Wrocław University of Science and Technology
Doctoral School

COURSE CARD

1. Basic information

Course name in English:	Workshop of 3D modeling and 3D printing	
Course name in Polish:	Warsztat modelowania i druku 3D	
Number of hours:	30	
Type of course:	Elective course	
Form of course:	mixed forms (combination of lecture, seminar and laboratory)	
Code of course:		
Course leader:	*Piotr Cyganowski*	
Faculty of the course leader:	W3 Faculty of Chemistry	
Email address of the course leader:	piotr.cyganowski@pwr.edu.pl	
Scientific discipline(s) assigned to the course (doctoral students representing the marked disciplines can participate in the course):	Architecture and urban planning	☒
	Automation, electronic, electrical engineering and space technologies	☒
	Information and communication technology	☐
	Biomedical engineering	☒
	Chemical engineering	☒
	Civil engineering, geodesy and transport	☒
	Materials engineering	☒
	Mechanical engineering	☒
	Environmental engineering, mining, and energy	☒
	Mathematics	☐
	Chemical sciences	☒
	Physical sciences	☐
	Management and quality studies	☐

2. Objectives

The aim of the course is to introduce PhD candidates to the basics of 3D printing technologies. It will be done within a mixed form, linking laboratory and project activities. First, the students will be introduced to the fundamentals of 3D modelling in CAD environment. Next, a series of projects will be implemented. Within these, the students will design engineering parts, and will further self-produce them using 3D printers operating in FDM and SLA technologies.

Within this concept, the differences, as well as engineering and practical aspects of different 3D-printing approaches will be presented, discussed and determined on the practical basis. Outcomes of the course will let the students to:

1. Get familiar with different methods for acquiring 3D designs.
2. Knowing limitations and advantages of different 3D printing technologies,
3. Be able to select a proper technology for desired application.
4. Get a set of tools possible to be used in their own area of interests.

3. Content

Detailed information about the course content, including topics and form of classes.

No.	Topic	Number of hours	Form of classes
1	(P. Cyganowski) Introdcution to the course, presentation of the software; basic approaches for 3D designing and 3D printing		lecture
2	(I. Polowczyk) Introduction to Autodesk Inventor and 3D modeling basics. Creating 3D models.		project
3	(I. Polowczyk) Introduction to Autodesk Inventor and 3D modeling basics. Managing parts and assemblies.		project
4	(I. Polowczyk) Advancing modeling techniques		project
5	(I. Polowczyk) Preparing models and design considerations for 3D printing.		project
6	(I. Polowczyk) Design optimization for 3D printing		project
7	(P. Cyganowski) Processing of 3D designs for SLA 3D printing. Introduction to SLA 3D printing technology. Preparing and initiating printing		laboratory
8	(P. Cyganowski) Using advantages of SLA printing technology. Designing and printing of selected, complex structures		laboratory
9	(P. Cyganowski) Using data and projects' open libraries for acquiring ready-to use 3D designs. Printing of selected structures.		laboratory
10	(P. Cyganowski) 3D printed joints and threads. Recognizing a variety of resins applied in SLA technology		laboratory
11	(M. Kruszelnicki) Processing of 3D designs. Introduction to FDM 3D printing technology.		laboratory
12	(M. Kruszelnicki) Preparing and initiating printing. Understanding print setup parameters.		laboratory
13	(M. Kruszelnicki) Basic 3D Printing Techniques. Optimizing print parameters. Post-processing techniques.		laboratory
14	(M. Kruszelnicki) Advanced FDM 3D printing techniques. Designing guidelines for optimizing printability.		laboratory
15	(M. Kruszelnicki) Troubleshooting and Maintenance of FDM 3D Printers. Diagnosing and resolving Print Quality Issues.		laboratory

4. Prerequisites

List of prerequisites relating to knowledge, skills and other competences for course participants.

Basic skills in operating AutoCAD software

5. Learning outcomes

List of learning outcomes at level 8 of the Polish Qualifications Framework assigned to the course (mark the learning outcomes in the last column).

Symbol	Learning outcome	
	KNOWLEDGE. Doctoral student knows and understands:	
SzD_W3	the main trends in the development of the scientific or artistic disciplines covered in the curricula;	☒
SzD_W4	research methodology;	☐
SzD_W5	the rules for the dissemination of scientific results, including in open access mode;	☐
SzD_W6	the fundamental dilemmas of modern civilization;	☐
SzD_W7	the legal and ethical conditions of scientific activity;	☐
SzD_W8	the economic and other relevant conditions of scientific activity;	☐
SzD_W9	basic principles of knowledge transfer to the economic and social spheres and commercialisation of results of scientific activity and know-how related to these results.	☐
	SKILLS. Doctoral student is able to:	
SzD_U2	use knowledge from different fields of science or art to creatively identify, formulate and innovatively solve complex problems or perform research tasks, in particular: - define the purpose and subject of scientific research, formulate a research hypothesis, - develop research methods, techniques and tools, and use them creatively, - draw conclusions on the basis of scientific research; critically analyse and evaluate the results of scientific research, expertise and other creative work and their contribution to knowledge development; transfer the results of scientific activities to the economic and social spheres;	☒
SzD_U3	communicate on specialised topics to the extent that they enable an active participation in the international scientific community;	☒
SzD_U4	disseminate research results, including in popular forms;	☐
SzD_U5	initiate debates and participate in a scientific discourse;	☐
SzD_U6	be able to speak a foreign language at B2 level of the Common European Framework of Reference for Languages to a level that enables them to participate in the international scientific and professional environment;	☐
SzD_U7	plan and implement an individual or collective research or creative activity, including in an international environment;	☒
SzD_U8	independently plan and act for one's own development and inspire and organize the development of others;	☒
SzD_U9	plan classes or groups of classes and implement them using modern methods and tools.	☐
	SOCIAL COMPETENCES. Doctoral student is ready to:	

SzD_K3	fulfilling the social obligations of researchers and creators, initiate public interest activities, thinking and acting in an entrepreneurial way;	☐
SzD_K4	maintaining and developing the ethos of research and creative environments, including: - carrying out scientific activities in an independent manner, - respecting the principle of public ownership of research results, taking into account the principles of intellectual property protection.	☐

6. Evaluation

Short description of the method(s) used to evaluate the learning outcomes assigned to the course, e.g., exam, test, report, presentation, etc.

The course will be evaluated on the report summarizing the developed designs

7. Teaching methods

Short description of the teaching methods used during the course, e.g., multimedia presentation, discussion, literature studies, developing written documents, own work, etc.

The project part: interactive co-designing supported by a tutor
The laboratory part: students' own work under the supervision of a tutor

8. Literature

List of primary and secondary literature used to prepare the course and including additional knowledge for participants, e.g., books, textbooks, research papers, standards, web pages, etc.

F. Stasiak, *Zbiór ćwiczeń Autodesk Inventor: Kurs Podstawowy*, Wyd. Expert Books, 2016, Aleksandrów Łódzki
F. Stasiak, *Zbiór ćwiczeń Autodesk Inventor: Kurs Zaawansowany*, Wyd. Expert Books, 2016, Aleksandrów Łódzki
Daniel T. Banach, Shawna Lockhart, Sheila Markazi, *Autodesk Inventor 2024 Essentials Plus*, SDC Publication, 2023
Luke Jumper, Randy H. Shih, *Parametric Modeling with Autodesk Inventor 2024*, SDC Publication, 2023
Joan Horvath - Mastering 3D Printing: A Guide to Modeling, Printing, and Prototyping, Apress (2020)
Ben Redwood, Filemon Schöffer, Brian Garret, *The 3D Printing Handbook: Technologies, design and applications*, 3D HUBS

9. Other remarks

Additional remarks, comments, (e.g., language of the course)

Language of the course: English