GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Lipidomics and glycomics, PG_00070036		
Field of study	InfoBioChem		
Date of commencement of studies	February 2026	Academic year of realisation of subject	2025/2026
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	1	Language of instruction	Polish
Semester of study	1	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Analytical Chemistry -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Agata Kot-Wasik	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	45.0	0.0	60

E-learning hours included: 0.0

eNauczanie source addresses:

Moodle ID: 2861 Lipidomika i glikomika
https://enauczanie.pg.edu.pl/2025/course/view.php?id=2861

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	60	5.0	10.0	75

Subject objectives

The course "Lipidomics and Glycomics" aims to introduce students to the theoretical and practical aspects of studying lipids and glycans, as well as modern analytical techniques in these fields. Students gain knowledge of the biology of lipids and glycans, including phospholipids, sphingolipids, triacylglycerols, N- and O-glycans, glycosaminoglycans, and gangliosides. The course covers the basics of liquid chromatography, mass spectrometry, extraction methods, and practical aspects of LC-MS analysis, including identification, quantification, and MS/MS spectrum interpretation. Students learn to design lipidomic and glycomic studies, prepare and analyze data using chemometric and statistical methods, work with databases, and integrate omics data, enabling comprehensive interpretation of results and assessment of the biological significance of lipids and glycans.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K7_K02] is ready to work in a team, taking on various roles depending on the needs of the task.	The student can collaborate effectively in a team during lipidomic and glycomic studies, performing different roles as required, participating in sample preparation, LC-MS analysis, MS/MS interpretation, chemometric and statistical analysis, and working with databases.	[SK3] Assessment of ability to organize work [SK1] Assessment of group work skills
	[K7_W02] has in-depth knowledge of omics science, including the principles of generating, analyzing, and interpreting omics data.	The student has advanced knowledge in omics sciences, understands the principles of generating, analyzing, and interpreting omics data, can use modern bioinformatics and chemometric tools, and collaborate effectively in a team when analyzing data, sharing knowledge and results efficiently.	[SW3] Assessment of knowledge contained in written work and projects [SW2] Assessment of knowledge contained in presentation
	[K7_U02] is able to use IT tools for operations on nucleotide and protein sequences.	The student can use computational tools to perform operations on nucleotide and protein sequences, including homology searches, sequence comparisons, and basic data analysis, and collaborate effectively in a team when analyzing sequences.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
	[K7_K01] is ready to determine the priorities of activities in the implementation of his/her own tasks or those assigned by others	The student can plan and conduct lipidomic and glycomic studies, including sample preparation, LC-MS analysis, MS/MS interpretation, and chemometric and statistical data analysis, use databases, and set priorities in individual and team work.	[SK2] Assessment of progress of work

Subject contents	Course content – lecture Introduction to the course, lipidomics and glycomics; biology of lipids and glycans; basics of liquid chromatography and mass spectrometry; extraction methods; LC-MS quantitative analysis; MS/MS interpretation; study design; data preparation, chemometric and statistical analysis; omics data integration; applications and results interpretation. **Lecture:** 1. Introduction to the course and to lipidomics and glycomics (WHB) 2. Biology of lipids and glycans (phospholipids, sphingolipids, triacylglycerols, N- and O-glycans, glycosaminoglycans, gangliosides) (WHB) 3. Basics of liquid chromatography 1 (AKW) 4. Basics of liquid chromatography 2 (AKW) 5. Basics of mass spectrometry 1 (AKW) 6. Basics of mass spectrometry 2 (AKW) 7. Methods for lipid and glycan extraction comparison, protocols (AKW) 8. LC-MS in lipidomics and glycomics practical aspects, quantitative analysis (WHB) 9. MS/MS fragmentation how to interpret fragment spectra? Identification of lipids and glycans (WHB) 10. Practical aspects of designing a lipidomic/glycomic study (WHB) 11. Introduction to lipidomic/glycomic data analysis: data preparation 1 (WHB) 12. Introduction to lipidomic/glycomic data analysis: data preparation 2 (TM) 13. Chemometric and statistical analysis (TM) 14. Omics data integration lipidomics + glycomics (TM) 15. Lipidomics and glycomics applications / interpretation of results Course content – project Project introduction and planning; homogenization and extraction of lipids and glycans; LC-MS and data interpretation; data preparation extraction, normalization, filtering, quantitative analysis; lipid/glycan identification HMDB, LIPIDMAPS; quality control and introduction to MetaboAnalyst; statistical and chemometric analysis; data integration and visualization; working on selected datasets and preparing presentations; project presentations. **Project:** 1. Introduction to the project, literature review, planning, data selection (WHB) 2. Homogenization and extraction of lipids and glycans from brain tissue (AKW/MM) 3. LC-MS analysis of lipids interpretation of MS, MS/MS spectra, chromatograms (WHB/MM)

4. Data preparation 1 extraction of chemical entities (WHB)

5. Data preparation 2 normalization, filtering (WHB)

6. Lipid/glycan identification HMDB, LIPIDMAPS (WHB)

7. Data preparation 3 quantitative analysis (WHB)

8. Data quality control and introduction to MetaboAnalyst RSD, PCA (WHB)

9. Statistical and chemometric analysis 1 (TM)

10. Statistical and chemometric analysis 2 (TM)

11. Data integration and visualization metabolic pathways, KEGG, LIPIDMAPS, heatmaps, PCA (WHB)

12. Working on selected datasets 1 results processing, preparation of presentation (WHB)

13. Working on selected datasets 2 results processing, preparation of presentation (TM)

14. Working on selected datasets 3 results processing, preparation of presentation (WHB)

15. Project presentations (WHB)

Prerequisites and co-requisites

Basic knowledge of analytical chemistry, instrumental analysis, organic chemistry, and statistical analysis.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Project report + presentation (project)	60.0%	60.0%
Exam	60.0%	40.0%

Recommended reading

Basic literature	S. Milewski, *Instrumental Methods for Studying the Structure and Activity of Biomolecules*, Gdańsk University of Technology Publishing House, 2013. P. Siuder, Anna Bodzoń-Kułakowska, Jerzy Silberring, *Mass Spectrometry*, AGH Publishing House, 2016. B. Buszewski, I. Staneczko-Baranowska, *Bioanalytics, Volumes 1-2*, PWN Publishing House, 2020. Patti, G. J., Yanes, O., Siuzdak, G. (2012). *Metabolomics: the apogee of the omics trilogy*. **Nature Reviews Molecular Cell Biology**, 13, 263269. The core literature will also include lecture notes made available on the eLearning platform, as well as selected materials provided by the instructors in the form of textbook chapters and review articles.
Supplementary literature	**Lipidomics: Methods and Protocols** N. Ekroos (Springer, 2017) Practical protocols and methods for studying lipids, including LC-MS and quantitative analysis. **Glycomics: Methods and Protocols** M. R. Wormald (Springer, 2014) Methods for isolation, analysis, and characterization of glycans.
eResources addresses	

Example issues/ example questions/ tasks being completed	How would you perform quality control of the obtained lipidomic data? How does the sample preparation technique used affect the resulting omics data? How would you plan a lipidomic or glycomic study? How do you interpret MS and MS/MS spectra for the identification of lipids and glycans? How would you perform quantitative analysis of lipids using LC-MS? How can omics data be normalized and filtered before chemometric analysis? How do you use HMDB and LIPIDMAPS databases to identify lipids and glycans? What does PCA mean, and what is its purpose in lipidomic/glycomic analysis? Explain the difference between chemometric and statistical analysis of omics data. What are the basic methods for integrating lipidomic and glycomic data? How do you interpret heatmaps and metabolic pathways in the context of lipidomic/glycomic results? You have LC-MS data from a lipid analysis what steps would you take to analyze it and prepare a report? In a glycomic project, unexpected glycans were detected what could be the reasons, and how would you verify the results? Design a short experiment comparing the lipid profiles of two types of tissues.
Practical activites within the subject	Not applicable

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