GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Hybrid and additive manufacturing processes, PG_00064939						
Field of study	Hybrydowe i addytywne metody wytwarzania						
Date of commencement of studies	February 2025		Academic year of realisation of subject	2025/2026			
Education level	second-cycle studies		Subject group	Specialty subject group Subject group related to scientific research in the field of study			
Mode of study	Part-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	Polish			
Semester of study	2		ECTS credits	4.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Institute of Manufacturing and Materials Technology -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Dawid Zieliński				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	18.0	0.0	9.0	9.0	0.0	36
	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	36		5.0	59.0	100	
Subject objectives	Introduction to the topics of hybrid and additive manufacturing methods along with reverse engineering used in the production of mechanical engineering parts and the development trends of modern manufacturing.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_U15] evaluates the feasibility of advanced methods and tools for solving complex engineering tasks of a practical nature, characteristic of the field of study, and selects and applies appropriate methods and tools for this purpose	The student demonstrates knowledge and ability to work in a computer environment in the field of hybrid and additive manufacturing methods. He is able to develop a complex process of manufacturing selected parts of mechanical engineering, considering the selection of appropriate technology, type of material and parameters of the process. In addition, he properly evaluates the obtained results from the point of view of selected technological and economic aspects of the process.	[SU4] Ocena umiejętności korzystania z metod i narzędzi [SU1] Ocena realizacji zadania
[K7_U11] communicates and justifies opinions on specialized topics in a manner understandable to diverse audiences, including the use of modern techniques, including information technology	The student uses modern computer methods related to hybrid and additive manufacturing technologies to solve engineering tasks. He is able to properly present and justify the selection of the manufacturing method for unconventional materials and specific features of the designed part.	[SU2] Ocena umiejętności analizy informacji [SU4] Ocena umiejętności korzystania z metod i narzędzi [SU5] Ocena umiejętności zaprezentowania wyników realizacji zadania
[K7_W12] identifies and interprets the main developmental trends and significant new achievements in the field of engineering and technical sciences and disciplines relevant to the course of study	Communication and data analysis skills for the presentation of designed manufacturing technology for mechanical components applied in mechanical engineering using hybrid and additive manufacturing methods.	[SW2] Ocena wiedzy zawartej w prezentacji
[K7_W04] demonstrates knowledge covering selected topics of advanced specific knowledge, in particular methods, techniques, tools specific to Mechanics and Mechanical Engineering processes, systems and equipment	The student has detailed knowledge of unconventional and hybrid manufacturing methods, especially additive technologies and special materials. He also has the knowledge necessary to develop manufacturing processes for selected mechanical engineering parts, considering the proper selection of the manufacturing method and process parameters.	[SW1] Ocena wiedzy faktograficznej

Subject contents

Course content – lecture

Basics of additive technologies and hybrid manufacturing; principles and characteristics of the development of the 3D printing process of mechanical engineering parts; characteristics of additive methods including powder technologies, resin technologies and methods based on extrusion of materials; characteristics of systems for 3D printing and hybrid manufacturing; application of hybrid and additive manufacturing methods in mechanical engineering parts.

Course content – laboratory

Basics of powder technology, based on extrusion of materials in the form of filament and resin: principle of operation and construction of 3D printers, preparation of the device for work, analysis of the process flow, postprocessing; basics of 3D printing from composite materials: principle of operation and construction of the 3D printer, preparation of the device for work, development of the printing process of selected parts of mechanical engineering software characteristics, analysis of the process flow, postprocessing; basics of reverse engineering.

Course content – project

Basics and characteristics of CAD/CAM software used in hybrid and additive manufacturing; development of a process for fabrication of selected mechanical engineering parts using subtractive technology with CAM software; development of a process for rapid prototyping of selected mechanical engineering parts using 3D printing technology with dedicated slicers; multi-criteria comparative evaluation of processes for fabrication of selected mechanical engineering parts using CNC cutting technology and 3D printing, considering technological and economic aspects.

Prerequisites and co-requisites

Knowledge of technical drawing, the basics of machine technology and cutting processes, as well as CAD/CAM computer-aided manufacturing systems.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Colloquium at the end of the semester	60.0%	40.0%
Project	60.0%	30.0%
Laboratory	60.0%	30.0%

<table>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>1.Redwood, B., Schffer, F., & Garret, B. (2017). The 3D printing handbook: technologies, design and applications. 3D Hubs.

2.Gebhardt, A. (2012). Understanding additive manufacturing. Munich: Carl Hanser Verlag.

3.Siemiński, P., & Budzik, G. (2015). Techniki przyrostowe: druk drukarki 3D. Warsaw, Poland: Oficyna Wydawnicza Politechniki Warszawskiej.

4. Katapian S. Manufacturing Engineering and Technology Pearson Education Inc. Upper Saddle River, New Jersey 2006.

5. Przemysław Kochan. EdgeCAM. Wieloosiowe frezowanie CNC. Wydawnictwo Helion. Gliwice 2014.</td></tr>
<tr><td>Supplementary literature</td><td>1. Deja, M., Dobrzyński, M., Flaszyński, P., Haras, J., & Zieliński, D. (2018). Application of Rapid Prototyping technology in the manufacturing of turbine blade with small diameter holes. Polish Maritime Research, 25(s1), 119-123.

2. Deja, M., & Zieliński, D. (2020). Application of 3D printing metal powder technology in the manufacture of components with complex geometries. Mechanik, 22-25.

3. Zieliński, D. (2020). Podstawy technologii selektywnego spiekania laserowego proszków polimerowychSLS. Tworzywa Sztuczne w Przemyśle, 81-83.

4. Zieliński, D. (2021). Drukowanie trwałych elementów z tworzyw termoplastycznych w technologii FDM/FFF. Tworzywa Sztuczne w Przemyśle, 103-106.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">1. Basics of 3d printing technology (definition, division into main areas of application, etc.)
2. Division of 3d printing technology (characteristics, examples of methods, etc.)
3. Comparison of subtractive (machining) processes and additive (incremental) technology
4. Advantages and disadvantages (limitations) of 3d printing technology.
5. Characteristics of 3d printing technology: DMLS/SLM (working principle, schematic, materials, application area)
6. Characteristics of 3d printing technology: SLS (working principle, schematic, materials, application area)
7. Characteristics of 3d printing technology: FFF/FDM (principle of operation, schematic, materials, area of application)
8. Characteristics of 3d printing technology: UV LCD/mSLA (principle of operation, schematic, materials, area of application)
9. Characteristics of the different stages of the rapid prototyping process of selected mechanical parts.
10. Indication of the main parameters in 3D printing software (slicers).
11. Characterization of selected post-processing procedures and methods for parts printed with various technologies: DMLS/SLM, SLS, FFF/FDM.
12. Importance of support structures in incremental technologies.
13. Characteristics of typical defects/defects found in selected 3D printing technologies.
14. Areas of application of 3d printing technologies - selected examples.
15. Construction of an exemplary 3d printer working in SLS technology (indication of selected and main elements of construction).
16. Construction of an example 3d printer working in FFF/FDM technology (indication of selected and main elements of construction).
17. Directions of development of 3D printing technology.
18. Characteristics of hybrid manufacturing.
19. Methods of hybrid machining using different 3D printing technologies.
20. Examples of hybrid machining and the purpose of its application.</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="2">Not applicable</td></tr>
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