KAPITAŁ LUDZKI
NARODOWA STRATEGIA SPÓJNOŚCI
Projekt współfinansowany przez Unię Europejską w ramach Europejskiego Funduszu Społecznego
UNIA EUROPEJSKA
EUROPEJSKI FUNDUSZ SPOŁECZNY

Course title

Graduate study lecture - Simple sugars – structure and stereochemistry

ECTS code

13.3.0395

Name of unit administrating study

Faculty of Chemistry

Studies

faculty	field of study		
Wydział Chemii	Chemia	type	drugiego stopnia
		form	stacjonarne
		specialty	chemia biomedyczna, analityka i diagnostyka chemiczna, chemia i technologia środowiska, chemia obliczeniowa
		specialization	wszystkie

Teaching staff

dr Barbara Dmochowska

Forms of classes, the realization and number of hours

Forms of classes

Lecture

The realization of activities

classroom instruction

Number of hours

Lecture: 30 hours

ECTS credits

3
classes 30 h
tutorial classes 10 h
studnet;s own work 35 h
TOTAL: 75 h - 3 ECTS

The academic cycle

2022/2023 summer semester

Type of course

obligatory

Language of instruction

polish

Teaching methods

multimedia-based lecture

Form and method of assessment and basic criteria for eveluation or examination requirements

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 mor 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 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.
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 chiralooptical 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. Świderski, 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 DG 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.

Contact

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