GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	, PG_00069397		
Field of study	Materials Engineering, Materials Engineering		
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	Institute of Nanotechnology and Materials Engineering -> Faculty of Applied Physics and Mathematics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Mateusz Cieślik	
	Teachers	dr inż. Mateusz Cieślik	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	15.0	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

The aim of this course is to familiarize students with the principles, methods, and applications of additive technologies in the design and production of innovative materials. Students will acquire knowledge of reverse engineering, 3D modeling, and the selection of printing technologies for the production of modern functional materials. Particular emphasis will be placed on the use of composites and nanomaterials, the analysis of their properties, and their application potential in advanced industries. The practical nature of the course includes design and laboratory exercises that develop the ability to independently plan, conduct, and evaluate processes for the additive production of innovative materials.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U03] Can critically analyze and evaluate the functioning – particularly in the context of materials engineering –existing technical solutions, particularly equipment, objects, systems, processes.	The student will be familiar with various additive technologies and understand their applications and limitations in materials engineering. The student will be knowledgeable about comparative criteria for evaluating 3D printing processes in terms of quality, efficiency, and feasibility for implementation in engineering practice.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
[K6_U04] Can use information and communication techniques used for the execution of typical engineering tasks, can apply learnt methods and mathematical and physical models to describe and explain chemical phenomena and processes.	The student understands the basic mathematical and physical modeling methods used to describe additive manufacturing processes and their impact on material properties. The student understands the application of information and communication technologies in 3D model design and printing process analysis. The student can use CAD/CAM software and tools for preparing and optimizing the 3D printing process.	[SU1] Assessment of task fulfilment [SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
[K6_W03] Has knowledge of materials science and can relate the properties of materials with their structure and composition, knows the theoretical description of phenomena occurring in materials subjected to external factors.	The student understands the principles of selecting additive technologies based on the structure and properties of materials. The student understands the impact of 3D printing processes and the selection of nanomaterials on the internal structure and mechanical, thermal, and electrical properties of materials. The student understands the theoretical foundations of the phenomena occurring in materials during additive manufacturing (including melting, bonding, and photochemical curing).	[SW2] Assessment of knowledge contained in presentation [SW1] Assessment of factual knowledge

Subject contents

Course content – lecture
Lectures:
1. Definition of additive technologies, advantages and limitations compared to traditional manufacturing methods, 3D printing, laser processing, milling.
2. Discussion of various 3D printing methods, technologies and materials used, advantages and limitations.
3. Possibilities of using materials science in 3D printing, composites with nanomaterials, surface modification.
4. Ecology and sustainability of 3D printing.
5. Preparing files for 3D printing, design performance analysis, model preparation, selecting appropriate printing parameters.
6. 4D printing.
7. Quality control.
8. Economic aspects of 3D printing.
Practical project, practical application of acquired knowledge:
1. Manufacturing composite materials with the addition of nanomaterials to achieve specific functional properties (e.g., electrical conductivity, hydrophobicity, magnetic properties).
2. Printing and testing using the produced printed materials, alternatively modifying the prints (e.g. roughening, creating a membrane, surface functionalization).

Prerequisites and co-requisites

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lecture	50.0%	50.0%
Project	50.0%	50.0%

Recommended reading

Basic literature	Druk 3D, Liza Wallach Kloski, Helion, 2022

	Supplementary literature	Podstawy szybkiego prototypowania : druk 3D : technologia FDM/FFF, Jerzy Bochnia, Tomasz Kozior, Kielce : Politechnika Świętokrzyska, 2024.
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. Describe the difference between FDM and SLA in 3D printing. What are their advantages and disadvantages? Compare both methods in the context of prototype production. 2. Explain what G-code is and how it is used in 3D printing. Describe the basic G-code commands and how they affect the printing process. 3. Discuss the different types of materials used in 3D printing. Compare thermoplastic and thermoset materials in terms of their applications and properties. Provide examples of products that can be printed using these materials.	
Practical activites within the subject	Not applicable	

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