GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Composite materials in the energy and transport, PG_00033868		
Field of study	Nanotechnology		
Date of commencement of studies	October 2020	Academic year of realisation of subject	2022/2023
Education level	first-cycle studies	Subject group	
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	3	Language of instruction	Polish
Semester of study	5	ECTS credits	1.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Solid State Physics -> 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	15.0	0.0	0.0	0.0	0.0	15

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	15	0.0	0.0	15

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 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
K6_W07	The student knows the methods of fabricating composite materials, knows their properties and characterisation methods.	[SW1] Assessment of factual knowledge
K6_W06	The student is able to explain the properties of composite materials and the interactions between components based on their structure and transport phenomena occurring in the materials.	[SW1] Assessment of factual knowledge

Subject contents	1. Composites - definition, classification, examples *Structural properties of composites - testing and characterization* 1. Composites of required structural properties - the most important features; methods for preparing 2. Methods of test for structural properties of composites: SEM, EDX, SPM, nanoindentation *Electrical properties of composites - testing and characterization* 1. The materials with mixed electrical conductivity (ion, proton, electron) 2. Percolation theory 3. Methods of mixed electrical conductivity testing *The division of composite materials, properties, manufacturing method, the interaction between the components* 1. Polymer matrix composites 2. Metal matrix composites 3. A ceramic matrix composites 4. Composites with carbon fibers matrix 5. Superconducting matrix composites *Areas of technological application of composite materials (transport, energy)*
Prerequisites and co-requisites	Knowledge of basic physics.
Assessment methods and criteria	Subject passing criteria: Written exam; Passing threshold: 50.0%; Percentage of the final grade: 100.0%
Recommended reading	Basic literature 1. Krishan K. Chawla, Composite materials. Science and engineering, Springer 2012 2. A. Boczkowska, J. Kapuściński, Z. Lindemann, D. Witemberg-Perzyk, S. Wojciechowski, Kompozyty, Oficyna Wydawnicza Politechniki Wrocławskiej 2013

	Supplementary literature	1. L. Nicolais, M. Meo, E. Milea, Composite materials. A vision for the future, Springer 2011 2. I. Riess, Mixed ionicelectronic conductors - material properties and applications, Solid State Ionics 157 (2003) 117 3. W. Bogusz, F.Krok, Elektrolity stałe. Właściwości elektryczne i sposoby ich pomiaru, Wydawnictwa Naukowo-Techniczne, Warszawa 1995 4. 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 5. 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 6. 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 7. Other scientific papers
	eResources addresses	Adresy na platformie eNauczanie: Materiały kompozytowe w energetyce i transporcie - Moodle ID: 26925 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=26925
Example issues/ example questions/ tasks being completed	1. Example of classification methods, and examples of composite materials belonging to each group2. 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	