



## Subject card

Subject name and code	Methods of Structural Studies, PG_00048870						
Field of study	Engineering and Technologies of Energy Carriers						
Date of commencement of studies	February 2023	Academic year of realisation of subject			2023/2024		
Education level	second-cycle studies	Subject group			Obligatory subject group in the field of study		
Mode of study	Full-time studies	Mode of delivery			at the university		
Year of study	1	Language of instruction			Polish		
Semester of study	2	ECTS credits			3.0		
Learning profile	practical profile	Assessment form			assessment		
Conducting unit	Department of Organic Chemistry -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Sławomir Makowiec				
	Teachers		dr hab. Sławomir Makowiec				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	30.0	0.0	0.0	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	A main goal is to teach students basic spectroscopic methods including: NMR, IR, UV, and MS, and their application in the analysis of the structure of organic compounds						
Learning outcomes	Course outcome	Subject outcome			Method of verification		
	K7_W03	Student know how devices for aquisition of spectra works. Student has knowledge of the physical basis of spectroscopic techniques such as 1H, 13C NMR, IR and MS.			[SW1] Assessment of factual knowledge		
	K7_U01	Student recognizes functional groups occurring in compounds based on IR spectra. Student can interprets 1H, 13C, IR and MS NMR spectra, Student is able to describe the NMR 1H 13C MS and IR spectra. Student can identify organic compounds based on 1H NMR, 13C MS and IR spectra.			[SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information		
Subject contents	I. Basics of spectroscopy: electromagnetic radiation, energy levels in molecules, radiation absorption, line shape, selection rules, application of Fourier transform in spectroscopy. II. NMR spectra, magnetic properties of atomic nuclei, physical basis of the NMR method, chemical shift, spin-spin coupling, magnetic anisotropy of groups, interpretation of 1H NMR spectra, spin systems, elements of 19F and 13C NMR spectroscopy. III. Infrared spectroscopy (IR), harmonic and anharmonic oscillators, oscillations of polyatomic molecules, normal vibrations, transition probability, group frequencies, aquisition of IR spectra, interpretation of spectra, hydrogen bonds in IR.IV. Mass spectrometry (MS): physical basis of MS spectrum measurement, sample ionization methods, types of ions in MS, determination of molecular weight and molecular formula, fragmentation processes.						

Prerequisites and co-requisites	1. Knowledge of theoretical basis of spectroscopy  2. Knowledge of structures of organic compounds  3. Knowledge of nomenclature of organic compounds		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Four tests during semester	60.0%	100.0%
Recommended reading	Basic literature	1. R. M. Silverstein, F. X. Webster, D. J. Kiemle "Spektroskopowe metody identyfikacji związków organicznych", PWN, Warszawa, 2007.  2. "Spektroskopowe metody badania struktury związków organicznych", praca zbiorowa red. A. Rajca, WNT, Warszawa, 1996 lub 2000.  3. R. M. Silverstein, G. C. Bassler "Spektroskopowe metody identyfikacji związków organicznych", PWN, Warszawa, 1970.  4. L. K. Kazicyna, N. B. Kuplerska "Metody spektroskopowe wyznaczania struktury związków organicznych", PWN, Warszawa, 1974	
	Supplementary literature	1. R. A.W. Johnstone, M. E. Rose "Spektrometria mas podręcznik dla chemików i biochemików", PWN, Warszawa, 2001.  2. A. Zschunke "Spektroskopia magnetycznego rezonansu jądrowego w chemii organicznej", PWN Warszawa, 1976.  3. Z. Kęcki "Podstawy spektroskopii molekularnej", PWN, Warszawa, 1972.  4. H. Günther, "Spektroskopia magnetycznego rezonansu jądrowego", PWN, Warszawa, 1983.  5. M. Szafran, Z. Dega-Szafran "Określenie struktury związków organicznych metodami spektroskopowymi", PWN, Warszawa, 1988	
	eResources addresses	Adresy na platformie eNauczanie: MBS ITNE 2023/24 - Moodle ID: 35049 <a href="https://enauczanie.pg.edu.pl/moodle/course/view.php?id=35049">https://enauczanie.pg.edu.pl/moodle/course/view.php?id=35049</a>	
Example issues/ example questions/ tasks being completed			
Work placement	Not applicable		