



Subject card

Subject name and code	, PG_00057797						
Field of study	Green Technologies						
Date of commencement of studies	October 2024		Academic year of realisation of subject		2026/2027		
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	3		Language of instruction		Polish		
Semester of study	5		ECTS credits		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Organic Chemistry -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Teresa Olszewska				
	Teachers		dr hab. inż. Teresa Olszewska				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 7657 Methods of structural studies https://enauczanie.pg.edu.pl/2025/course/view.php?id=7657						
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	30		2.0		18.0	50
Subject objectives	The aim of the course is to provide students with knowledge of the application of fundamental spectroscopic methods in structural analysis and to develop practical skills in the interpretation of IR, NMR, and MS spectra of organic compounds.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[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		possesses fundamental knowledge of physical, organic, and inorganic chemistry, as well as mathematics, necessary for the analysis and interpretation of spectroscopic data.		[SW1] Assessment of factual knowledge		
	[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.		has fundamental knowledge of IR, 1H and 13C NMR, and MS spectroscopy and understands the principles and applications of the key spectroscopic methods used for structural analysis of organic compounds.		[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		is able to interpret IR, MS, and 1H and 13C NMR spectra and determine the structure of an organic compound using the spectroscopic techniques studied.		[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information		

Subject contents	Course content – lecture		
	I. Introduction to the fundamentals of spectroscopy, including electromagnetic radiation, molecular energy levels, radiation absorption processes, spectral line shapes, selection rules governing spectroscopic transitions, and the application of Fourier transform methods in modern spectroscopic techniques. II. NMR spectroscopy: magnetic properties of atomic nuclei; physical principles of the NMR technique; chemical shifts and spin-spin coupling; magnetic anisotropy of functional groups; analysis of spin systems; the Karplus relationship and its application to conformational analysis; dynamic effects in NMR spectroscopy; pulsed Fourier transform NMR (FT-NMR); and basic principles of NMR spectroscopy of other nuclei, including ¹³C NMR III. Infrared (IR) spectroscopy: harmonic and anharmonic oscillators, molecular vibrations in polyatomic molecules, normal vibrational modes, transition probabilities, characteristic group frequencies, recording and interpretation of IR spectra, and the analysis of hydrogen bonding using IR spectroscopy. IV. Mass spectrometry (MS): physical principles of mass spectrometric analysis; sample ionization techniques; types of ions observed in mass spectra; determination of molecular mass and molecular formula; and selected fragmentation pathways and processes.		
	Course content – laboratory		
	Providing students with practical experience in the interpretation of MS, IR, ¹H NMR, and ¹³C NMR spectra. Determining the molecular mass of an organic compound and identifying possible fragmentation pathways based on MS spectra. Identifying functional groups in organic molecules based on IR spectra. Determining the carbon skeleton and proton arrangement in organic molecules based on ¹H and ¹³C NMR spectra. Applying the acquired skills in the interpretation of MS, IR, ¹H NMR, and ¹³C NMR spectra to elucidate the structures of organic compounds.		
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
	three tests assessing knowledge acquired during lectures and laboratory sessions	60.0%	100.0%
Recommended reading	Basic literature		
	1. Robert M. Silverstein, Francis X. Webster, David J. Kiemle, David L. Bryce "Spectrometric Identification of Organic Compounds", 8th Edition, John Wiley & Sons 2014 2. Ian Fleming, Dudley Williams, "Spectroscopic Methods in Organic Chemistry", 2020, Springer Nature Switzerland AG 3. Joseph B. Lambert, Herbert F. Shurvell, David A. Lightner, R. Graham Cooks, "Organic Structural Spectroscopy" Pearson, 1998 4. Stefan Bienz, Laurent Bigler, Thomas Fox, Herbert Meier "Spectroscopic Methods in Organic Chemistry", 2021, Thieme Publishing Group		

	Supplementary literature	1. R. A.W. Johnstone, M. E. Rose "Spektrometria mas – podręcznik dla chemików i biochemików", PWN, Warszawa, 2001. 2. Gensicka-Kowalewska M., Milewska M.J., Podstawy metod badań struktury związków organicznych w zadaniach, Wydawnictwo PG 2024 3. H. Günther, "Spektroskopia magnetycznego rezonansu jądrowego", PWN, Warszawa, 1983. 4. M. Szafran, Z. Dega-Szafran "Określenie struktury związków organicznych metodami spektroskopowymi", PWN, Warszawa, 1988
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Sketch the ^1H NMR spectrum for each of the following compounds: (a) butan-1-ol, (b) butan-2-ol, (c) cumene, and (d) benzylamine. 2. How can benzamide, N,N-dimethylbenzamide, and N-methylbenzamide be distinguished in an IR spectrum? 3. Describe how you would distinguish between pentan-2-one and pentan-3-one using their mass spectra. 4. How many sets of chemically nonequivalent protons are present in (a) <i>p</i>-diethylbenzene and (b) 1,1,4-trichlorobutane?	
Practical activities within the subject	Not applicable	

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