

Subject card

Subject name and code	Graduate study lecture - Simple sugars – structure and stereochemistry, PG_00040376						
Field of study	Chemistry						
Date of commencement of studies	October 2024	Academic year of realisation of subject			2024/2025		
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	1	Language of instruction			Polish		
Semester of study	2	ECTS credits			3.0		
Learning profile	academic	Assessment form			credit		
Conducting unit	Laboratory of Carbohydrate Chemistry -> 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		5.0		40.0	75
Subject objectives	<ul style="list-style-type: none"> • To introduce students to the basic division of sugars according to the number of carbon atoms; • to introduce students to the nomenclature of sugars (IUPAC and customary); • to introduce students to the conformations of the five-membered ring, six-membered ring of sugar and cyclic unsaturated systems; • to introduce students to steric and electron interactions in pyranoses; • learning the basics of calculating the composition of the equilibrium mixture, calculating G of conformational and configurational equilibrium; • learning the basics of physical methods of construction monosaccharides. 						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[CHEMMU2_W05] Has extended knowledge in the field of the specialisation studied.	<ul style="list-style-type: none"> Formulates and defines basic laws and concepts used in carbohydrate chemistry. Knows the IUPAC nomenclature rules for chain and cyclic sugars. Distinguishes stereochemical relationships between monosaccharides. Identifies factors affecting the magnitude of the anomeric effect. Differentiates between the anomeric effect and the reverse anomeric effect. Presents conformational and configurational equilibrium and identifies factors affecting ΔG of conformational and configurational equilibrium. Knows the physical methods for studying the structure of sugars in carbohydrate chemistry and the spectral characteristics of sugars and their derivatives. 	[SW4] test/exam - oral or written
	[CHEMMU2_K01] Knows the limitations of her/his own knowledge; understands the need for further education and can inspire other people to do so.	<ul style="list-style-type: none"> Appreciates and understands the role of sugars in human life. Understands the need for further education to gain a deeper understanding of the reactions occurring in living organism cells. 	[SK1] oral statement/conversation/discussion
[CHEMMU2_U02] Critically assesses the results of conducted, performed observations and theoretical calculations and discusses errors.	<ul style="list-style-type: none"> Possesses the ability to critically evaluate the results of experiments, observations, and/or theoretical calculations. 	[SU4] test/exam - oral or written	
Subject contents	<p>Topics of the lectures:</p> <ol style="list-style-type: none"> The occurrence and the role of sugars in nature. Classified sugars according to the number of carbons. Structure and constitution of the parent monosaccharides in the acyclic form (aldose and ketose family tree). The Fischer and Newman projection of the acyclic forms. Nomenclature of D,L-sugars configuration. Enantiomers. Diastereoisomers. Epimers. Classification of sugars by functional groups other than OH. Family tree of diastereoisomers. IUPAC and trivial nomenclature of sugars higher than hexacarbons and modification sugars. The family tree in acyclic forms: hemiacetals. Configuration (and the rules of nomenclature) of the anomeric carbon atom: piranoses, furanoses and sugars having carbon numbers greater than six. 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. The constitutional isomerism monosaccharides in an aqueous solution. Structure and naming of selected monosaccharides: O- and N-glycosides, deoxysugar, glycosyl halides, unsaturated monosaccharides, disaccharides, oligosaccharides, uronic acids, aldaric acids. Vitamin C. The Mills depiction. The conformational isomerism (determination of the stability of erythro- and threo-but-2,3-diol). Conformations of acyclic sugar derivatives. The rules transformation Fisher formulas to a perspective formulas. Zig-zag and crescent conformations, destabilizing effects: 1,2-syn and 1,3-syn. The conformations of the pyranose rings (nomenclature). Conformational symbols to distinguish the epimers and diastereoisomeric sugars. 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 cyclitol models and selected pairs of anomers of sugars and their derivatives. The destabilizing effects. The calculation of conformational and configuration G equilibrium. Anomeric effect. Impact on the stability of the conformation of the sugar. The reverse anomeric effect. Solvent effects and the exo-anomeric effect. Physical methods analysis of carbohydrates: Infrared Spectroscopy, NMR spectroscopy (information about: the chemical shifts of the signals; their integration; the coupling constants J deduced from the detected multiplets), determination of the composition of the equilibrium mixture of free sugars in D₂O, determination of pyranose configuration, spin-spin coupling, relations configuration of protons in pyranose and furanose rings, long range coupling, spectra analysis, ¹³C NMR comparison to the furanose and pyranose. 		
Prerequisites and co-requisites	Organic chemistry, Spectroscopic techniques.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	The final course grade is determined by the average of the grades of the written three tests of the individual parts of the lecture or one grade of the written overall test.	51.0%	100.0%

Recommended reading	Basic literature	J. F. Stoddart <i>Stereochemistry of Carbohydrates</i> A. Wiśniewski, J. Madaj <i>Podstawy Chemii Cukrów</i>
	Supplementary literature	T. Sokołowska, A. Wiśniewski <i>Nomenklatura węglowodanów</i> odpowiednik <i>Nomenclature of Carbohydrates</i> (Recommendations 1996) B. O. Fraser-Reid, K. Tatsuta, J. Thiem <i>Glycoscience: Chemistry and chemical Biology</i> G-J Boons, K. J. Hale <i>Organic Synthesis with Carbohydrates</i> S. A. Brooks, M. V. Dwek, U. Schumacher <i>Functional & Molecular Glycobiology</i> P. Crabbé <i>Metody chiralooptyczne w chemii</i> J. Świdorski, J. Struciński, A. Temeriusz <i>Podstawy chemii węglowodanów</i>
	eResources addresses	
Example issues/ example questions/ tasks being completed	questions from the program content of the lecture	
Work placement	Not applicable	

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