



Subject card

Subject name and code	Composite materials, PG_00066242						
Field of study	Chemistry						
Date of commencement of studies	February 2026		Academic year of realisation of subject		2026/2027		
Education level	second-cycle studies		Subject group		Specialty subject group		
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		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		dr hab. inż. Anna Schmidt				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	15.0	45
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 8463 Materiały kompozytowe https://enauczanie.pg.edu.pl/2025/course/view.php?id=8463						
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		25.0	75
Subject objectives	The aim of the course is to familiarize students with the structure, classification, preparation methods, properties and applications of composite materials. Particular emphasis is placed on composition–structure–properties–application relationships and the role of the interphase. The course covers structural and functional composites, including biocomposites, adsorptive, catalytic, photocatalytic, magnetic and conductive materials. The classes develop skills in composite preparation and characterization as well as critical analysis of scientific literature.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_W01] recognizes problems of modern chemistry, including properties and obtaining chemical compounds, necessary for making calculations, including the dependence of the compound's structure and its reactivity		has knowledge to explain relationships between the composition, structure, preparation method and properties of composite materials, and selects composite components according to the intended properties and application.		[SW1] Assessment of factual knowledge [SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects		
	[K7_K03] understands non-technical aspects and effects of the graduate's activities, including the impact of the chemical industry on the environment		understands the importance of durability, safety, environmental impact, recyclability and end-of-life management of composite materials and takes these aspects into account when assessing their applications.		[SK1] Assessment of group work skills [SK3] Assessment of ability to organize work [SK5] Assessment of ability to solve problems that arise in practice		
	[K7_U01] integrates and interprets information from literature, databases and other sources		is able search, integrate and critically interpret information on composite materials obtained from scientific literature, databases and other reliable sources, and uses it to analyse material properties and applications.		[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools [SU5] Assessment of ability to present the results of task		

Subject contents	Course content – lecture Introduction to composite materials: definitions, classification, structure and basic functions of components. Polymer, ceramic and metal matrices and their influence on composite properties. Reinforcing and functional phases: fibres, particles, mineral fillers and nanomaterials. Interphase phenomena: adhesion, wettability, component compatibility and surface modification. Fibre-reinforced, particulate and layered composites. Nanocomposites and the influence of nanoscale structure on material properties. Methods of composite material preparation. Composition–structure–properties–application relationships. Characterization methods: FTIR, XRD, SEM, DSC/TGA, surface analysis and mechanical testing. Functional composites: adsorptive, catalytic, photocatalytic, magnetic and conductive materials. Biocomposites and materials based on renewable resources. Composites for environmental, biomedical and pharmaceutical applications. Durability, ageing and degradation of composite materials. Recycling and end-of-life management of composite waste. Current trends in multifunctional and smart composite materials.		
	Course content – laboratory Preparation of a polymer composite containing an inorganic phase and evaluation of the effect of composition on its properties. Preparation of a biocomposite and investigation of swelling, water uptake and material stability. Preparation of an adsorptive composite and evaluation of its ability to remove a model pollutant. Preparation of a magnetic or photocatalytic composite and evaluation of its functional properties. Characterization of selected composite materials and interpretation of composition–structure–properties relationships.		
	Course content – seminar Analysis of current trends in composite materials based on scientific literature. Criteria for selecting matrix and functional phases for specific applications. Comparison of preparation and characterization methods for selected groups of composites. Functional composites in environmental protection, energy, biomedicine and chemical technology. Biocomposites and materials derived from renewable resources. Nanocomposites and multifunctional materials. Durability, degradation, regeneration and recycling of composites. Critical analysis of selected scientific publications. Preparation and presentation of a selected topic in modern composite materials. Discussion of the potential and limitations of selected composite materials.		
Prerequisites and co-requisites	Basic knowledge of general, inorganic, organic and physical chemistry, as well as polymer and materials chemistry. Familiarity with basic instrumental methods used for the characterization of substances and materials, and basic laboratory skills. Ability to use scientific literature and databases, interpret experimental results and work in a team. English language skills sufficient to read and use scientific publications.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Laboratory – completion of exercises, data processing and interpretation	50.0%	30.0%
	Seminar – presentation, literature analysis and participation in discussion	50.0%	30.0%
	Written test covering lecture content	50.0%	40.0%
Recommended reading	Basic literature	- Boczkowska, A., Kapuściński, J., Lindemann, Z., Witemberg-Perzyk, D., Wojciechowski, S., <i>Kompozyty</i>, 2nd revised ed., Oficyna Wydawnicza Politechniki Warszawskiej, Warsaw, 2003. Biblioteka Cyfrowa WUT - Chawla, K.K., <i>Composite Materials: Science and Engineering</i>, 4th ed., Springer, Cham, 2019, DOI: 10.1007/978-3-030-28983-6. Springer Nature Link - Hull, D., Clyne, T.W., <i>An Introduction to Composite Materials</i>, 2nd ed., Cambridge University Press, Cambridge, 1996. - Matthews, F.L., Rawlings, R.D., <i>Composite Materials: Engineering and Science</i>, 2nd ed., Woodhead Publishing, Cambridge, 1999. - Mallick, P.K., <i>Fiber-Reinforced Composites: Materials, Manufacturing, and Design</i>, 3rd ed., CRC Press, Boca Raton, 2007.	
	Supplementary literature	- Gibson, R.F., <i>Principles of Composite Material Mechanics</i>, 4th ed., CRC Press, Boca Raton, 2016. - Utracki, L.A., Wilkie, C.A. (eds.), <i>Polymer Blends Handbook</i>, 2nd ed., Springer, Dordrecht, 2014, DOI: 10.1007/978-94-007-6064-6. Springer Nature Link - Thomas, S., Joseph, K., Malhotra, S.K., Goda, K., Sreekala, M.S. (eds.), <i>Polymer Composites</i>, Vols. 1–3, Wiley-VCH, Weinheim, 2012–2013. Wiley-VCH - Ajayan, P.M., Schadler, L.S., Braun, P.V. (eds.), <i>Nanocomposite Science and Technology</i>, Wiley-VCH, Weinheim, 2003, ISBN 978-3-527-30359-5, DOI: 10.1002/3527602127. Wiley Online Library - Wool, R.P., Sun, X.S., <i>Bio-Based Polymers and Composites</i>, 1st ed., Academic Press, Elsevier, Burlington, 2005.	
	eResources addresses		

Example issues/ example questions/ tasks being completed	• Classification of composite materials and functions of their components. • Selection of a matrix and reinforcing or functional phase for a specific application. • Influence of the type, content and distribution of the dispersed phase on composite properties. • Importance of the interphase, adhesion and wettability. Comparison of preparation methods for polymer, ceramic and metal matrix composites. • Interpretation of FTIR, XRD, SEM and thermal analysis results for composite materials. • Evaluation of the effect of composition on swelling, water uptake, stability and functional properties. • Determination of model pollutant removal efficiency and adsorption capacity of a composite. • Analysis of the advantages and limitations of magnetic, photocatalytic and conductive composites. • Critical analysis of a scientific paper on modern composite materials. • Evaluation of recycling, regeneration and end-of-life management options for composite materials. • Development and presentation of a concept for a composite material designed for a selected application.
Practical activities within the subject	Not applicable

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