


KAPITAŁ LUDZKI
 NARODOWA STRATEGIA SPÓJNOŚCI

 Projekt współfinansowany przez
 Unię Europejską w ramach
 Europejskiego Funduszu
 Społecznego

UNIA EUROPEJSKA
 EUROPEJSKI
 FUNDUSZ SPOŁECZNY


Course title		ECTS code	
Graduate study lecture - Simple sugars – structure and stereochemistry		13.3.0395	
Name of unit administrating study			
Faculty of Chemistry			
Studies			
faculty	field of study	type	drugiego stopnia
Wydział Chemii	Chemia	form	stacjonarne
		specjalty	chemia biomedyczna, chemia i technologia środowiska, analityka i diagnostyka chemiczna, chemia obliczeniowa
		specialization	wszystkie
Teaching staff			
dr Barbara Dmochowska			
Forms of classes, the realization and number of hours		ECTS credits	
Forms of classes		3	
Lecture		classes 30 h	
The realization of activities		tutorial classes 10 h	
classroom instruction		studnet;s own work 35 h	
Number of hours		TOTAL: 75 h - 3 ECTS	
Lecture: 30 hours			
The academic cycle			
2022/2023 summer semester			
Type of course		Language of instruction	
obligatory		polish	
Teaching methods		Form and method of assessment and basic criteria for evaluation or examination requirements	
multimedia-based lecture		Final evaluation	
		Graded credit	
		Assessment methods	
		(mid-term / end-term) test	
		The basic criteria for evaluation	
		positive grade from the written test consisting of 10 or 12 open questions covering only the issues listed in the lecture	
Method of verifying required learning outcomes			
Required courses and introductory requirements			
A. Formal requirements			
Organic Chemistry			
B. Prerequisites			
Organic Chemistry, Technics of Spectroscopy			
Aims of education			
To introduce the students with a fundamental types of sugars, depending on the number of carbon atoms;			
To introduce the students with the nomenclature of sugars (IUPAC and other);			
To introduce the students the conformations of five-membered ring, six-sugar and unsaturated cyclic systems;			
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;			
Learning the basics of physical methods of construction monosaccharides			
Course contents			

Topics of the lectures:

The occurrence and the role of sugars in nature.

Classification of sugars according to the number of carbon atoms. 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 an alternate nomenclature of sugars higher than hexacarbons and modification sugars.

The family tree in acyclic forms: hemiacetals. Configuration (and the system of nomenclature) of the anomeric carbon atom: pyranoses, furanoses and sugars having carbon numbers more 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. 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 projection formulas.

The conformational isomerism (determination of the stability of erythro- and threo-but-2,3-diol). Conformations of acyclic sugar derivatives. The rules transforming Fischer 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 cyclitol 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.

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 unprotected 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 spectra of furanose and pyranose.

The chiroptical spectroscopic methods (optical activity, circular dichroism, Cotton effect, optical rotatory dispersion (ORD) curves).

Bibliography of literature

Literature required to pass the course

A. Literatura wymagana do ostatecznego zaliczenia zajęć (zdania egzaminu):

J. F. Stoddart – Stereochemistry of Carbohydrates

A. Wiśniewski, J. Madaj – Podstawy Chemii Cukrów

A.1. Literatura wykorzystywana podczas zajęć

A. Wiśniewski, J. Madaj – Podstawy Chemii Cukrów, Agra-Emviro, 1997

T. Sokołowska, A. Wiśniewski – Nomenklatura węglowodanów – odpowiednik Nomenclature of Carbohydrates (Recommendations 1996), Wrocław 2000

B. O. Fraser-Reid, K. Tatsuta, J. Thiem – Glycoscience: Chemistry and chemical Biology

G-J Boons, K. J. Hale – Organic Synthesis with Carbohydrates

S. A. Brooks, M. V. Dwek, U. Schumacher – Functional & Molecular Glycobiology

P. Crabbé – Metody chiralooptyczne w chemii

B. Extracurricular readings

2. studiowana samodzielnie przez studenta

B. Literatura uzupełniająca:

J. Świdorski, J. Struciński, A. Temeriusz – Podstawy chemii węglowodanów

The learning outcomes (for the field of study and specialization)**Knowledge**

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 ΔG conformational and configuration energy, knows the physical methods for testing the structure of monosaccharides in carbohydrate chemistry and the properties of unprotected sugars and their derivatives spectra, indicates the factors affecting the characteristic value.

Skills

Has the ability to critically evaluate the results of conducted experiments,

	observations and / or theoretical calculations.
	Social competence
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.	
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