

## CURRICULUM

### Module Title:

Title: **3D printing for health care**

Subtitle: *Improving digital skills for Ergonomics and Bioengineering Innovations for inclusive Health Care*

### Short Description:

Specialised interdisciplinary education concept of theoretical and practical aspects of additive technologies application in biomedical engineering to enhance human health and wellbeing.

### Course Description:

The course provides a specialised interdisciplinary education concept of theoretical and practical aspects of additive technologies application in biomedical engineering to enhance human health and wellbeing. The graduates gain a comprehensive understanding of core engineering principles related to the implants and prosthesis produced by additive technologies. The education concept is built for the ability to start an interesting career for highly skilled personnel in 3D printing for inclusive health care.

Students will utilise knowledge from the biomaterials and their processing technologies, basic medical issues, digital support in medicine, medical and hospital instrumentation, ergonomics, as well management of process of the 3D printing for health care. The applied complex of the interdisciplinary engineering knowledge and skills enables the graduate of the course to design and to produce personalised implants and prosthesis for improvement of human life.

### Course Level:

Undergraduate / Graduate / Postgraduate / Lifelong education

### Course Type:

Mandatory (included in the already existing course) or Elective (to organise a specific new course)

### Duration

On-site: 14 weeks + 1 week for final examination

On-line: self-paced

### Admission Process (Selection criteria):

Self-assessment test

## Prerequisites:

### 1. Knowledge

Demonstrating knowledge at a level enabling their practical application in:

- Mathematics - Arithmetic / Algebra & Geometry / Trigonometry / Probability and Statistics / Calculus
- Descriptive geometry - Orthogonal projection of 3D objects
- Physics - Mechanics of rigid and flexible bodies and environments / Kinematics
- Chemistry - Chemical bonds / Solids & Liquids & Solutions / Chemical reactions – Oxidation & Reduction
- Material science - Crystalline solids & Ceramics & Polymers structure & properties / Imperfections in Solids / Diffusion / Dislocations and Strengthening / Degradation of materials
- Computer graphics - Basic 3D modelling theory
- Thermomechanics - an introductory background (first year university level)
- Hydromechanics - an introductory background (first year university level)

Mastering the

- Basics of materials technology and production of machine structures
- Methods and means of technical and experimental research of machines as well as the means of controlling machines and processes

Knowing the

- Principles of the main scientific methods of the professional field and using some of their basic variants in practical contexts

### 2. Skills

General digital skills on intermediate level - Digital foundation skills / Communicating / Handling information and content / Transacting / Problem-solving / Being safe and legal online

Ability to

- construct simple components, assemblies up to the design of a simpler machine with all the necessary strength calculations and economic balance sheets
- use professional terminology and process technical documentation
- read technical drawings of products or parts and propose the most efficient methods and procedures for their production
- analyse and evaluate technical solutions
- perform basic analysis of machinery and production technologies
- to carry out technical supervision at workplaces, check compliance with technological procedures
- verify new production procedures, collaborate on the implementation of technological changes and innovative activities
- prepare, carry out and compile a report on the result of a laboratory experiment
- provide technical preparations for changes to the assortment and introduce new products

- determine the method of quality control and technical tests, to cooperate on production quality control
- PROBABLY THIS NO - design technical facilities and their number, kind and type of machines and machinery for production based on the established procedure and target capacity
- PROBABLY THIS NO - ensure and organize the technological preparations of engineering production, to propose the layout of machines and fixtures, the flow of material, the continuity of workplaces and other technical conditions

### 3. Attitudes

Application of knowledge and understanding in a way that shows a professional approach to their work or profession, and they have competences that are usually demonstrated by creation and defending arguments and solving problems in this professional field.

Collecting and interpreting relevant data (usually in the professional field) and reach judgments from them that also consider relevant social, scientific and ethical consequences.

Communication of information, ideas, problems and solutions to both experts and lay people

Ability of independent learning and studying

## List of contents

1. Introduction: The benefits of implantology in the health care system, management of patient and production process (Soft skills + management + ergonomics) for people with special needs
2. Introduction of the biomaterials and biocompatible materials
3. Processing technologies of the biomaterials and biocompatible materials
4. 3D printing of the metals, ceramics and polymers
5. Anatomy of the implantology, geometry, sizes and general and special examples
6. Material selection for implant (use the knowledge of the biomaterials and biocompatible materials and their processing technologies) as a function of the anatomy of the application
7. Human implant compatibility test methods and surgery in implantology.
8. Databases, programming, AI
9. Telemedicine system, medical informatics
10. 3D scanning, process and device
11. Medical Imaging (CT/MRI/USG)
12. Application of the 3D images for designing as a function of the processing technology (digital tools for designing)
13. Medical equipment, hospital equipment
14. Integrating exercise

## Learning outcomes

### 1. Knowledge

Graduate will be able:

- to identify the need of use of biomaterials for 3D printing on his own in health care,
- to understand the requirement of biomaterials and biocompatible materials,
- to understand basic human body functions / working and ability to complex suggestion procedures,
- to understand basic medical issues in health care service,

- to understand the attitude how to address to people with special needs and adopt inclusive centred approach with soft skills and emotions,
- to understand basic knowledge for management for inclusive health care.

## 2. Skills

Graduate will be able:

- to select the most appropriate material for real application,
- to propose an inclusive solution to medical product development,
- to work with patient data and using digital tools for implantology and prosthetics,
- to select appropriate technology (casting, CNC, 3D printing, surface processing, heat treatment, colouring) for implants and prosthetics production,
- to design implants and prosthetics with free available software,
- to use medical tools (medical imaging and 3d scanning) for people with special needs,
- to use ergonomics methodologies and tools for manufacturing personalised implants/prosthesis,

## 3. Attitude:

- Application of knowledge and understanding in a way that shows a professional approach to their work or profession, and they have competences that are usually demonstrated by creation and defending arguments and solving problems in this field of study,
- Collecting and interpreting relevant data (usually in their own field of study) and from them reach judgments that also take into account relevant social, scientific and ethical problems;
- Communication of information, ideas, problems and solutions to both experts and lay people;
- Developed the ability for further education, necessary for studying with a high degree of independence.

## Teaching methods

- Activating (simulation, games, dramatisation)
- Monological (lecture, instruction)
- Dialogic (Discussion, conversation, brainstorming)
- Demonstration
- Lecturing
- E-learning
- Methods of working with the text (study book, book)
- Individual work of students
- Students work in pairs
- Teamwork
- Laboratory work
- Exercise on the computer
- Practice exercises

- Dealing with situational issues - learning in situations

## **Methods for verifying learning outcomes and assessment criteria (Examination):**

Learning outcomes are verified as follows:

Self-assessment (not mandatory) in a form of a quiz after each topic

5 out of 20 questions will be chosen from a question bank

Final test will be carried out after studying 13 topics. For this aim we will use the question bank and will chose 10 questions

For 14 topics a practical task will be assigned for an assessment.

## **Assessment scale (applicable for a final test):**

Assessment scale:

**A** 94 – 100%

**B** 89 – 94%

**C** 81 – 88%

**D** 73 – 80%

**E** 66 – 72%

**F** 0 – 65 %

## **Scope/duration of online training:**

14 weeks of education and 15<sup>th</sup> week for final test

## **n. of ECTS recommended:**

at least 3 ECTS