



Subject card

Subject name and code	Degradation, recycling and upcycling of materials, PG_00072355						
Field of study	Technologies for Industry 5.0						
Date of commencement of studies	October 2024		Academic year of realisation of subject		2026/2027		
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	5		ECTS credits		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Functional Materials Engineering -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Patryk Błaszczak				
	Teachers		dr inż. Patryk Błaszczak				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	0.0	15.0	30
	E-learning hours included: 0.0						
	eNauczanie source address: https://enauczanie.pg.edu.pl/2025/course/view.php?id=7655						
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	The aim of the course is to familiarize students with issues related to material degradation and an environmentally sustainable approach to waste management following the end of a product's life cycle. In addition, the course aims to discuss the main causes of material degradation, with particular emphasis on methods for preventing deterioration processes, as well as the recycling and upcycling of used materials.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K6_W03] demonstrates knowledge on materials used in industrial technologies, their structure and fabrication, knows the principles of conducting research, analyzing it and creating technical documentation		The student demonstrates knowledge of the mechanisms of material degradation, methods for assessing material durability, and basic and advanced methods of recycling and upcycling, as well as knowledge of the principles of analyzing degradation processes and processing used materials.		[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge		
	[K6_K01] is aware of the need to constantly update and enrich knowledge and practical skills, and improve professional, personal and social competences		The student is aware of the need to continuously update and expand their knowledge of new methods for preventing material degradation, recycling and upcycling, as well as to develop practical skills related to the sustainable use of materials and changes in LCA (Life Cycle Assessment) practices.		[SK5] Assessment of ability to solve problems that arise in practice		

Subject contents	Course content – lecture		
	1. Groups of structural and functional materials, including the characteristics of their basic mechanical and physicochemical properties. 2. Degradation processes in the identified groups of materials: a) Polymer degradation b) Metal degradation c) Ceramic degradation d) Thermal degradation e) Oxidative degradation f) Photochemical and radiation-induced degradation g) Ageing in biological environments 3. Prevention of degradation processes. 4. Assessment of product lifetime and life cycle (LCA). 5. Technological methods for processing material waste. 6. EU directives and national regulations concerning the recycling of critical materials. 7. Conventional recycling: material, feedstock, and energy recovery. 8. Contemporary advanced recycling methods. 9. The concept of upcycling and the processing of functional materials. 10. Assessment of the environmental impact of laboratory contaminants. 11. Laboratory safety and occupational health and safety (OHS) principles.		
	Course content – seminar		
	1) New tools for the investigation of material degradation. 2) Contemporary solutions for preventing material degradation. 3) Extending product lifetime. 4) Innovative methods for recycling critical materials. 5) Circular economy. 6) Innovative methods for upcycling used electrochemical devices.		
Prerequisites and co-requisites	The student has basic knowledge of chemistry and materials science. The student is familiar with the basic groups of materials and is able to characterize them in terms of their chemical, physical, and mechanical properties.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Lecture exam	51.0%	60.0%
	Seminar presentation	51.0%	40.0%
Recommended reading	Basic literature	• Andrzej Zieliński, Maria Głowacka, <i>Podstawy materiałoznawstwa</i>, Politechnika Gdańska, 2014 • Life Cycle Assessment (LCA): A Guide to Best Practice, Walter Klöpffer, Birgit Grahl, ISBN: 978-3-527-65564-9, 2014 • <i>Nowoczesne technologie recyklingu materiałowego</i> • Ewa Klugmann-Radziemska, Janusz Datta, Marcin Włoch, Józef Haponiuk, Krzysztof Formela, Maciej Sienkiewicz, Politechnika Gdańska, 2017	
	Supplementary literature	• Callister W.D. Jr., Rethwisch D.G., <i>Materials Science and Engineering: An Introduction</i>, 10th Edition, John Wiley & Sons, Hoboken, NJ, 2018. • Scientific publications from Scopus, Elsevier and Science Direct databases	
	eResources addresses		
Example issues/ example questions/ tasks being completed	Describe the basic mechanisms of metal degradation in a hydrogen atmosphere.		
	Present two basic methods of polymer recycling.		
	Propose a technological solution for the upcycling of waste from fuel cells.		
Practical activities within the subject	Not applicable		

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