GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Nanosensors and biosensors, PG_00069748		
Field of study	Nanotechnology		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	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	1	Language of instruction	Polish
Semester of study	2	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Leszek Wicikowski	
	Teachers		

Lesson types and methods of instruction

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

E-learning hours included: 0.0

eNauczanie source addresses:

Moodle ID: 1221 Nanoczujniki i biosensory
https://enauczanie.pg.edu.pl/2025/course/view.php?id=1221

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	5.0	50.0	100

Subject objectives

Course objectives

1. To provide knowledge of the operating principles of nanosensors and biosensors.
2. To explain the role of nanomaterials in sensor design and performance.
3. To develop practical skills in measurement and data analysis using biosensors.
4. To train students in designing and presenting new biosensor concepts.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W02] has enhanced, theoretically supported, detailed knowledge of selected branches of nanotechnology and, according to the needs, within the scope of related fields of science and technology.	The student is able to classify types of nanosensors. He can determine the scope of their use. He knows the advantages and disadvantages of the appropriate sensors	[SW1] Assessment of factual knowledge
[K7_U07] can apply the obtained specialist knowledge to the problems within exact sciences, natural or technical sciences.	The student is able to use knowledge about nanosensors to determine howto monitor processes. He can choose the type of sensor adequate to the phenomenon being monitored	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W04] has practical and theoretical knowledge of physical and chemical experimental methods of nanotechnology.	The student knows the methods of manufacturing nanosensors. He can indicate materials suitable for their production, He understands physical phenomena occuring in nanosensors	[SW1] Assessment of factual knowledge
[K7_W03] has general knowledge on current development directions and discoveries in physics, chemistry, technology and applications of nanostructures.	The student knows the latest research and developments in production of nanosensors. He is familiar with scientific literature on nanosensors	[SW2] Assessment of knowledge contained in presentation

Subject contents

Lecture (15 h)

1. Introduction to nanosensors and biosensors definitions, classification, applications.
2. Biosensor components: bioreceptor, transducer, readout system.
3. Principles of chemical, biological, optical, and electrochemical sensing.
4. Nanomaterials in sensors: graphene, carbon nanotubes, metallic nanoparticles, quantum dots.
5. Bioreceptor immobilization strategies: enzymes, antibodies, DNA, aptamers.
6. Optical biosensors: SPR, SERS, fluorescence-based.
7. Electrochemical biosensors: potentiometric, amperometric, impedimetric.
8. Miniaturization and integration with microfluidics (lab-on-a-chip).
9. Application examples: medicine, environment, industry, food safety.
10. Challenges and trends: mobile biosensors, IoT integration.

Laboratory (15 h)

1. Introduction to laboratory equipment and safety rules.
2. Characterization of simple chemical sensors.
3. Electrochemical measurements with enzymatic biosensors (e.g., glucose).
4. Optical measurements fluorescence biosensors.
5. Data analysis and preparation of laboratory reports.

Project (15 h)

1. Development of a biosensor concept (choice of nanomaterial, bioreceptor, transduction method).
2. Preparation of a written project report.
3. Group presentation and defense of the project.

Prerequisites and co-requisites

- Fundamentals of physical and analytical chemistry,
- Basics of nanomaterials and nanotechnology,
- Fundamentals of electronics and optics.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
project (report and presentation)	50.0%	30.0%
lab exercises (performance and reports)	50.0%	30.0%
final test (Lecture)	50.0%	40.0%

Recommended reading

Basic literature

1. Katz E., Willner I., *Biosensors Fundamentals and Applications*, Wiley-VCH.
2. Diamond D., *Principles of Chemical and Biological Sensors*, Wiley.
3. Buck R. P., *Chemical Sensors and Biosensors*, Springer.
4. NANOSENSORS PHYSICAL, CHEMICAL,AND BIOLOGICAL Vinod Kumar Khanna, CRC Press, Taylor & Francis Group 2012

	Supplementary literature	1. Journals: *Biosensors and Bioelectronics*, *Sensors and Actuators B*, *Nanotechnology*. 2. Teaching materials provided by the lecturer.
	eResources addresses	
Example issues/ example questions/ tasks being completed	Distinguish between sensors and transducers giving examples. Justify the statement, All transducers contain a sensor and mostly, although not always, sensors will also be transducers.List and describe the important parameters and characteristics of a sensor. An example of the project - Monitoring the quality of milk	
Work placement	Not applicable	

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