GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Chemical structure of composite materials, PG_00071179						
Field of study							
Date of commencement of studies	February 2027		Academic year of realisation of subject	2026/2027			
Education level	second-cycle studies		Subject group				
Mode of study	Part-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	Polish			
Semester of study	1		ECTS credits	2.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Department of Polymer Technology -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Michał Strankowski				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	3.0	0.0	6.0	0.0	0.0	9
	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	9		6.0	35.0	50	
Subject objectives	The aim of the course is to familiarize students with the chemical and supramolecular structure of modern polymer composites and to understand how molecular architecture affects the mechanical, thermal, and processing parameters of finished products.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U04] is able to conduct a detailed analysis of the obtained results and develop them in the form of a technical report or presentation, also in English	The student is able to conduct an analysis of the cross-linking degree or fracture morphology of composites and present the obtained results in the form of a professional technical report.	[SU2] Assessment of ability to analyse information [SU5] Assessment of ability to present the results of task
[K7_W04] has in-depth knowledge in the field of chemical sciences/ chemical engineering/materials engineering, enabling the description of the properties of materials, processes and technological operations involving them, taking into account recycling	The student possesses advanced knowledge of the physical chemistry of the interface in polymer composites, enabling the description of adhesion processes and methods of surface modification of reinforcing materials.	[SW1] Assessment of factual knowledge
[K7_K04] is able to cooperate and work in a group, taking on different roles	The student can effectively work in a laboratory team, taking responsibility for assigned tasks and the joint implementation of a research project.	[SK1] Assessment of group work skills [SK3] Assessment of ability to organize work
[K7_U06] is able to assess the usefulness and possibility of using new achievements (techniques and technologies) in the field of design, modernization and optimization of material technologies and their recycling	The student is able to evaluate innovative solutions in materials engineering in terms of their applicability in zero-waste technologies and raw material recycling.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject
[K7_K03] is aware of the non-technical aspects and effects of the Master of Science in Chemical Engineering's activities, including the impact on the environment, and is aware of the responsibility for the decisions made, the observance and development of the principles of professional ethics and actions to ensure compliance with these principles	The student demonstrates responsibility for the reliability of conducted laboratory tests and is aware of the environmental impact of polymer composite production and disposal.	[SK5] Assessment of ability to solve problems that arise in practice [SK2] Assessment of progress of work
[K7_W01] has extensive knowledge of technologies related to the production and management of waste from various material groups	The student characterizes the chemical structure of matrices and fillers and describes their influence on the thermal and mechanical properties of composites, considering recycling aspects and waste management of polymer materials.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture

Classification and characteristics of polymer matrices (1h):

- Detailed comparison of thermoplastic matrices (PP, PA, PEEK) and thermosetting matrices (epoxy, polyester, phenolic resins).
- The influence of the chemical structure of the chain on process viscosity, processing shrinkage, and thermal stability.

Fillers and manufacturing technologies (1h):

- Classification of fillers: powder (chalk, talc), fiber (short, continuous, mats) and nanofillers.
- Discussion of the main methods of obtaining composites (injection molding, laminating, pultrusion, RTM) in the context of maintaining the structural integrity of the polymer.

Mechanical and thermal properties (1 h):

- Analysis of mechanical parameters: stiffness (Young's modulus), tensile and flexural strength, impact resistance (impact strength).
- Thermal properties: heat deflection temperature (HDT), Vicat softening temperature and the effect of fillers on dimensional stability.

Course content – laboratory

- **Laboratory 1 (2 h):** DSC analysis, testing of composite phase transitions. (Determination of glass transition temperature (Tg) and degree of reaction (cross-linking) of the polymer matrix.
- **Laboratory 2 (2 h):** TGA analysis, analysis of the thermal stability of the composite and filler content. (Determination of the thermal resistance of the material and the percentage content of mineral filler).
- **Laboratory 3 (2 h):** DMA analysis and correlation with HDT, determination of viscoelastic properties. Testing of the conservative (E') and loss (E") modules, tangent of the phase shift angle (Tanδ) and determination of the heat deflection temperature (HDT).

<table>
<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Exam</td><td>50.0%</td><td>100.0%</td></tr>
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<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>-</td></tr>
<tr><td>Supplementary literature</td><td>-</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">-</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="2">Not applicable</td></tr>
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