University of Gdańsk

Subject card

Subject name and code	Selected aspects of biomolecular analysis, PG_00049928		
Field of study	Chemistry		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2026/2027
Education level	Master's studies	Subject group	Obligatory subject group in the field of study Optional subject group
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	2.0
Learning profile	academic	Assessment form	
Conducting unit	Faculty of Chemistry -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Irena Bylińska	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	0.0	30.0	0.0	0.0	0.0	30

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	30	5.0	15.0	50

Subject objectives

To familiarize students with the procedure for preparing a peptide or protein sample for NMR spectra measurements.

To familiarize students with the methods for determining the primary and secondary structure of peptides and proteins based on 1D and 2D NMR spectra.

To familiarize students with the methods for spectroscopic analysis of 1D and 2D NMR spectra of peptides, proteins, oligo- and polysaccharides.

To familiarize students with the issues of: determining the primary structure oligo- and polysaccharides (bacterial) - components of biomolecules, using chemical methods, mass spectrometry (EI MS, CI MS, MALDI TOF MS) and NMR.

To familiarize students with the rules enabling the interpretation of 1H, 13C NMR, homo- and heterocorrelation and MS spectra of bacterial polysaccharides.

To familiarize students with selected techniques of absorption and emission spectroscopy and their application in the analysis of biomolecules.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[CHEMMU2_K01] Knows the limitations of her/his own knowledge; understands the need for further education and can inspire other people to do so.	The student learns about new techniques or their new application. The student knows what are the possibilities and limitations of individual techniques. The student knows that not every research problem can be solved with a chosen technique. The student knows that the issues discussed during the course do not exhaust the topics discussed and are only an introduction.	[SK1] oral statement/conversation/ discussion
	[CHEMMU2_W04] Applies the acquired knowledge to an in-depth description of the properties of chemical connections, methods of their synthesis and analysis.	The student is able to use 1D and 2D NMR spectra to determine the primary and secondary structure of peptides and proteins. The student is able to use methods of spectroscopic analysis of 1D, 2D NMR spectra of peptides, proteins, oligo- and polysaccharides. The student uses knowledge in the field of determining the primary structure of oligo- and polysaccharides (bacterial) using chemical methods, mass spectrometry (I MS, CI MS, MALDI TOF MS) and NMR. The student is able to apply rules enabling the interpretation of spectra: 1H, 13C NMR, homo- and heterocorrelation and MS of bacterial polysaccharides. The student is able to use selected techniques of absorption and emission spectroscopy in the analysis of biomolecules.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW3] text preparation/written work [SW5] implementation of a problem task
	[CHEMMU2_U04] Applies acquired knowledge of chemistry and related scientific disciplines.	The student is able to perform the procedure of preparing a peptide or protein sample for measuring NMR spectra. The student is able to use 1D and 2D NMR spectra to determine the primary and secondary structure of peptides and proteins. The student is able to use methods of spectroscopic analysis of 1D, 2D NMR spectra of peptides, proteins, oligo- and polysaccharides. The student uses knowledge in the field of determining the primary structure of oligo- and polysaccharides (bacterial) using chemical methods, mass spectrometry and NMR. The student is able to apply rules enabling the interpretation of spectra: 1H, 13C NMR, homo- and heterocorrelation and MS of bacterial polysaccharides. The student is able to use selected techniques of absorption and emission spectroscopy in the analysis of biomolecules.	[SU1] oral statement/conversation/ discussion [SU3] text preparation/written work [SU4] test/exam - oral or written [SU5] implementation of a problem task [SU6] demonstration of practical skills

Course outcome	Subject outcome	Method of verification
[CHEMMU2_W07] Selects experimental and theoretical techniques to the extent necessary to understand the description and modelling of medium complexity chemical processes.	The student knows and is able to apply experimental and theoretical techniques enabling determination of primary and secondary structure of peptides and proteins. The student knows and is able to apply methods of spectroscopic analysis of 1D, 2D NMR spectra of peptides, proteins, oligo- and polysaccharides. The student knows and is able to use knowledge in the field of determination of primary structure of oligo- and polysaccharides (bacterial) using chemical methods, mass spectrometry and NMR. The student is able to apply rules enabling interpretation of spectra: 1H, 13C NMR, homo- and heterocorrelation and MS of bacterial polysaccharides. The student knows and is able to apply selected techniques of absorption and emission spectroscopy in the analysis of biomolecules.	[SW4] test/exam - oral or written [SW1] oral statement/ conversation/discussion [SW3] text preparation/written work [SW5] implementation of a problem task

Subject contents

Structural analysis of peptides includes such topics as: History of nuclear magnetic resonance in application to peptides and proteins, method of preparing a peptide or protein sample for NMR studies, advantages and disadvantages of the NMR technique in application to peptides and proteins, interpretation of TOCSY, NOESY, COSY spectra of peptides, determination of the spatial structure of peptides using CSI (chemical shift index) data - coupling constants and NOE effects, interpretation of 1D NMR spectra of temperature peptides in order to determine temperature coefficients. Brief characteristics of selected biomolecules containing sugar fragments. Determination of the primary structure of oligo- and polysaccharide parts of biologically active compounds. Sugar and methylation analysis - interpretation of mass spectra (EI MS, CI MS) of acetyl derivatives and acetyl derivatives of partially methylated alditols. Use of MALDI TOF MS to determine the molecular weight of glycoconjugates. Interpretation of NMR spectra of polysaccharides on the example of bacterial antigens (1H and 13C NMR spectra, homo- and heterocorrelation NMR spectra). Study of spectral and photophysical properties of biomolecules containing fluorophore and analysis of changes in these properties, deepened by correlation analysis: cause/effect/conclusion.

Prerequisites and co-requisites

Completed courses in organic chemistry, biochemistry, physical chemistry, chemical spectroscopy.Knowledge of the basic chemistry of saccharides and polysaccharides, amino acids, peptides and proteins. Knowledge of introductory information on spectroscopic methods of studying the structure of simple organic compounds.Ability to observe and draw conclusions.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Passing the thematic part I (concerning the structural analysis of peptides)	51.0%	33.34%
Passing the thematic part III (concerning selected biomolecules containing fluorophores)	51.0%	33.33%
Passing the thematic part II (concerning selected biomolecules containing saccharide fragments	51.0%	33.33%

Recommended reading	Basic literature	1) Zieliński W., Rajca A. (red) Metody spektroskopowe i ich zastosowanie do identyfikacji związków organicznych, WNT, Warszawa, 1995. 2) Johnstone R. A. W., Rose M. E. Spektrometria mas, PWN, Warszawa, 2001. 3) Silverstein R. M., Webster F. X., Kiemle D. J. Spektroskopowe metody identyfikacji związków organicznych, PWN, Warszawa, 2007. 4) Wiśniewski A., Madaj J. Podstawy chemii cukrów, AGRA-ENVIRO Lab., Poznań Gdańsk, 1997. 5) E. de Hoffman, J. Charette, V. Stroobant, Spektrometria mas, WNT, Warszawa 1998. 6) J.R. Lakowicz, Principles of Fluorescence Spectroscopy, Wydanie drugie, Kluwer Academic/Plenum Publishers, New York, Boston, Dordrecht, London, Moscow, 1999 7) A. Kawski, Fotoluminescencja roztworów, PWN, Warszawa 1992. 8) Z. Kęcki, Podstawy spektroskopii molekularnej, PWN Warszawa 1998.
	Supplementary literature	Wütrich K. NMR in Biological Research: Peptides and Proteins. Amer. Elsevier, INC, New York, 1976.Günter H. Spektroskopia magnetycznego rezonansu jądrowego, Wydawnictwo Naukowe PWN, Warszawa, 1985.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	Explain the rules of primary and secondary fragmentation in mass spectrometry.Based on the 2D NMR spectrum, determine the amino acid sequence of the peptide.List examples of fluorescent labeling methods (direct and indirect) for biomolecules.Describe the changes in the emission spectrum of tryptophan that will be recorded during denaturation of a protein containing this amino acid in a polar environment.	
Work placement	Not applicable	

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