University of Gdańsk

Subject card

Subject name and code	Synthesis of biologically active compounds, PG_00117755						
Field of study	Chemistry						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2024/2025			
Education level	postgraduate studies		Subject group	Obligatory subject group in the field of study			
Mode of study	full-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	Polish Polish			
Semester of study	2		ECTS credits	3.0			
Learning profile	academic		Assessment form				
Conducting unit	Pracownia Chemii Związków Biologicznie Czynnych -> Katedra Biochemii Molekularnej -> Faculty of Chemistry						
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. Piotr Rekowski					
	Teachers						
Lesson types	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		5.0	40.0	75	
Subject objectives	familiarization with the nomenclature used in the chemistry of peptides, sugars, chiral compounds familiarization with the methods of peptide bond synthesis, organic asymmetric syntheses, glycoamine conjugate syntheses familiarization with the methods of determining the structure of the polysaccharide part of a glycopeptide familiarization with the methods of forming an O-glycosidic bond and the synthesis of oligosaccharides knowledge about optically active compounds and methods for determining optical purity familiarizing students with methods of synthesizing racemic compounds						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[CHEMMU2_W04] Applies the acquired knowledge to an in-depth description of the properties of chemical connections, methods of their synthesis and analysis.	1. Names amino acid derivatives, peptides and their derivatives 2. Lists protective groups and those used in peptide synthesis 3. Characterizes methods of peptide bond formation 5. Shows the state of equilibrium of simple sugar in solution 6. Lists ways to activate the anomeric carbon atom 7. Lists the effects of the anomeric effect in mono-, oligo- and polysaccharides 8. Describes the conditions of optical isomerism and its role in interactions with biological objectives. 11. Gives examples of optically active compounds having an asymmetry center, asymmetry axis and asymmetry plane. 12. Lists, compares and characterizes basic methods for determining optical purity of compounds. Identifies error sources specific to each method. 13. Distinguishes between a racemic compound, a racemic mixture and a meso compound. 14. Has general knowledge about the basic methods of obtaining optically active compounds and the scope of their application. 3. Defines the basic concepts related to the determination of optical purity of chemical compounds	[SW4] test/exam - oral or written

Course outcome	Subject outcome	Method of verification
[CHEMMU2_U02] Critically assesses the results of conducted, performed observations and theoretical calculations and discusses errors.	1. Uses chemical terminology to the extent necessary for the presentation (in written and oral form) of the course content 2. Designs peptide synthesis in a schematic form Synthesis of biologically active compounds #13.3.0448 | 1aba4c5fc2fff561e9d0b4bf6163842 | Strona 3 z 4 Synthesis of biologically active compounds #13.3.0448 Sylabusy - Centrum Informatyczne UG Dział Kształcenia 3. Anticipates the possibility of some adverse reactions during peptide synthesis 4. Proposes methods for determining the structure of the sugar part in glycopeptide and glycoamino acid 5. Draws conclusions from the fragmentation of MS alditoli obtained after hydrolysis and reduction of the high molecular sugar portion of the glycopeptide 6. Suggests O- and N-glycosidic linking of sugar and amino acid 7. Performs the synthesis of amino acid derivatives and performs their characterization 8. Separates the racemic mixture of amino acids 9. Measures the specific rotation of isolated compounds and analyzes the results of conducted experiments 10. Performs calculations of enantiomeric (diastreomeric) excess based on the provided experimental data.	[SU4] test/exam - oral or written
[CHEMMU2_K02] Works in a team taking on various roles in it.	1. Appreciates the need for teamwork skills through discussion and consultation 2. Demonstrates responsibility in laboratory work (including for work tools entrusted	[SK4] test/exam - oral or written
[CHEMMU2_K04] Correctly identifies and resolves dilemmas related to the profession of a chemist.	1. Is aware of the need for critical analysis of own work, shows creativity in the search for alternative solutions to him, generally available apparatus and laboratory equipment) 2. Appreciates the need to continually expand knowledge and practical skills 3. Be careful when handling chemicals	[SK4] test/exam - oral or written
[CHEMMU2_W10] Uses knowledge of the principles of operation of the basic scientific and research apparatus used in chemistry.	1. Illustrates the principles of solid-peptide synthesis 2. Lists ways of forming O- and N-glycosidic bond with amino acids 3. Presents the basic methods for determining optical purity and understands the sources of errors in measuring the purity of each of these methods.	[SW4] test/exam - oral or written

Subject contents	**Problems of the lecture:** **Part I** (Peptide synthesis) will be devoted to the chemical synthesis of peptides, including such issues as: the chemical structure of protein amino acids; peptide bond; amino, carboxyl, alcohol, guanidine, thiol, imidazole, indole, amide function protecting groups; putting on and taking off covers from the mentioned groups and advantages and disadvantages of the discussed protective groups; prevention of adverse reactions and processes during the use of protective groups; methods of peptide bond synthesis: azide, anhydride, active esters, carbodiimide, phosphorus and uronium compounds, tactics and strategy for chemical peptide synthesis; tactics for the synthesis of Boc / Bzl and Fmoc / t-Bu (Trt); solid support peptide synthesis (Merrifield synthesis); racemization during peptide synthesis, carrier resins; **Part II** (Synthesis of structure and properties of the sugar part of glycoconjugates) will cover such issues as: definitions of glyconjugates, in particular glycoamino acids and glycopeptides, structure of a simple sugar molecule, instability factors, equilibrium state in solution, methods of glycoside formation (O- and N -), methods of selective blocking and removal of hydroxyl groups, anomeric effect and its effects, qualitative analysis of the sugar part of a glycoamino acid or glycopeptide, selected methods of Can-N bond formation and methods of purification of formed compounds. **Part III** (Organic Asymmetric Synthesis) covers the following topics: Optical Isomerism. The importance of optical isomerism for the biological activity of compounds. Chirality. Center, axis and plane of asymmetry. Enantiomers and diastereomers. Racemic mixture, racemic compound, solid racemic solution, meso isomer and their physicochemical properties. Optical purity of chemical compounds. Enantiomeric and diastereomeric excess. Methods for determining the optical purity of compounds: polarimetry, NMR methods (Mosher's reagent and its derivatives, chemical shift reagents, chiral solvents). Chromatographic techniques in determining the optical purity of compounds and preparative separation of enantiomers. Chromatography of diastereomers. Liquid and gas chromatography on chiral phases. Types of chiral phases and the scope of their application. Methods of obtaining optically active compounds. Methods of separation of racemic mixtures / compounds: formation of diastereomeric compounds, kinetic separation of racemic mixtures / compounds. Asymmetric synthesis. The use of a chiral auxiliary group. The use of enzymes to separate racemic mixtures / compounds. Biotechnological methods for obtaining optically active compounds and comparison of these methods with chemical synthesis. Asymmetric synthesis of amino acids. The use of enzymes in asymmetric synthesis. The use of microorganisms to obtain optically active compounds.
Prerequisites and co-requisites	Completed courses in organic chemistry, biochemistry, physical chemistry, chemical spectroscopy
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
written exam with open questions	51.0%	100.0%

Recommended reading	Basic literature	-Shwan Doonan, "Peptides and Proteins" PWN, Warsaw 2007. - H.-D. Jakubke, H. Jeschkeit, "Amino acids, peptides, proteins", PWN, Warsaw, 1989. - A. Kołodziejczyk "Natural organic compounds", PWN, 2003. - Fundamentals of Chemistry of Carbohydrates, Świderski J., Strusiński J., Temeriusz A., 1973. - Fundamentals of Sugar Chemistry, Wiśniewski A., Madaj, J., 1997. - Współczesna synteza organiczna, J. Gawroński, Wydawnictwo naukowe PWN
	Supplementary literature	Literature supplementing other textbooks discussing issues in the chemistry of amino acids, sugar peptides and asymmetric synthesis.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1, Design the peptide synthesis 2. Preparation of the glycosyl donor and acceptor for the synthesis of a glycosidic bond. 3.. Methods of separation of racemic mixtures	
Work placement	Not applicable	

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