GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Bioorganic Chemistry and Stereochemistry, PG_00058276		
Field of study	Biotechnology		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
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	general academic profile	Assessment form	assessment
Conducting unit	Department of Organic Chemistry -> Faculty of Chemistry		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Maria Milewska	
	Teachers	prof. dr hab. inż. Maria Milewska dr inż. Andrzej Skwarecki dr hab. Sławomir Makowiec	

Lesson types and methods of instruction

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	2.0	18.0	50

Subject objectives

Broadening of knowledge on biologically active compounds, especially concerning structure-activity relationship, including the optically active molecules.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U04] is able to predict potential properties of biomolecules and biologically active compounds on the basis of knowledge of their chemical structure and apply methods of molecular modelling of biomolecules	The student has in-depth knowledge of organic compounds with particular emphasis on stereochemical aspects	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W02] has advanced knowledge of structure and activity of enzymes and biologically active compounds also in pharmacological context, knows basic instrumental methods of qualitative and quantitative analysis and activity studies of biomolecules	The student knows how to plan the asymmetric synthesis of organic compounds, also this of macromolecular compounds, is able to recognize the chirality of the molecule. The student knows how to plan the synthesis of organic compounds, taking into account systemic and non-technical aspects, to obtain products with specific properties and applications.	[SW1] Assessment of factual knowledge
[K7_K02] is aware of the limitations and the necessity of continuous development of knowledge and technology; understands the need for education and constant training	The student updates the state of knowledge about stereochemistry and biological activity of biomolecules; understands the need for education and training throughout life.	[SK2] Assessment of progress of work

Subject contents

Biostereochemistry

1. Conformation of carbon compounds - parameters of molecular geometry; conformations of linear compounds non-bonding interactions; conformations of cyclic compounds; anomeric effect

2. Configuration and chirality of a molecule - elements of symmetry and operations of symmetry; point groups of symmetry examples of molecules; chiral molecules with more than one stereogenic center; configurations meso, erythro/threo and syn/anti; epimers; chirality of molecules lacking stereogenic centers, axial and plane chirality, intrinsically dissymmetric molecules; separation of stereoisomers; resolution; applications of circular dichroism

3. Dynamic stereochemistry - heterotopic and homotopic ligands and faces; heterotopicity and NMR spectroscopy, nomenclature Re/Si; conformational and configurational changes racemisation and epimerisation processes; inversion of configuration; inhibition of free rotation around a bound atropoisomerism; conformational equillibria in cyclic systems ring inversions

4. Carbohydrates stereochemical issues in carbohydrates; pyranose ring configuration and conformation; interactions between substituents in pyranose rings; determination of ring size, pyranose and furanose forms; anchimeric effect neighboring group effect

5. Amino acids stereochemical issues in amino acids; peptide bond structure; Ramachandran diagram; racemization of amino acids and their derivatives

6. Organocatalysts synzymes; types of organocatalysts; reactions catalyzed by organocatalysts; enantiomeric and diastereomeric excess; mechanisms of catalysis using synzymes

7. Steroids structure of steroids; steroid reactivity; stereochemical problems in steroids

Bioorganic chemistry

1. Nucleic acids Basic interactions in DNA. Biosynthesis, chemical synthesis and separation of DNA. Chemical reactions involving DNA. RNA structure. RNA biosynthesis and degradation.
2. Proteins and peptides Chemical synthesis of peptides on the solid phase. Protein kinases and proteases mechanisms of action. Enzymes using organic cofactors.
3. Carbohydrates - Chemistry and enzymology of the glycosidic bond. Glycans: polysaccharides. Glycans: glycoproteins. Chemical synthesis of oligosaccharides.
4. Polyketides Chemical structure and biosynthesis. Polyketides in the human body. Other natural polyketides
5. Terpenes Human terpenes chemical structure and biosynthesis. Other terpenes of natural origin.

Prerequisites and co-requisites

Knowledge of basic principles of organic chemistry, in particular issues related to chirality and sterochemistry.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Written examination part I - Biostereochemistry	55.0%	50.0%
Written examination part II - Bioorganic Chemistry	55.0%	50.0%

Recommended reading

Basic literature

1. D. van Vranken, G. Weiss, *Introduction to Bioorganic Chemistry and Chemical Biology*, Garland Science Taylor & Francis Group, New York and London 2013
2. E. L. Eliel, S. H. Wilen, L. N. Mander, *STEREOCHEMISTRY OF ORGANIC COMPOUNDS*, J. Wiley&Sons, Inc., 1994
3. N. Purdie, H.G. Brittain, *Analytical Applications of Circular Dichroism ,* Elsevier Science B.V., 1994
4. B. C. Serban, M. Bumbac, I. Schiketanz, C. M. Nicolescu, M. V. Popescu, O. Buju, *Organic Sterochemistry Basic Concepts and Applications*, PRINTECH ISBN: 978-606-23-0885-8

Supplementary literature

1. G. L. Patrick, An introduction to medicinal chemistry sixth edition, Oxford University Press, Oxford 2017
2. P. Kafarski, B. Lejczak, Chemia Bioorganiczna, Polskie Wydawnictwo Naukowe 1994
3. C. H. Wong, G. M. Whitesides ENZYMES IN SYNTHETIC ORGANIC CHEMISTRY, Pergamon 1995
4. M. Nogradi,*Stereochemia. Podstawy i zastosowania,* PWN Warszawa, 1988
5. I. Z. Siemion *Biostereochemia*, PWN Warszawa, 1985

eResources addresses

Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	1. Determine the R / S configuration of all the stereogenic mevinoline centers 2. Calculate the specific rotation of coniine, the toxic component of poison hemlock, if a solution containing 0.75g/10 mL is placed in a 1-dm polarimeter tube and observed rotation at 25^{o}C (D line) is +1.2^{o}. What is the specific rotation of the enantiomer of coniine? 3. How many chiral C's are there in an open-chain (a) aldohexose such as glucose and (b) 2-ketohexosese such as fructose? Hoe many stereoisomers does an aldohexose have? 4. Propose the arrow-pushing mechanisms for the reactions catalysed by all domains of human fatty acids synthase.
Work placement	Not applicable

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