



## 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	<p><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 complexes  <b>Organometallic compounds:-</b>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.</p>														
Prerequisites and co-requisites	Basic knowledge of general and inorganic chemistry (subjects "General Chemistry" I sem., "Inorganic Chemistry" II sem.).														
Assessment methods and criteria	<table border="1" data-bbox="448 573 1489 712"> <thead> <tr> <th data-bbox="448 573 794 607">Subject passing criteria</th> <th data-bbox="794 573 1141 607">Passing threshold</th> <th data-bbox="1141 573 1489 607">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="448 607 794 640">Lecture - test</td> <td data-bbox="794 607 1141 640">60.0%</td> <td data-bbox="1141 607 1489 640">40.0%</td> </tr> <tr> <td data-bbox="448 640 794 674">Seminar - presentation</td> <td data-bbox="794 640 1141 674">60.0%</td> <td data-bbox="1141 640 1489 674">30.0%</td> </tr> <tr> <td data-bbox="448 674 794 712">Laboratory - test, report</td> <td data-bbox="794 674 1141 712">60.0%</td> <td data-bbox="1141 674 1489 712">30.0%</td> </tr> </tbody> </table>			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%
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Recommended reading	<p>Basic literature</p> <p>Supplementary literature</p> <p>eResources addresses</p>	<p>- P. Atkins, L. Jones, Chemia Ogólna, PWN</p> <p>- A. Bielański, Podstawy Chemii Nieorganicznej, PWN</p> <p>- B. D. Gupta, A. J. Elias, Basic organometallic chemistry. Concepts, syntheses and applications, Universities Press</p> <p>- D. Astruc, Organometallic chemistry and catalysis, Springe</p>													
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.</li> </ul> <p>[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>] i [Pt(PEt<sub>3</sub>)<sub>4</sub>]</p> <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														