COURSE DESCRIPTION CARD - SYLLABUS

Course name
Additive manufacturing and virtual reality in medicine

Course

Field of study
Biomedical engineering
Area of study (specialization)
-
Level of study
First-cycle studies
Form of study
full-time

Year/Semester
2/4
Profile of study
general academic
Course offered in
Polish
Requirements
compulsory

Number of hours

Lecture
15
Laboratory classes
30
Other (e.g. online)
0
Tutorials
0
Projects/seminars
15

Number of credit points

4

Lecturers

Responsible for the course/lecturer:
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Faculty of Mechanical Engineering

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Responsible for the course/lecturer:
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Faculty of Mechanical Engineering

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Prerequisites

Knowledge in scope of information technologies, computer graphics and engineering drawing, CAD systems. Knows basics of manufacturing technologies and engineering materials.

Skills in operation of computer systems for 3D graphics (e.g. CAD systems)

Social competences: student is open to implementation of modern computer technologies in science and technology. Can self-develop new skills and knowledge. Can work in a team.

Course objective

Getting familiar with additive manufacturing technologies, as well as gaining knowledge about hardware and software used in interactive Virtual Reality (VR) and Augmented Reality (AR) applications, created for medicine and biomedical engineering. Gaining skills in application of the above mentioned technologies in medicine.

Course-related learning outcomes

Knowledge

1. Student has knowledge of additive manufacturing processes and their application in medicine and biomedical engineering, knows the advantages, disadvantages and limitations of these processes.

2. Student has knowledge of the basic processes of additive manufacturing: Fused Deposition Modeling, stereolithography, Selective Laser Sintering, powder printing and laminated object manufacturing.

3. Student defines, distinguishes and classifies concepts of Virtual Reality, Augmented and Mixed Reality. Indicates possibilities and examples of VR and AR systems applications in medicine.

4. Student has knowledge about VR and AR hardware – interaction and projection systems.

Skills

1. Student can plan and implement the process of additive manufacturing: uses specialized software to prepare a batch file, selects the correct positioning of objects, division into layers and options for generating supports, supports devices working in the FDM technique, performs model processing.

2. Student can plan the process of building a VR / AR system useful in medical applications.

3. Student has a skill of creating a simple VR application useful in medical applications, starting from the preparation of 3D data, through behavior programming, to the preparation of the user interface.

Social competences

1. Student is aware of consequences of use of computer systems in public life.

2. Student is open to application of additive manufacturing and VR / AR technologies in medicine.

3. Student can work in a team using VR systems and additive manufacturing technologies.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

Partial marks:

a) lectures:

- on the basis of answers to questions regarding material from previous lectures,

b) laboratories:

- on the basis of evaluation of current advancement in realization of given tasks,

c) project:

- on the basis of evaluation of current project progress.

Summary mark:

a) lectures:

- evaluation of knowledge by written exam with open and closed questions; questions are assessed on a point scale, and to pass it is required to collect at least 50% of the total possible number of points

b) laboratories:

- evaluation on the basis of reports from laboratory exercises; to obtain a pass, it is necessary to submit reports on all the exercises indicated by the teacher, according to the detailed requirements agreed with the teacher (a report template will be provided)

c) project:

- evaluation on the basis of final project report - it is necessary to implement at least 50% of the features / functionalities listed in the detailed guidelines provided by the teacher at the beginning of the class..

Programme content

Lecture:

1. Basic concepts in the area of additive techniques and rapid manufacturing. Uses, advantages, disadvantages and limitations.

2. Basic additive manufacturing processes and their medical applications: Fused Deposition Modeling (FDM / FFF), stereolithography (SLA) and related processes, including PolyJet and DLP, selective laser sintering (SLS) and related processes, including Electron Beam Melting (EBM), Selective Laser Melting (SLM); powder printing: MultiJet Printing / ColorJet Printing (MJP / CJP) and similar, layer lamination (LOM).

3. Data preparation for additive manufacturing - STL models, development methods including use of medical data, problems and errors. Data preparation software (slicers).

4. Basic concepts of Virtual Reality (VR) and Augmented Reality (AR). A general overview of VR and AR applications in medicine.

5. VR and AR systems – hardware: projection and interaction systems; software.

Laboratory:

1. Basics of creation of simple interactive application in VR environment (Unity engine) with use in medicine.

2. Building simple medical AR and VR applications.

3. Data preparation for additive manufacturing: mesh processing, preparation of 3D models, technology development, preparation of manufacturing programs.

4. Realization of the additive manufacturing processes on selected machines in the FDM / SLA / DLP technology, post processing.

Project:

Work in teams consisting of 2-3 students. Two possible paths (elective):

A. Building a VR or AR application for medical use, involving selected equipment available in the laboratory.

B. Design and rapid manufacturing with additive techniques of a selected medical device.

Teaching methods

Lecture: presentation with multimedia.

Laboratories: experiments, problem solving, discussion, teamwork. Work using computer.

Project: solving practical problems, searching sources, teamwork, discussion.

Bibliography

Basic

1. F. J. Rybicki, G. T. Grant (Eds.), 3D Printing in Medicine: A Practical Guide for Medical Professionals, Springer 2017

2. R. Riener, M. Harders, Virtual Reality in Medicine, Springer, 2012

Additional

1. F. Górski, Metodyka budowy otwartych systemów rzeczywistości wirtualnej: zastosowanie w inżynierii mechanicznej, Wyd. Politechniki Poznańskiej, 2019

Breakdown of average student's workload

	Hours	ECTS
Total workload	100	4,0
Classes requiring direct contact with the teacher	62	2,5
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) [1]	38	1,5

[1] delete or add other activities as appropriate