COURSE DESCRIPTION CARD - SYLLABUS

Course name
Basics of 3D printing [S1MiBM2>PD3D]

Course

Field of study
Mechanical Engineering

Year/Semester
4/7

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

Lecturers

Prerequisites

KNOWLEDGE: the student has a basic general knowledge of the structure of the surrounding world and the laws that govern it. SKILLS: the student is able to integrate obtained information, interpret it, draw conclusions, formulate and justify opinions SOCIAL COMPETENCES: the student is aware of the importance of additive manufacturing techniques

Course objective

Construction and modeling in CAx systems. Preparation of models for incremental manufacturing techniques. 3D printing methods. Materials and applications of printing techniques in engineering design. Characteristics of printed materials. Computer simulation of structures using printed materials.

Course-related learning outcomes

Knowledge:
The student has a structured, theoretically supported knowledge of strength of materials in the following areas: methods of determining external and internal forces and moments, basic tests for determining mechanical properties of materials including printed materials, determination of stresses and displacements.
The student has a basic knowledge of information technology and computer science in the fundamentals of computer hardware and software in the processing, transmission, presentation and

security of information. The student has knowledge of computer-aided engineering systems in mechanics, mechanical engineering and technology, in particular engineering CAx computer systems in product design and improvement and in product preparation for production. He can design components of machine parts using incremental manufacturing techniques (3D modeling, finite element method, 3D printing).

Skills:
He/she is able to acquire information from literature, databases and other appropriately selected sources (also in English or another foreign language recognized as the language of international communication) in the field of mechanics and mechanical engineering and other engineering and technical issues consistent with the field of study; he/she is able to integrate obtained information, interpret it, and draw conclusions and formulate and justify opinions.
He/she can prepare documentation on the implementation of an engineering task in the field of mechanics and mechanical engineering (construction, technology, organization) and prepare a text containing a discussion of the results of the implementation of this task.
He/she can select printed engineering materials for applications in mechanics and mechanical engineering.
He/she can select and apply AM manufacturing technologies to shape the form, structure and properties of products, design technological processes with the selection of equipment for printing by incremental methods.

Social competences:
The student is aware of the importance and understanding of the non-technical aspects and consequences of engineering activities, including their impact on the environment and the related responsibility for decision-making.
He/she is able to interact and work in a group, taking various roles in it.
He/she can appropriately determine priorities for the implementation of a task defined by him/herself or others.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

For discussion and ongoing preparation and activity in class. Written credit. Compulsory implementation of projects related to 3D printing. Final credit for laboratory classes.

Programme content

Lecture:
The role and place of 3D printing in product development. Applications of 3D printing techniques. Industrial applications of incremental manufacturing techniques. Methods and materials in 3D printing. Advantages and limitations of applicability of incremental techniques. Data formats used in 3D printing techniques. Errors in the printing process for FDM, SLA, SLS, SLM techniques. Optimization of printing processes to improve the quality and durability of manufactured components. Estimating the accuracy of components produced by incremental techniques. Mechanical testing of printed materials and the numerical implementation process.
Laboratory
Introduction to design principles using SolidWorks systems. Preparation of gemetric models for FDM, SLA, CJP printing techniques. Selection of design from GRABCAD, ZOLTRAX Library databases. Preparation and possible repair of STL files. Optimization of the printing process. Generation and preparation of models in gCode format. Printing and assembly of the design. Strength testing of the accuracy and functionality of the obtained prints from FDM, SLA, CJP processes.

Course topics

none

Teaching methods

1. Lecture with multimedia presentation
2. Laboratory - laboratory exercises on 3D printing by FDM, SLA, FDM-metal methods

Bibliography

Basic:
1. McConnell Steve, Szybkie projektowanie. Zapanuj nad chaosem zadań i presją czasu, Helion 2017 [in Polish]
2. Oczoś K.E.: Kształtowanie materiałów skoncentrowanymi strumieniami energii, Wyd. Pol. Rzeszowskiej, Rzeszów 1988. [in Polish]
3. Chlebus E.: Techniki komputerowe CAx w inżynierii produkcji, WNT Warszawa 2000. [in Polish]
4. Olszewski H, LABORATORIUM SZYBKIEGO PROTOTYPOWANIA : Inżynieria odwrotna. Elbląg 2012 [in
Polish]

Additional:
1. Kamrani K., Abouel E., Rapid Prototyping, Springer 2006.
2. Leong K., Lim Ch. Rapid Prototyping: Principles and Applications (3rd Edition), 2010.
3. D. Schob, I. Sagradov, R. Roszak, H. Sparr, R. Franke, M. Ziegenhorn et al., Experimental determination and numerical simulation of material and damage behaviour of 3D printed polyamide 12 under dynamic loading, Engineering Fracture Mechanics 2019 (2019)

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00