GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Hybrid and additive manufacturing processes, PG_00064860						
Field of study	Mechanical Engineering						
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	Full-time studies		Mode of delivery	at the university			
Year of study	1		Language of instruction	English			
Semester of study	2		ECTS credits	2.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Division of Manufacturing and Production Engineering -> Institute of Manufacturing and Materials Technology -> Faculty of Mechanical Engineering and Ship Technology -> Wydziały Politechniki Gdańskiej						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Dawid Zieliński				
	Teachers						
Lesson types and methods of instruction	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						
	eNauczanie source address: https://enauczanie.pg.edu.pl/moodle/course/view.php?id=41796						
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	5.0	15.0	50		
Subject objectives	Introduction to the topics of hybrid and additive manufacturing methods along with reverse engineering applied to the manufacture 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 for manufacturing selected parts of mechanical engineering, taking into account the selection of appropriate technology, type of material and process parameters. In addition, he properly evaluates the obtained results from the point of view of selected technological and economic aspects of the process.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[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 of hybrid and additive manufacturing technologies when solving engineering tasks. He can properly present and justify the selection of a manufacturing method for unconventional materials and specific features of the designed part.	[SU5] Assessment of ability to present the results of task [SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information
[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 presenting the designed manufacturing technology for mechanical components used in mechanical engineering using hybrid and additive manufacturing methods.	[SW2] Assessment of knowledge contained in presentation
[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 a deep 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, taking into account the proper selection of the manufacturing method and process parameters.	[SW1] Assessment of factual knowledge

Subject contents

Lectures: 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 taking into account 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.

Project classes: basics and characteristics of CAD/CAM software used in hybrid and additive manufacturing; development of the process of making selected parts of mechanical engineering with subtractive technology using CAM software; development of the process of rapid prototyping of selected parts of mechanical engineering with 3D printing technology using dedicated slicers; multi-criteria comparative evaluation of the processes of making selected parts of mechanical engineering with the use of CNC cavity technology and 3D printing, taking into account technological and economic aspects; basics of incremental technologies: principle of operation and construction of 3D printers, preparation of the device for operation, analysis of the process flow, postprocessing.

Prerequisites and co-requisites

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

Assessment methods and criteria

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

Recommended reading	Basic literature	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.
	Supplementary literature	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.
	eResources addresses	
Example issues/ example questions/ tasks being completed	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.	
Work placement	Not applicable	

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