



## COURSE DESCRIPTION CARD - SYLLABUS

Course name

Rapid design and manufacturing of prostheses and orthoses

---

### Course

Field of study

Biomedical Engineering

Area of study (specialization)

-

Level of study

Second-cycle studies

Form of study

full-time

Year/Semester

1/2

Profile of study

general academic

Course offered in

Polish

Requirements

elective

---

### Number of hours

Lecture

15

Tutorials

Laboratory classes

15

Projects/seminars

Other (e.g. online)

### Number of credit points

3

---

### Lecturers

Responsible for the course/lecturer:

Filip Górski, PhD., Eng.

email: [filip.gorski@put.poznan.pl](mailto:filip.gorski@put.poznan.pl)

tel. +48 61 665 27 08

Faculty of Mechanical Engineering

Piotrowo 3, PL-60-965 Poznań, POLAND

Responsible for the course/lecturer:

---

### 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 technology. 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 their 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:

Partial marks:

a) lectures:

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



b) project:

- 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

b) project:

- evaluation of advancement in project realization
- evaluation of project results, e.g. obtained product and a report summarizing the project

### 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.

Project - 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 WHO, AFO, RoboHand 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,
- design of manufacturing process (machine, material, parameters, post processing),
- manufacturing, processing and assembly of a product, practical verification, preparing report.

### 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	75	3,0
Classes requiring direct contact with the teacher	50	2,0
Student's own work (literature studies, preparation for laboratory classes/tutorials, preparation for tests/exam, project preparation) <sup>1</sup>	25	1,0

<sup>1</sup> delete or add other activities as appropriate