GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Composite materials - fabrication, properties and prospects of application, PG_00042270		
Field of study	Nanotechnology		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	second-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	2	Language of instruction	English
Semester of study	3	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Instytut Nanotechnologii i Inżynierii Materiałowej -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Beata Bochentyn	
	Teachers	dr hab. inż. Beata Bochentyn	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	0.0	0.0	30

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	30	2.0	18.0	50

Subject objectives

Presentation of the purpose and principles of composite materials fabrication. Presentation of different types of composites, their properties, fabrication methods, interactions between the components. Presentation of the influence of structural factors on the resulting properties of composites. Presentation of the methods of testing the structural and electrical properties of composite materials. Presenting examples of technological application of composites in transport and energy.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_W02	The student is able to define the types of composite and nanocomposite materials and their basic structural, electrical and mechanical properties. The student knows the methods of obtaining composite materials and their influence on the resulting properties. The student is able to theoretically design a composite material based on the theory of summing the properties of components or their resulting properties. The student is able to determine the properties of a composite depending on the properties, geometry, arrangement, size and quantity of individual components. The student knows the physical basics and the possibilities of applying the latest techniques for studying the structural and electrical properties of materials (including nanostructures) in relation to composite materials.	[SW1] Assessment of factual knowledge
K7_W03	The student knows the current directions in the development of physical, chemical and materials sciences and their impact on the state of knowledge about composite materials.	[SW1] Assessment of factual knowledge

Subject contents	**Introduction** 1. Composites - definition, classification, examples 2. History of composite materials 3. Principles of composite designing 4. The influence of a size, orientation, volume fraction of reinforcement, adhesion and strength of components on the final properties of composite materials **The division of composite materials, properties, manufacturing method, the interaction between the components** 5. Fiber reinforced composites 6. Powder composites 7. Structural composites 8. Polymer matrix composites 9. Metal matrix composites 10. Ceramic matrix composites 11. Superconducting matrix composites 12. Composites with carbon fibers reinforcement 13. Nanocomposites **Special properties of composites testing and characterization** 14. Composites of required structural properties. Methods of analysis 15. Composites of required electrical properties. Mixed electrical conductivity (ion, proton, electron). Methods of analysis. Percolation theory. 16. Composite materials in fuel cells and thermoelectrics **Application areas of composite materials** 17. Composites for transport application 18. Composites for building industry and energetics
Prerequisites and co-requisites	Knowledge of the basics of physics and material engineering. Knowledge of basic English terminology in the field of materials science.
Assessment methods and criteria	

Subject passing criteria	Passing threshold	Percentage of the final grade
Written exam	50.0%	100.0%

Recommended reading	Basic literature	1. Krishan K. Chawla, Composite materials. Science and engineering, Springer 2012 2. L. Nicolais, M. Meo, E. Milea, Composite materials. A vision for the future, Springer 2011
	Supplementary literature	1. I. Riess, Mixed ionicelectronic conductors - material properties and applications, Solid State Ionics 157 (2003) 117 2. Chunli Gong, Zhigang Xue, Sheng Wen, Yunsheng Ye, Xiaolin Xie, Advanced carbon materials/olivine $LiFePO_4$composites cathode for lithium ion batteries, Journal of Power Sources 318 (2016) 93-112 3. S. Ummartyotin, N. Bunnak, H. Manuspiya, A comprehensive review on modified clay based composite for energy based materials, Renewable and Sustainable Energy Reviews 61 (2016) 466472 4. P. Zhang, X. Xiao, Z.W. Ma, A review of the composite phase change materials: Fabrication, characterization, mathematical modeling and application to performance enhancement, Applied Energy 165 (2016) 472510 5. Other scientific papers
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	1. Example of classification methods, and examples of composite materials belonging to each group 2. The principles of designing composites and the resulting properties of the composite materials (+ examples) 3. Percolation theory - basic issues. 4. Methods of mixed electrical conductivity testing	
Work placement	Not applicable	