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EUROPEAN UNIVERSITY FOR CUSTOMISED EDUCATION

STUDY GUIDE

FROM SCAN TO SUPPORT: 3D PRINTED POLYMER ANKLE FOOT ORTHOSES

Organised by

Poznan Univesity of Technology

1. IDENTIFYING DATA.	
· Course Name.	From Scan to Support: 3D Printed Polymer Ankle Foot Orthoses
· Coordinating University.	Poznan University of Technology
· Partner Universities Involved.	-
· Course Field(s).	Biomedical Engineering; Mechanical Engineering; Additive Manufacturing; Medical Devices; Rehabilitation Engineering
· Related Study Programme.	Open to students of Biomedical Engineering, Mechanical Engineering, Materials Engineering, Product Design, Rehabilitation Technologies and related programmes.
· ISCED Code.	0715, 0914
· SDG.	SDG 3 – Good Health and Well-being (supporting rehabilitation and improving quality of life through personalised orthotic devices) SDG 9 – Industry, Innovation and Infrastructure (application of advanced additive manufacturing technologies in healthcare) SDG 12 – Responsible Consumption and Production (efficient use of materials and reduction of waste through customised production) SDG 10 – Reduced Inequalities (increasing accessibility of affordable, patient-specific medical devices)
· Study Level.	Bachelor, Master and Doctoral students
· EUNICE Key Competencies	[Indicate the Key Competencies offered by the course.] • Green – strongly • Orange - moderately • Red – partially • Blank cell - not at all

Problem solving	Green
Teamworking	Orange
Communication	Green
Self-management	Green

	Cognitive flexibility	Green
	Digital competence	Green
	Technical competence	Green
	Global intercultural competence	Green

· Number of ECTS credits allocated.	5
· Mode of Delivery.	Online self-study and Online live
· Language of Instruction.	English
· Course Dates.	1.10.2026 – 29.01.2027
· Precise Schedule of the Lectures.	2.10.2026 Introduction & clinical context Introduction to ankle-foot orthoses (AFO), biomechanics of the ankle joint and rehabilitation needs. Overview of personalised medicine and the role of additive manufacturing in orthotics. 9.10.2026 3D scanning & data processing Acquisition of patient-specific geometry using 3D scanning systems. Processing of point clouds and mesh optimisation (e.g. cleaning, alignment, smoothing). Introduction to scan accuracy and common sources of geometric deviations. 16.10.2026 CAD modelling & orthosis design Scan-to-CAD workflow. Design principles for AFOs in CAD software. Structural features, thickness optimisation and ergonomics. Preparation of models for additive manufacturing. 23.10.2026 Additive manufacturing & materials Polymer and fibre-reinforced materials (PLA, PETG, ABS, PA, CF composites). FDM/FFF process parameters, slicing strategies and manufacturing limitations. Practical session on 3D printers (e.g. Bambu Lab systems). 6.11.2026 Mechanical analysis & validation Introduction to mechanical testing (tensile, bending) and surface quality. Basics of finite element analysis (FEA/MES) for orthotic

	structures. Comparison of simulation and experimental results. Case studies of 3D-printed AFOs.
· Key Words.	ankle-foot orthoses, AFO, 3D printing, additive manufacturing, polymer composites, biomedical engineering, 3D scanning, CAD, rehabilitation, personalised medical devices
· Catchy Phrase.	From patient scan to personalised support — discover how 3D printing shapes modern orthotic care.

· Prerequisites and co-requisites.	[Provide information on: - whether a student must have successfully completed certain courses before s/he can take this course and any other requisites such as i.e. linguistic skills; - The study levels this course is available for (B, M or D); - Required linguistic skills]
· Number of EUNICE students that can attend the Course.	20
· Number of EUNICE students that can attend the course per institution	10
· Course inscription procedure(s).	The standard EUNICE process

2. CONTACT DETAILS.	
· Department.	Poznan University of Technology
· Name of Lecturer.	Justyna Rybarczyk
· E-mail.	Justyna.Rybarczyk@put.poznan.pl
· Other Lecturers.	Magdalena Żukowska

3. COURSE CONTENT.

This course introduces students to the complete workflow for designing and manufacturing personalised ankle-foot orthoses (AFOs) using additive manufacturing technologies. Starting from clinical needs and patient-specific requirements, participants will gain hands-on knowledge in 3D scanning, digital data processing, CAD-based design, and material selection. The course also covers manufacturing using FDM/FFF technologies, including process parameters and limitations. Students will explore mechanical testing methods and basic finite element analysis (FEM) for validation of orthotic devices. Emphasis is placed on real-world applications, interdisciplinary collaboration, and the role of digital technologies in modern healthcare and rehabilitation engineering.

4. LEARNING OUTCOMES.

Upon successful completion of this course, students will be able to:

- Understand the clinical context and functional requirements of ankle-foot orthoses.
- Acquire and process 3D scan data of anatomical structures.
- Design personalised orthotic devices using CAD software.
- Select appropriate materials and additive manufacturing parameters for medical applications.
- Understand the principles of FDM/FFF 3D printing technologies.
- Perform basic mechanical analysis and interpret results of experimental tests.
- Apply introductory finite element analysis (FEM) to orthotic structures.
- Evaluate the quality, usability, and limitations of 3D-printed medical devices.
- Work effectively in interdisciplinary teams on engineering-medical projects.
- Communicate technical concepts related to biomedical design and manufacturing.

5. OBJECTIVES.

The main objectives of the course are:

- To introduce students to personalised orthotic design using digital technologies.
- To develop practical skills in 3D scanning, CAD modelling, and additive manufacturing.
- To familiarise students with materials and processes used in medical device production.
- To provide basic knowledge in mechanical testing and simulation methods.
- To promote interdisciplinary collaboration between engineering and healthcare domains.
- To enhance students' ability to solve real-world problems in rehabilitation engineering.
- To raise awareness of sustainable and innovative production methods in healthcare.

6. COURSE ORGANISATION.

UNITS

1.	Clinical background and biomechanics of ankle-foot orthoses
2.	3D scanning and digital data processing
3.	CAD modelling and orthosis design
4.	Additive manufacturing technologies and materials
5.	Mechanical testing and validation methods

LEARNING RESOURCES AND TOOLS.

- 3D scanning devices and software
- CAD software (e.g. Fusion 360, SolidWorks, or equivalent)
- Slicing software (e.g. Bambu Studio, Cura)

- FDM/FFF 3D printers
- Simulation tools (basic FEA software)
- Scientific articles and open-access educational materials
- Online learning platform (for course materials and communication)

PLANNED LEARNING ACTIVITIES AND TEACHING METHODS.

- Lectures (theoretical introduction)
- Live demonstrations
- Hands-on practical sessions (3D scanning, CAD, printing)
- Case studies analysis
- Group work and discussions
- Project-based learning
- Individual assignments

7. ASSESSMENT METHODS, CRITERIA AND PERIOD.

The course will be assessed based on continuous assessment and a final project.

Assessment methods:

- Individual assignments (e.g. CAD modelling, data processing tasks)
- Group project – design and presentation of a personalised AFO
- Final presentation or report

Criteria:

- Technical quality and correctness of the design
- Application of appropriate methods and tools
- Understanding of the workflow from scan to final product
- Innovation and problem-solving approach
- Quality of presentation and documentation

Assessment period:

- Continuous assessment throughout the course
- Final project submission and presentation at the end of the course

Grading: Graded (pass/fail or numerical grade depending on institutional requirements)

OBSERVATIONS.

8. BIBLIOGRAPHY AND TEACHING MATERIALS.

1. Górski, F.: Computer Aided Design of 3D Printable Anatomically Shaped Medical Devices: Methodologies and Applications, ISBN-13: 978-1040370728

2. Raj, R., Dixit, A. R., Łukaszewski, K., Wichniarek, R., Rybarczyk, J., Kuczko, W., & Górski, F. (2022). Numerical and Experimental Mechanical Analysis of Additively Manufactured Ankle–Foot Orthoses. *Materials*, *15*(17), 6130. https://doi.org/10.3390/ma15176130
3. Advances in Science and Technology Research Journal, 2025, 19(7), 346–359 https://doi.org/10.12913/22998624/204052 ISSN 2299-8624, License CC-BY 4.0 (The application of additive manufacturing technology in designing and producing individualized lower limb orthoses Klaudia Jańczak, Filip Górski, Magdalena Żukowska, Justyna Rybarczyk, Tomasz Barteczka, Wiesław Kuczko)