]<sup>+</sup> i [Pt(PEt<sub>3</sub>)<sub>4</sub>]<sup>+</sup></li></ul> <ul style="list-style-type: none"><li>Describe the structure and methods of NHC-carbene preparation on the example of a selected carbene.</li></ul>		
Work placement	Not applicable		

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