GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

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|---|---|---|---|
| Subject name and code | BIOORGANIC CHEMISTRY AND STEREOCHEMISTRY, PG_00065572 | | |
| Field of study | CHEMIA BIOORGANICZNA I BIOSTEREOCHEMIA | | |
| Date of commencement of studies | October 2024 | Academic year of realisation of subject | 2025/2026 |
| Education level | second-cycle studies | Subject group | Optional subject group<br>Specialty subject group<br>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 -> Wydziały Politechniki Gdańskiej | | |
| Name and surname of lecturer (lecturers) | Subject supervisor | prof. dr hab. inż. Maria Milewska | |
| | Teachers | prof. dr hab. inż. Maria Milewska<br>dr inż. Andrzej Skwarecki<br>dr hab. Sławomir Makowiec | |

**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

eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=1085

Moodle ID: 1085 CHEMIA BIOORGANICZNA I BIOSTEREOCHEMIA
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Additional information:

Każdy z egzaminów musi być zaliczony na co najmniej 40%, przy czym sumaryczny wynik z trzech elementów musi być co najmniej 59%

**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_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 | 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 nontechnical aspects, to obtain products with specific properties and applications. | [SU3] Ocena umiejętności wykorzystania wiedzy uzyskanej w ramach przedmiotu |
| | [K7_K02] is aware of the potential risks and opportunities associated with the development of science and technology for the natural environment and society | The student updates their knowledge of the biological effects of organic molecules, particularly on living organisms and the natural environment. | [SK2] Ocena postępów pracy |
| | [K7_W02] explains the structure and function of biomolecules and the methods and instruments for determining their quantity and activity | The student is able to explain the potential properties of biologically active compounds based on the knowledge of their chemical structure; is able to determine their biological activity | [SW1] Ocena wiedzy faktograficznej |

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| Subject contents | **Biostereochemistry**<br><br>1. Conformation of carbon compounds - parameters of molecular geometry; conformations of linear and of cyclic compounds; anomeric effect<br><br>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;<br><br>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;<br><br>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<br><br>5. Amino acids stereochemical issues in amino acids; peptide bond structure;<br><br>6. Organocatalysts synzymes; types of organocatalysts; reactions catalyzed by organocatalysts; mechanisms of catalysis using synzymes<br><br>7. Steroids structure of steroids; steroid reactivity; stereochemical problems in steroids<br><br>**Bioorganic chemistry**<br><br>1. Nucleic acids Basic interactions in DNA. Biosynthesis, chemical synthesis and separation of DNA. Chemical reactions involving DNA. RNA structure. RNA biosynthesis and degradation.<br>2. Proteins and peptides Chemical synthesis of peptides on the solid phase. Protein kinases and proteases mechanisms of action. Enzymes using organic cofactors.<br>3. Carbohydrates - Chemistry and enzymology of the glycosidic bond. Glycans: polysaccharides. Glycans: glycoproteins. Chemical synthesis of oligosaccharides.<br>4. Polyketides Chemical structure and biosynthesis. Polyketides in the human body. Other natural polyketides<br>5. Terpenes Human terpenes chemical structure and biosynthesis. Other terpenes of natural origin.<br><br>Molecular Machines Preparation and Application<br>Chemical Synthesis of Oligonucleotides (Gene Synthesis)<br>Ribozymes in Medicine<br>Peptide Nucleic Acids<br>Nanocarriers in Medicine<br>Chemistry and Doping in Sports<br>Chemistry of Addiction Photosensitizers in Anticancer Therapy<br>C-C Bond Formation Catalyzed by Vitamin $B_{12}$<br>Enzymatic Synthesis of the Glycosidic Bond |
| 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 |
|---|---|---|
| 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, *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

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|---|---|---|
| | Supplementary literature | 1. G. L. Patrick, An introduction to medicinal chemistry sixth edition, Oxford University Press, Oxford 2017<br>2. P. Kafarski, B. Lejczak, Chemia Bioorganiczna, Polskie Wydawnictwo Naukowe 1994<br>3. C. H. Wong, G. M. Whitesides ENZYMES IN SYNTHETIC ORGANIC CHEMISTRY, Pergamon 1995<br>4. M. Nogradi,*Stereochemia. Podstawy i zastosowania,* PWN Warszawa, 1988<br>5. I. Z. Siemion *Biostereochemia*, PWN Warszawa, 1985 |
| | eResources addresses | |
| Example issues/ example questions/ tasks being completed | 1. Determine the R / S configuration of all the stereogenic mevinoline centers<br><br>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 25ºC (D line) is +1.2º. What is the specific rotation of the enantiomer of coniine?<br><br>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?<br><br>4. Propose the arrow-pushing mechanisms for the reactions catalysed by all domains of human fatty acids synthase. | |
| Practical activites within the subject | Not applicable | |

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