GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Instrumental Methods of Studying the Structure of Biomacromolecules, PG_00054941		
Field of study	Biotechnology		
Date of commencement of studies	October 2021	Academic year of realisation of subject	2023/2024
Education level	first-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	3	Language of instruction	Polish Some of the materials provided, especially scientific papers, will be available only in English.
Semester of study	6	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Physical Chemistry -> Faculty of Chemistry		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Piotr Bruździak	
	Teachers	dr hab. inż. Piotr Bruździak dr inż. Szymon Mania dr inż. Kamila Rząd dr hab. inż. Rafał Piątek dr hab. inż. Tomasz Laskowski dr hab. inż. Iwona Gabriel dr hab. inż. Jakub Karczewski dr inż. Paweł Szczeblewski dr inż. Weronika Hewelt-Belka dr hab. inż. Jarosław Wawer	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	30.0	0.0	0.0	45

E-learning hours included: 0.0

Additional information:
Lecture: classes conducted for 15 weeks, 1 hour each; each week is devoted to a different research technique or a specific issue within a given method; whenever possible, a given topic is taught by a specialist and practitioner in a given field.

Laboratory: classes are divided into 7 thematic blocks, lasting 4 hours each, with further division: 2 hours practical part in the laboratory and 2 hours computer part with processing of the obtained results; classes are conducted in laboratories with access to equipment; students work in groups of several people and together prepare one report collecting the results and analyzes obtained during classes; the main object of research during laboratory classes will be lysozyme from chicken egg white.

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	3.0	27.0	75

Subject objectives	This course aims to familiarize students with both classical and contemporary instrumental methods of analyzing the structure of biologically significant macromolecules. In the lecture, students learn about the fundamentals and technical aspects of methods and current developments in biomolecule structural analysis.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_W02	The student explains the theoretical basis of instrumental techniques for studying the structure of biomolecules.	[SW1] Assessment of factual knowledge
K6_U02	The student is able to indicate the physical and chemical basis of the methods used and is able to select methods and analysis tools for a given experimental problem.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment
K6_U09	The student understands the basics of selected research methods and is able to apply them in practice. The student is able to independently analyze the obtained data and present it in the form of a concise report.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information [SU1] Assessment of task fulfilment
K6_W09	During laboratory classes, the student applies the knowledge acquired in lectures. The student is able to use the available literature to analyze the obtained experimental data.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge

Subject contents	LECTURE The lecture will present the minimum necessary theory needed to understand the technique, with greater emphasis on practice, i.e. the following issues: Typical research equipment - key features for biological applications: - technical solutions, important from a practical point of view (specific types of technique, materials and their selection for a specific sample, etc.) - sample requirements (concentrations, form, isotopes, etc.) - advantages and limitations of the method with practical examples; scope of applicability: what can and cannot be measured/determined? Measurements: - what kind of data is received directly? - what processing do raw data require (mathematical, chemometric methods, databases, etc.)? - processing software are there any "open source" versions? Framework lecture program: - Mass spectrometry - IR and Raman spectroscopy - X-ray- NMR spectroscopy - DSC/ITC calorimetry - AFM microscopy - Rheometry of protein solutions - DLS and other scattering methods - CD-UV and VCD circular dichroism - Optical microscopy using IR/Raman - Electron microscopy and Cryo-EM - Directions in the development of methods for examining the structure of biomolecules

LABORATORY:

- Students use various techniques to test, whenever possible, preparations of the same protein - lysozyme - and try to combine all the results in one final report,

- Students work in groups, and classes last 4 hours, divided into 2 parts: 2 hours of classes in the laboratory + 2 hours of classes in the computer room or at the computer in the laboratory (processing and analysis of results).

Framework program of laboratory classes:

- Mass spectrometry purity, particle size, etc.

- X-ray - preparation of lysozyme crystals and their characteristics

- NMR spectroscopy

- DSC calorimetry stability and energetics of the lysozyme molecule

- FTIR spectroscopy changes in secondary structure

- Rheometry - mechanical strength of preparations, energetics of interactions

- AFM characteristics of preparations degree of polymerization, particle size

Prerequisites and co-requisites

Students should have theoretical foundations of classical methods for studying the structure of molecules (IR, NMR, MS, etc.) acquired in Structural Research Methods, Physical Chemistry, Analytical Chemistry or similar subjects.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Class report (laboratory)	60.0%	50.0%
Lecture test (lecture)	60.0%	50.0%

Recommended reading

Basic literature	1. Komorowski i Olszowski, Chemia Fizyczna tom 4. Laboratorium fizykochemiczne, PWN, 2013; 2. Rabek, Biopolimery tom 2. Metody badań strukturalnych w praktyce, PWN, 2023; 3. Milewski, Instrumentalne metody badania struktury i aktywności biomolekuł, Wydawnictwo Politechniki Gdańskiej, 2013. The basic literature will also include lecture notes available on the eNauczanie platform and materials selected and made available by the lecturers in the form of chapters from selected textbooks and review scientific publications.
Supplementary literature	not applicable
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	1. Which of the known methods will you use to characterize the morphology of protein aggregates obtained in the process of amyloidogenesis in vitro? 2. Which level of protein structure can be characterized using FTIR spectroscopy? 3. Which technique would you choose to characterize the tertiary structure of an unknown protein?
Work placement	Not applicable