GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00059104		
Field of study	Nanotechnology		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
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	3	Language of instruction	Polish
Semester of study	6	ECTS credits	4.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Chemistry Technology and Biotechnology of Food -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Robert Tylingo	
	Teachers	dr inż. Szymon Mania dr hab. inż. Robert Tylingo dr inż. Adrianna Banach-Kopeć	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	15.0	0.0	0.0	15.0	45
	E-learning hours included: 0.0						
	eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=5107						

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
The aim of the course is to introduce students to the physicochemical properties of nanofluids and their technical applications in engineering systems, energy technologies, cooling systems, biomaterials, and medical technologies. Students learn the mechanisms of heat and mass transfer in nanofluids, methods of their synthesis and stabilization, and the influence of nanoparticles on the properties of materials and technological systems. Particular emphasis is placed on the interactions of nanofluids with microorganisms and eukaryotic cells, as well as on safety aspects and technological risk assessment. The course also develops skills in scientific literature analysis, presentation of results, and preparation for writing an engineering diploma thesis.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K6_K05	The student is able to prepare and present a study on a selected topic related to nanofluids, participate in scientific discussion, and critically evaluate their own work and the work of others.	[SK4] Assessment of communication skills, including language correctness [SK2] Assessment of progress of work
K6_W06	The student has structured knowledge of the structure, physicochemical properties and mechanisms of nanofluids. The student understands the influence of nanoparticle type and structure on transport properties, dispersion stability, and interactions with materials and biological systems. Sposób weryfikacji:	[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation
K6_U02	The student is able to analyse engineering problems related to the application of nanofluids, select appropriate materials and technological parameters, and interpret experimental and literature data.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
K6_U04	The student is able to design and perform a basic experiment related to nanofluid properties or their interactions with materials and microorganisms, and critically analyse the obtained results.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU5] Assessment of ability to present the results of task

Subject contents	Course content – lecture 1. Introduction to nanofluids definition, development history and classification. 2. Methods of nanofluid preparation and stabilization of nanoparticle dispersions. 3. Heat and mass transfer mechanisms in nanofluids. 4. Nanofluids in cooling and energy systems (electronics, batteries, heat exchangers). 5. Nanofluids in materials engineering and functional coatings. 6. Interactions of nanoparticles with bacterial cells antimicrobial mechanisms. 7. Influence of nanofluids on eukaryotic cells and biomaterials. 8. Nanofluids in medicine and tissue engineering. 9. Safety aspects and risk assessment of nanomaterials. 10. Industrial applications and future perspectives of nanofluid technologies. Course content – exercises 1. Analysis of physicochemical properties of nanofluids. 2. Evaluation of nanoparticle dispersion stability under different environmental conditions. 3. Analysis of process parameters influencing nanofluid properties. 4. Interpretation of experimental and literature data. 5. Design of engineering applications of nanofluids. Course content – seminar Participation in Oxford-style debates based on the following topics: 1. Nanofluids in EV battery cooling technological advantage or unnecessary risk? 2. Nanofluids in the food industry increased efficiency or excessive reputational risk? 3. Hospitals and cryomedicine can we afford to experiment with nanofluids? 4. Nano in cosmetics technology of the future or a marketing strategy? 5. Disposal of nanofluids is industry ready for the full life cycle of this technology? 6. Nanocarriers for drug delivery in medicine a breakthrough in disease therapy or a technology too difficult to implement clinically? 7. Antibacterial nanoparticles a new tool in the fight against microorganisms or a risk of creating new microbiological problems? 8. Nanotechnology in biomaterials and tissue engineering real improvement in cellmaterial interactions or unnecessary complexity in biomaterial design?

	9. Nanoparticles in cleaning and hygiene products real improvement in effectiveness or mainly a marketing strategy by manufacturers?
Prerequisites and co-requisites	Students should have basic knowledge of chemistry, physics, materials science and nanotechnology. The ability to use scientific literature and basic experimental data analysis methods is required. Basic knowledge of biomaterials is recommended.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Oral exam (lecture)	60.0%	50.0%
Exercise report	60.0%	35.0%
Active participation in seminar debates	60.0%	15.0%

Recommended reading

Basic literature	1. Das S.K., Choi S.U.S., Yu W., Pradeep T., *Nanofluids: Science and Technology*, Wiley. 2. Kakac S., Pramuanjaroenkij A., *Review of Convective Heat Transfer Enhancement with Nanofluids*, International Journal of Heat and Mass Transfer. 3. Kole M., Dey T., *Thermal conductivity and viscosity of nanofluids*, Experimental Thermal and Fluid Science. 4. Bhushan B., *Springer Handbook of Nanotechnology*, Springer.
Supplementary literature	1. Zhang H., *Nanoparticles in Biology and Medicine*, Springer. 2. Rai M., *Metal Nanoparticles in Microbiology*, Springer. 3. ASTM Standards for Nanotechnology Materials. 4. Wybrane artykuły naukowe z czasopism: *Nanotechnology*, *ACS Nano*, *Applied Nanoscience*.
eResources addresses	

Example issues/ example questions/ tasks being completed

1. Mechanisms of enhanced heat transfer in nanofluids.
2. Stability of nanocolloids and factors influencing nanoparticle aggregation.
3. Nanofluids in cooling systems for batteries and electronics.
4. Antimicrobial mechanisms of metal nanoparticles.
5. Influence of nanofluids on biomaterial and hydrogel properties.
6. Analysis of environmental and biological risks of nanofluids.
7. Conceptual design of an engineering application using nanofluids.

Practical activites within the subject

Not applicable

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