



Subject card

Subject name and code	BIOORGANIC CHEMISTRY AND STEREOCHEMISTRY, PG_00065572						
Field of study	Biotechnology						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2026/2027		
Education level	second-cycle studies		Subject group		Optional subject group Specialty subject group 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 -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		prof. dr hab. inż. Maria Milewska				
	Teachers		prof. dr hab. inż. Maria Milewska				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	15.0	45
	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	45		2.0		13.0	60
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_W02] explains the structure and function of biomolecules and the methods and instruments for determining their quantity and activity		has the necessary knowledge to discuss the potential properties of biomolecules and biologically active compounds based on an understanding of their chemical structure; is able to determine their biological activity		[SW1] Assessment of factual knowledge		
	[K7_U04] predicts the interaction of biomolecules and biologically active compounds on living organisms and the course of processes involving them based on knowledge in biology, biotechnology and related fields and computer methods of data analysis, modeling and simulation		knows how to plan the asymmetric synthesis of organic compounds, also this of macromolecular compounds, is able to recognize the chirality of the molecule; knows how to plan the synthesis of organic compounds, taking into account systemic and nontechnical aspects, to obtain products with specific properties and applications.		[SU3] Assessment of ability to use knowledge gained from the subject		
	[K7_K02] is aware of the potential risks and opportunities associated with the development of science and technology for the natural environment and society		is ready to independently improve their knowledge of the biological effects of organic molecules, particularly on living organisms and the natural environment.		[SK2] Assessment of progress of work		

Subject contents	Course content – lecture		
	Biostereochemistry		
	1. Conformation of carbon compounds - parameters of molecular geometry; conformations of linear and 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; axial and plane chirality, intrinsically dissymmetric molecules; separation of stereoisomers; resolution; 3. Dynamic stereochemistry - heterotopic and homotopic ligands and faces; conformational and configurational changes racemisation and epimerisation processes; inversion of configuration; inhibition of free rotation around a bound atropoisomerism; 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; 6. Organocatalysts synzymes; types of organocatalysts; reactions catalyzed by organocatalysts; 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.		
	Course content – seminar		
	Molecular Machines Preparation and Application Chemical Synthesis of Oligonucleotides (Gene Synthesis) Ribozymes in Medicine Peptide Nucleic Acids Nanocarriers in Medicine Chemistry and Doping in Sports Chemistry of Addiction Photosensitizers in Anticancer Therapy C-C Bond Formation Catalyzed by Vitamin B ₁₂ Enzymatic Synthesis of the Glycosidic Bond		
Prerequisites and co-requisites	Knowledge of basic principles of organic chemistry, in particular issues related to chirality and stereochemistry.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Presentation on a selected topic	60.0%	10.0%
	Written examination part II - Bioorganic Chemistry	59.0%	45.0%
	Written examination part I - Biostereochemistry	59.0%	45.0%
Recommended reading	Basic literature	1. D. van Vranken, G. Weiss, <i>Introduction to Bioorganic Chemistry and Chemical Biology</i> , Garland Science Taylor & Francis Group, New York and London 2013	
		2. E. L. Eliel, S. H. Wilen, L. N. Mander, <i>STEREOCHEMISTRY OF ORGANIC COMPOUNDS</i> , J. Wiley&Sons, Inc., 1994	
		3. N. Purdie, H.G. Brittain, <i>Analytical Applications of Circular Dichroism</i> , Elsevier Science B.V., 1994	
		4. B. C. Serban, M. Bumbac, I. Schiketanz, C. M. Nicolescu, M. V. Popescu, O. Buju, <i>Organic Stereochemistry Basic Concepts and Applications</i> , 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, <i>Stereochemia. Podstawy i zastosowania</i>, PWN Warszawa, 1988 5. I. Z. Siemion <i>Biostereochemia</i>, PWN Warszawa, 1985
	eResources addresses	
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°C (D line) is +1.2°. 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-ketohexoses such as fructose? How many stereoisomers does an aldohexose have? 4. Propose the arrow-pushing mechanisms for the reactions catalysed by all domains of human fatty acids synthase.	
Practical activities within the subject	Not applicable	

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