University of Gdańsk

Subject card

Subject name and code	Chemical spectroscopy, PG_00057669						
Field of study	Chemical Business						
Date of commencement of studies	October 2024		Academic year of realisation of subject		2026/2027		
Education level	Bachelor's 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	3		Language of instruction		Polish no		
Semester of study	5		ECTS credits		2.0		
Learning profile	academic		Assessment form		exam		
Conducting unit	Faculty of Chemistry -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. Sylwia Rodziewicz-Motowidło				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	0.0	0.0	15
	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	15		2.0		33.0	50
Subject objectives	Introducing students to the physical principles of the interaction between electromagnetic radiation and matter, as well as the theoretical foundations of spectroscopic methods. The program includes knowledge acquisition in the fundamentals of mass spectrometry, vibrational spectroscopy (IR), and nuclear magnetic resonance spectroscopy (NMR) in 1D and 2D for ^{1}H-^{1}H and ^{13}C-^{1}H. nuclei. Special emphasis will be placed on the practical applications of these techniques in chemical analysis, structural studies, and compound identification. The lectures will also focus on developing skills in spectrum interpretation, which is a key element in both laboratory and research work.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[BCHINŻ_W10] Applies safety and hygiene principles when working on a test and measurement stand or in the field.	The student knows and understands the basic principles of occupational safety and health (OSH) at the research and measurement workplace, including the principles of operating spectroscopic (IR, NMR, MS) equipment and handling chemical samples. Understands the importance of using personal protective equipment (e.g., gloves, safety glasses) and collective protective equipment (e.g., ventilation systems) in laboratory work. Knows the potential hazards associated with the use of scientific apparatus, including the risks of working with electromagnetic radiation, chemicals or high voltages.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
	[BCHINŻ_U09] Using the acquired knowledge, skills and various sources of scientific information independently prepares written papers and oral presentations.	The student understands the physical basis of the interaction of electromagnetic radiation with matter and the principles of spectroscopic techniques such as mass spectrometry, oscillatory spectroscopy (IR) and nuclear magnetic resonance (NMR) spectroscopy. He knows the applications of these methods in chemical analysis and structural studies.	[SU1] oral statement/conversation/ discussion [SU4] test/exam - oral or written
	[BCHINŻ_W03] Describes the techniques of higher mathematics and IT tools necessary to describe and model chemical phenomena and technological processes.	The student is familiar with the mathematical basis of spectroscopic spectra analysis, such as Fourier transforms, and can explain how they are applied to spectroscopic techniques. He or she is familiar with computer tools that support structural modeling and analysis of spectroscopic data, such as programs for processing NMR, IR and mass spectrometry spectra.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
	[BCHINŻ_K04] Demonstrates responsibility for the safety of her/ his own and others' work.	The student knows the safety rules associated with working with spectroscopic and measuring apparatus, including procedures to minimize risks in laboratory and research work. Understands the risks associated with electromagnetic radiation and chemicals used in the context of spectroscopic methods.	[SK1] oral statement/conversation/ discussion [SK4] test/exam - oral or written
	[BCHINŻ_W07] Describes the construction and operating principles of basic scientific, technological and control-measuring apparatus.	The student knows the theoretical basis of the techniques and conditions of the measuring apparatus in structural research and analysis of chemical compounds.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion
	[BCHINŻ_K02] Works individually demonstrating initiative and independence in actions, and effectively cooperates in a team, performing various roles in it.	The student understands the importance of independence and initiative in research work and in the analysis of complex scientific issues such as spectroscopy and measurement data analysis. He or she knows the mechanisms and strategies for effective teamwork, including the principles of division of roles and responsibilities in a team working on probblematic projects.	[SK1] oral statement/conversation/ discussion [SK4] test/exam - oral or written

	Course outcome	Subject outcome	Method of verification
	[BCHINŻ_U08] Uses the chemical nomenclature and engineering terminology properly.	The student is familiar with basic and advanced terms used in spectroscopy, such as chemical shift, spin-spin coupling, IR, MS, NMR spectra and terminology related to structural analysis and interpretation of measurement results. He understands the principles of chemical nomenclature in the context of describing chemical compounds and their properties on the basis of spectroscopic spectra.	[SU1] oral statement/conversation/ discussion [SU4] test/exam - oral or written
Subject contents	Properties of electromagnetic radiation and interaction of radiation with molecular systems: absorption, scattering, emission. Overview of MS, IR, 1D and 2D NMR techniques. 1D NMR spectra with 2D elements - COSY, TOCSY, HETCOR/HMQC, NOESY, DEPT etc; elements of spin systems analysis; identification of molecules with masses up to ~300 D; configuration, conformation, dynamics of molecules; emphasis on integrated application of spectroscopy methods for the most effective achievement of the mentioned goals; elements of conformational analysis of biomolecules.		
Prerequisites and co-requisites	Passed basic organic chemistry and physical chemistry courses		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	exam	50.0%	100.0%
Recommended reading	Basic literature	-Collective edited by W. Zieliński and A. Rajca: Spectroscopic methods their application to the identification of organic compounds, WNT W-wa 1995, 2000.-R.M. Silverstein, F.X. Webster, D.J. Kiemle: Spectroscopic methods for the identification of organic compounds, PWN W-wa 2007 A.1.	
	Supplementary literature	- A.S. Płaziak: Mass spectrometry of organic compounds, Wydaw. Naukowe UAM Poznań 1997- R.A.W. Johnstone, M.E. Rose: Mass spectrometry, PWN W-wa 2001.- Z. Kęcki: Fundamentals of Molecular Spectroscopy, PWN W-wa 1998.- I.Z. Siemion: Biostereochemistry, PWN Warsaw 1985.- K. Wüthrich: NMR in biological research: peptides and proteins, North-Holland, Amsterdam 1976.	
	eResources addresses		
Example issues/ example questions/ tasks being completed	1. Explain the terms (formula, definition, unit): a) force constant, b) natural vibration, c) overtone, d) Fermi resonance.2. Explain how inductive and mesomeric effects affect the chemical shift of nuclei in 1H NMR spectroscopy.3. Calculate the number of degrees of freedom for a formaldehyde molecule (H2C=O) and then assign each of the degrees of freedom to a specific band of this molecule. Draw the IR spectrum of this molecule and mark on it the vibrations described earlier.		
Work placement	Not applicable		

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