COURSE DESCRIPTION CARD - SYLLABUS

Course name
Rapid design and manufacturing of orthoses and prostheses [S2IBio1E-UMiR>SPiW]

Course

Field of study
Biomedical Engineering

Year/Semester
2/3

Area of study (specialization)
Medical and Rehabilitation Devices

Profile of study
general academic

Level of study
second-cycle

Course offered in
English

Form of study
full-time

Requirements
elective

Number of hours

Lecture
15

Laboratory classes
15

Other (e.g. online)
0

Tutorials
0

Projects/seminars
0

Number of credit points

2,00

Coordinators

Lecturers

Prerequisites

Knowledge in scope of information technologies and technical drawing, CAD/CAM, manufacturing technologies; knowledge of orthopaedic and prosthetic supplies. Skills in solid modelling of an object in a CAD 3D system; designing an orthopaedic or prosthetic supply. Social competences: cooperation in a project team, awareness of responsibility for assigned tasks, understanding the need for new knowledge.

Course objective

Getting familiarized with techniques and methods of automated design of orthopaedic and prosthetic products, using reverse engineering and KBE and rapid manufacturing of these products using additive manufacturing technologies (3D Printing).

Course-related learning outcomes

Knowledge:
1. Describes role of design in modern design engineering process.
2. Describes technological foundations of additive technology of FDM and possibilities of its application in orthopaedics and prosthetics.
3. Describes possibilities of design using reverse engineering and KBE.

Skills:

1. Creates 3D models, prepares and processes a triangular mesh file (STL), selecting resolution for the needs of additive manufacturing.
2. Manufactures orthopaedic products using FDM technologi. Prepares a batch file and selects parameters. Performs post processing.
3. Processes triangular mesh and uses intelligent CAD models for generating a design of an orthosis/prosthesis.

Social competences:
1. Is open on implementation of rapid manufacturing in engineering activities.
2. Is able to develop knowledge on they own.
3. Is able to work in a project team using rapid product development techniques.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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) laboratory:
- on the basis of evaluation of current advancement in realization of given tasks,
Summary mark:
a) lectures:
- evaluation of knowledge by written final test 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) laboratory:
- evaluation of advancement in realization of project of a given orthosis/prosthesis
- evaluation of results, e.g. obtained product and a summarizing report
- to obtain a pass, it is necessary to present a report describing the completed project of the orthosis / prosthesis, containing description of at least 3 out of 4 stages of the process (these are: obtaining and processing patient data, obtaining the base 3D model of the orthosis / prosthesis, model improvement, manufacturing and assembly of the product)

Programme content

Lectures:
- mass customization in medical engineering - production of individualized supplies,
- reverse engineering techniques (3D scanning) in medicine - hardware, software, methodology of gathering and processing data,
- rapid manufacturing technologies - Fused Deposition Modelling in prosthetics and orthotics (basics, materials, applications, machines, software, planning and realization of a process, post processing),
- design automation techniques - basics of KBE (Knowledge Based Engineering) and auto-generating models in medical applications.
Laboratory - course:
- presentation of a process of rapid design and manufacturing of orthopaedic and prosthetic supplies in Laboratory of Virtual Reality and Laboratory of Rapid Manufacturing,
- division into 3-4 person groups, selection of a product (openwork hand orthosis, leg orthosis, hand prosthesis),
- digitization of patient"s limb (patient is a member of a project team) by 3D scanning,
- data processing and automated generation of a project of orthosis/prosthesis using intelligent CAD models supplied by a supervisor, improvements in the model
- design of manufacturing process (machine, material, parameters, post processing),
- manufacturing, processing and assembly of a product, practical verification, preparing report.

Course topics

none

Teaching methods

- informative lecture

- multimedia presentation
- case study
- project method

Bibliography

Basic
1. F. J. Rybicki, G. T. Grant (Eds.), 3D Printing in Medicine: A Practical Guide for Medical Professionals, Springer 2017
2. Chua C. K., Leong K. F., and Lim C. S., 2010, “Rapid Prototyping: Principles and Applications”, World Scientific Publishing Co. Pte. Ltd., Singapore
Additional
1. Pająk E., Dudziak A., Górski F., Wichniarek R., Techniki przyrostowe i wirtualna rzeczywistość w procesach przygotowania produkcji, Poznań 2011, ISBN 978 83 86912 56 8, Wydawnictwo Promocja 21
2. Skarka W., Catia v5. Podstawy budowy modeli autogenerujących. Helion, 2009

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