



Subject card

Subject name and code	, PG_00037563						
Field of study	Green Technologies						
Date of commencement of studies	October 2020	Academic year of realisation of subject			2021/2022		
Education level	first-cycle studies	Subject group			Obligatory subject group in the field of study 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	4	ECTS credits			4.0		
Learning profile	general academic profile	Assessment form			assessment		
Conducting unit	Department of Organic Chemistry -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Teresa Olszewska					
	Teachers	dr hab. inż. Teresa Olszewska dr hab. Sławomir Makowiec					
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	30.0	0.0	0.0	60
	E-learning hours included: 0.0 Adresy na platformie eNauczanie:						
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	60	5.0		35.0		100
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		
	[K6_W02] has a basic knowledge of chemistry including general chemistry, inorganic, organic, physical, analytical, including the knowledge necessary to describe and understand the phenomena and chemical processes occurring in the environment; measurement and the determination of the parameters of these processes.	The student knows the physical basis of IR, NMR and MS spectroscopy.			[SW1] Assessment of factual knowledge		
	[K6_U03] is able to use information and communication technologies relevant to the common tasks of engineering, is able to use known methods and mathematical-physical models to describe and explain phenomena and chemical processes	Student is able to analyze the IR, NMR, MS spectra and assign the appropriate structural formula of the compound.			[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_W01] has a basic knowledge from some branches of mathematics and physics useful for formulating and solving simple problems in the field of environmental technologies and modern analytical methods	The student knows the physical basis of IR, NMR and MS spectroscopy.			[SW1] Assessment of factual knowledge			

Subject contents	<p>Principles of spectroscopy – electromagnetic radiation, energy levels in molecules, absorption of radiation, line shape, selection rules, application of the Fourier transformation in spectroscopy.</p> <p>NMR – magnetic properties of atomic nuclei, the chemical shift, the spin-spin coupling, diamagnetic anisotropy of molecules, interpretation of the proton NMR spectra, spin systems, the Karplus equation, dynamic effects, NOE, the Fourier transformation (FT-NMR), two-dimensional spectra (2D-NMR), basics of ¹⁹F and ¹³C NMR, elements of NMR of other nuclei.</p> <p>Infrared spectroscopy (IR) – harmonic and anharmonic oscillator, vibrations of multiatom molecules, the normal vibrations, transition probability, group frequencies, measurements of the IR spectra, interpretation of the IR spectra, hydrogen bonds in the IR spectroscopy, the Raman spectroscopy.</p> <p>Mass spectroscopy (MS) – physical basis of the MS spectroscopy, methods of sample ionization including electro- and thermospray, ion types in MS, determination of molecular mass and molecular formula, fragmentation of molecules.</p> <p>Electronic spectra (UV-vis) – electronic levels, spectrometers, selection rules, band shape, vibronic transitions, simple chromophores, aromatic chromophores, influence of substituents, steric effects, solvent effects.</p>											
Prerequisites and co-requisites	<ol style="list-style-type: none"> 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	<table border="1"> <thead> <tr> <th data-bbox="456 958 794 987">Subject passing criteria</th> <th data-bbox="799 958 1137 987">Passing threshold</th> <th data-bbox="1142 958 1481 987">Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td data-bbox="456 994 794 1023">theoretical colloquium</td> <td data-bbox="799 994 1137 1023">60.0%</td> <td data-bbox="1142 994 1481 1023">25.0%</td> </tr> <tr> <td data-bbox="456 1030 794 1059">Midterm colloquium H and C NMR, IR, MS, UV</td> <td data-bbox="799 1030 1137 1059">60.0%</td> <td data-bbox="1142 1030 1481 1059">75.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	theoretical colloquium	60.0%	25.0%	Midterm colloquium H and C NMR, IR, MS, UV	60.0%	75.0%
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Recommended reading	Basic literature	<ol style="list-style-type: none"> 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. Kuplarska "Metody spektroskopowe wyznaczania struktury związków organicznych", PWN, Warszawa, 1974 										

	Supplementary literature	<p>1. R. A.W. Johnstone, M. E. Rose "Spektrometria mas – podręcznik dla chemików i biochemików", PWN, Warszawa, 2001.</p> <p>2. A. Zschunke "Spektroskopia magnetycznego rezonansu jądrowego w chemii organicznej", PWN Warszawa, 1976.</p> <p>3. Z. Kęcki "Podstawy spektroskopii molekularnej", PWN, Warszawa, 1972.</p> <p>4. H. Günther, "Spektroskopia magnetycznego rezonansu jądrowego", PWN, Warszawa, 1983.</p> <p>5. M. Szafran, Z. Dega-Szafran "Określenie struktury związków organicznych metodami spektroskopowymi", PWN, Warszawa, 1988</p>
Example issues/ example questions/ tasks being completed	eResources addresses	
Work placement	Not applicable	