

Subject card

Subject name and code	Graduate study lecture - Fundamentals of Sugar and Peptide Chemistry, PG_00179664						
Field of study	Chemistry						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2025/2026		
Education level	Master'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	1		Language of instruction		Polish		
Semester of study	2		ECTS credits		3.0		
Learning profile	academic		Assessment form		credit		
Conducting unit	Department of Organic Chemistry -> Faculty of Chemistry -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Barbara Dmochowska				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	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		10.0		40.0	80
Subject objectives	dr hab. Barbara Dmochowska:						
	To introduce the students with the nomenclature of sugars (IUPAC and other); To introduce the students the conformations of five-membered ring, six-sugar; To introduce the students to a steric and electron interactions in pyranoses; Learning the basics of calculating the composition of equilibrium mixture, calculate ΔG conformational equilibrium and a configuration;						
	dr hab. Magdalena Wysocka, prof. UG:						
	The purpose of the course is to familiarize students with the properties of amino acids and peptides, basic covering groups used in peptide synthesis, methods of peptide bond formation, strategy and tactics of peptide synthesis.						
Subject objectives	dr hab. Emilia Sikorska, prof. UG:						
	To deepen students' knowledge of both basic and advanced physicochemical methods used in the analysis of the structure, properties, and functions of peptides and sugars, as well as in the investigation of intermolecular interactions						

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.	*Appreciates and understands the role of sugars in human life; *Understands the need for further education in order to deeper understand of the reactions that occurs in the cells of a living organism; *Characterizes the basic analytical techniques used in the synthesis of peptides. *Understands the importance of lifelong learning in the information-driven society of the 21st century; *Respects ethical guidelines and copyright principles;	[SK1] oral statement/conversation/discussion
	[CHEMMU2_U02] Critically assesses the results of conducted, performed observations and theoretical calculations and discusses errors.	*Has the ability to critically evaluate the results of conducted experiments, observations and/or theoretical calculations; *Describes the basic side reactions that occur during the insertion and removal of protecting groups and the cleavage of a peptide from a solid support, characteristic of certain amino acid residues or peptide sequences.	[SU4] test/exam - oral or written
	[CHEMMU2_W05] Has extended knowledge in the field of the specialisation studied.	*Formulates and defines basic concepts and terminology used in carbohydrate chemistry; *Knows the rules of the IUPAC nomenclature for the chain and cyclic sugars; *Determines stereochemical relationships between monosaccharides; *Determines the factors affecting the size of the anomeric effect; *Distinguishes the anomeric effect and the reverse anomeric effect; *Presents the conformational and configuration energy, and determines the factors affecting delta G conformational and configuration energy; *Describes and characterizes basic protective groups, methods of their insertion and removal, and methods of peptide bond synthesis. *Understands the roles and significance of sugars and peptides in human life. *Is familiar with the operating principles and application areas of modern analytical techniques; *Has practical with knowledge of how physicochemical methods are used in research on peptides and sugars.	[SW4] test/exam - oral or written

Subject contents	dr hab. Barbara Dmochowska: - Nomenclature of D,L-sugars configuration. Enantiomers. Diastereoisomers. Epimers. Classification of sugars by functional groups other than OH. Family tree of diastereoisomers. IUPAC; - The family tree in acyclic forms: hemiacetals. Configuration (and the system of nomenclature) of the anomeric carbon atom: pyranoses, furanoses; - Anomeric configuration: mutarotation, optical activity, reduction, oxidation, enediol reactions, properties of the anomeric OH group, and the another OH groups, acetal structure, conversion from aldoses to ketoses. Isomerism monosaccharides in an aqueous solution; - The conformational isomerism (determination of the stability of erythro- and threo-but-2,3-diol). Conformations of acyclic sugar derivatives. The rules transforming Fisher formulas to a perspective formulas. Zig-zag arrangement of the carbon chain and crescent conformations, destabilizing effects: 1,2-syn and 1,3-syn; - The conformations of the pyranose rings (nomenclature). Conformation symbols to distinguish the epimers and diastereoisomeric sugars (furanoid ring system: E,T). Map of conformational transformation of the sugar ring. Energy diagram for sugars and cyclohexane. Steric and electronic effects in a pyranoses. Factors influencing the overall conformational energy value varieties pyranoses. Method of determining the interaction energy values based on the examination of non-binding equilibrium formation of borate complexes cyklitol models and selected pairs of anomers of sugars and their derivatives. The destabilizing effects; - The calculation of conformational and configuration ΔG equilibrium. Anomeric effect. Impact on the stability of the conformation of the sugar. The reverse anomeric effect. Solvent effects and the exo-anomeric effect. dr hab. Magdalena Wysocka, prof. UG: - Physical and chemical properties of amino acids. Coding (protein) and non-coding amino acids. - Structure and properties of peptide bonding. - Carboxyl group sheaths. Shields of the amino group. Shields of functional groups of side chains. - Peptide bond formation. Preactivation and in situ activation. - Classical synthesis of peptides in solution. Application of step-by-step synthesis, linking peptide fragments. Application of full synthesis of side-chain functional groups, strategy using minimal shielding of side-chain functional groups. Synthesis on solid support. Boc chemistry and Fmoc chemistry of peptide synthesis on solid support. - Structure and characterization of the most commonly used carriers in peptide synthesis. Typical amino acid derivatives used in solid carrier synthesis. Selection of solid carrier. - Manual, semi-automatic and automatic synthesis of peptides. Monitoring of acylation reactions in solid support synthesis. Separation of peptides from the solid carrier, their isolation and purification. Side reactions in peptide synthesis. - Difficult peptide sequences and difficult amino acid residues. Designing peptide synthesis. Solving basic problems that arise during synthesis. Basic analytical techniques used to determine the amino acid composition, sequence and purity of peptides. dr hab. Emilia Sikorska, prof. UG: - Characterization, chemical structure, and fundamental physicochemical properties of peptides and sugars. - Application of a range of analytical techniques including spectroscopic methods (UV-VIS, IR, NMR, CD, fluorescence), mass spectrometry (ESI-MS, MALDI-TOF), chromatography (HPLC, GC, SEC) and other complementary techniques (DSC, ITC, DLS, TEM) in the structural and functional analysis of peptides and sugars.		
Prerequisites and co-requisites	Organic chemistry, spectroscopic techniques. Knowledge of basic reactions in organic chemistry, basic types of organic compounds, functional groups in organic compounds and how to transform them, the concept of acidity/alkalinity in organic chemistry, knowledge of electron effects (inductive, mesomeric, superconjugation), conformation, hydrophobicity, hydrogen bonds, van der Waals dispersive and hydrophobic interactions.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
		51.0%	100.0%
Recommended reading	Basic literature	J. F. Stoddart: Stereochemistry of Carbohydrates. A. Wiśniewski, J. Madaj: Podstawy Chemii Cukrów. - Zbiorowa pod red. W. Zieliński i A. Rajca: Metody spektroskopowe ich zastosowanie do identyfikacji związków organicznych, WNT W-wa 1995, 2000. - R.M. Silverstein, F.X. Webster, D.J. Kiemle: Spektroskopowe metody identyfikacji związków organicznych, PWN W-wa 2007 W. Danikiewicz: Spektrometria mas: Podstawy i zastosowania, PWN W-wa 2020 - I.Z. Siemion: Biostereochemia, PWN Warszawa 1985. K. Wüthrich: NMR in biological research: peptides and proteins, North-Holland, Amsterdam 1976. - Internet: poszukiwania samodzielne, weryfikowane przez prowadzącego zajęcia. - Wysocka M., Materiały niepublikowane, udostępniane podczas zajęć - Jakubke H.D, Jeschkeit H.: Aminokwasy, peptydy białka (1989) wydanie drugie PWN, Warszawa	

	Supplementary literature	1. T. Sokołowska, A. Wiśniewski Nomenklatura węglowodanów odpowiednik Nomenclature of Carbohydrates (Recommendations 1996), Wrocław 2000 2. B. O. Fraser-Reid, K. Tatsuta, J. Thiem Glycoscience: Chemistry and chemical Biology 3. G-J Boons, K. J. Hale Organic Synthesis with Carbohydrates 4. S. A. Brooks, M. V. Dwek, U. Schumacher Functional & Molecular Glycobiology 5. P. Crabbé Metody chiralooptyczne w chemii 6. J. Świderski, J. Struciński, A. Temeriusz Podstawy chemii węglowodanów 7. Shawn Doonan: Białka i peptydy (2008), PWN Warszawa
	eResources addresses	
Example issues/ example questions/ tasks being completed	Questions on the program content of the course lecture.	
Work placement	Not applicable	

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