GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Nanotechnology in Chemistry and Medicine, PG_00068249		
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2029/2030
Education level	first-cycle studies	Subject group	Optional 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	4	Language of instruction	Polish
Semester of study	7	ECTS credits	3.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Chemistry and Technology of Functional Materials -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Ewa Wagner-Wysiecka	
	Teachers		

Lesson types

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

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	45	3.0	27.0	75

Subject objectives

The aim of the course is to introduce the basic concepts related to nanotechnology. Students will become familiar with methods of nanostructure preparation, techniques for investigating their properties, and examples of applications in biomedical sciences. The course also includes laboratory exercises that provide insight into the practical aspects of nanotechnology.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U07] can apply methods of process and function support, specific to the field of study	The student is able to select and apply methods of nanostructure preparation and modification, specific to chemistry and biomedical engineering, in order to obtain defined chemical and functional properties.	[SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
[K6_W53] Knows and understands, to an advanced extent, selected aspects of materials science and biomaterials constituting general knowledge related to the field of study	The student knows and understands, at an advanced level, the structure, properties, and methods of preparation of nanostructures used in chemistry and biomaterials, as well as their importance in designing functional materials for biomedical engineering.	[SW1] Assessment of factual knowledge
[K6_U52] can determine properties of materials and biomaterials used in biomedical engineering	The student is able to analyse how the physicochemical properties of materials change as their dimensions are reduced to the nanoscale, in relation to their chemical structure and methods of preparation. The student can list the characteristic features of (bio)nanomaterials and provide examples of their applications in biomedical engineering.	[SU3] Assessment of ability to use knowledge gained from the subject

<table>
<tr><td>Subject contents</td><td>Course content – lecture

Lecture: Molecules and bonds. Types of bonds and the material properties. Chemical bonds and interactions in nanotechnology (covalent, ionic, metallic, coordinative, hydrogen bridge bonds, van der Waals, dipol-dipol, hydrophobic interactions). Bottom-up and top-down methods. Precursors, building blocks, assembly of building blocks, reaction equilibrium. Nanoparticle size control. Zero-dimensional nanostructures: metallic, semiconducting, ceramic, polymer and carbon nanoparticles. One-dimensional nanostructures: nanorods, nanotubes, nanowires. Two-dimensional nanostructures: monolayers and thin films of metals, ceramics, polymers, carbon and organic compounds. Langmuir-Blodgett technique. Surface modification. Lipofilic and lipofobic materials. Doping of nanostructures. Composite materials, hybrid materials (metal-organic etc.). Examination methods of chemical properties. Examples of nanostructures implementation in chemistry and medicine.

Laboratory:

1. Synthesis, characterization and applications of metal-organic frameworks 4 h
2. Quantum dots preparation and characterization 4 h
3. Metal nanoparticles preparation, properties, and applications 3 h
4. Electrochemical methods for the preparation of metallic nanostructures 4 h</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Student uses basic chemical terms. Student defines basic terms concernig structure of matter. Student lists types of chemical compounds, organic and inorganic.</td></tr>
<tr><td>Assessment methods and criteria</td><td><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Written test</td><td>50.0%</td><td>60.0%</td></tr>
<tr><td>Attendance and active participation in all laboratory classes, passing short tests, and submitting laboratory reports.</td><td>100.0%</td><td>40.0%</td></tr>
</table></td></tr>
<tr><td>Recommended reading</td><td><table>
<tr><td>Basic literature</td><td>1. Guazhong Cao. NANOSTRUCTURES& NANOMATERIALS. Synthesis, Properties, and Applications. Imperial College Press, 2004. 2. M. Kohler, W. Fritzsche. Nanotechnology. Wiley-Vch, 2003 3. C.C. Koch. NANOSTRUCTURED MATERIALS. Processing, Properties and Potential Applications. Noyes Publications, 2002. 3. K. Żelechowska. Nanotechnologia w chemii i medycynie. Wydawnictwo PG, Gdańsk 2015

Lecture materials including references to current advances in nanotechnology, and laboratory instructions containing relevant literature sources.</td></tr>
<tr><td>Supplementary literature</td><td>1. R. W. Keldall i inni. Nanotechnologie. PWN, 2008. 2. H. Dodziuk. Wstęp do chemii supramolekularnej. Wydawnictwo Uniwersytetu Warszawskiego, 2008.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
</table></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Define the concept of a nanostructure (according to a chosen criterion) and describe how scaling down from the macro to the nanoscale affects selected (specify) properties of materials/substances. Indicate which factors determine these properties. Provide two examples illustrating the change in physicochemical properties as a consequence of size reduction.
2. Provide examples of nanostructures occurring in nature and discuss their impact on human health, life, and the environment. Indicate potential areas for the application of such nanosystems.
3. Quantum dots properties, methods of preparation, and areas of application in chemistry and medicine.</td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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