BIOMEDICAL ENGINEERING | MSc

Institute of Information and Electrical Technology| Faculty of Engineering and Information Technology | **UNIVERSITY OF PÉCS**
H-7624 Pécs, Boszorkány u. 2. HUNGARY | Phone: +36 72 501 500/23635 | e-mail: biomedicalengineering@mik.pte.hu, | web: https://english.mik.pte.hu/

General information:

1. **Name and address of the Institution:**
   University of Pécs, Faculty of Engineering and Information Technology

2. **Addresses of the Institution:**
   Official address: 7622 Pécs, Vasvári P. u. 4.
   Location of education: 7624 Pécs, Boszorkány u. 2.

3. **Name of the Program:**

   Biomedical Engineering MSc (4 semesters)

4. **Degree:**

   Biomedical Engineer

5. **Study form:** full time

   Language of instruction: English

6. **Duration of the Program:** 4 semesters
   Total number of ECTS credits: 120 credits
   Prescribed Professional Practice: 4 weeks (External Professional practices with Certification shall be organized during the summer holiday or in the preceding exam period.)
   ECTS (European Credit Transfer System) means the European Credit Transfer System, which facilitates student mobility among European higher education institutions for the students of institutions accepting the principles of ECTS.

7. **Intake:** September
   Time schedule of the Academic Year:
   a) the start of the autumn semester is the first week of September ,
   b) the autumn break is the same as the autumn break according to the state education,
   c) the start of the spring semester is the first week of February,
   d) the spring break is the week starting with Easter Monday.

   Every semester consists of an instruction period of 15 weeks and an exam period of 4 weeks

8. **Courses:**

Based on its role in the curriculum, a course can be

a) mandatory;
b) elective whose adding and completion is mandatory, and of which students have to add and complete a given number of credits as specified in the curriculum;
c) optional, not identified by the curriculum on an itemised basis, but of which students have to add and complete a given number of credits; or
d) a criterion requirement of which students have to add and complete a given number of subjects to obtain their degree or qualification.

The credit required for the completion of a course shall be earned by the accomplishment of the courses (lecture, practice, laboratory) assigned to it.

The recommended curriculum includes the recommendation which, if followed, makes the completion of studies possible within the length of training rendered to the major.

Courses with contact hours can have the following types:

a) lecture,
b) practice or
c) laboratory, drawing room or field practice ('laboratory practice').

Types of evaluation

The quality of fulfilling study requirements assigned to a given course at the Faculty is evaluated with a grade based on a scale of five.

- 5 ("Jeles") - (excellent)
- 4 ("Jó") - (good)
- 3 ("Közepes") - (average)
- 2 ("Elégséges") - (satisfactory)
- 1 ("Elégtelen") - (failed)

Knowledge can be tested by

a) in the instruction period: written, oral or practical tests taken during the contact hour, classroom test, assignment prepared by work performed at home (plan, measuring records, essay), and assessment of work performed on practice,
b) exam taken in the exam period,
c) final exam,
d) final closing exam.

End-of-semester grade may be given by

a) mid-term grade in the case of both theory-oriented and practice-oriented courses on the basis of tests and assessments carried out during instruction period,
b) exam grade which may be defined on the basis of the performance at the exam exclusively or by taken into consideration performance on mid-term tests and the exam jointly. In the latter case the exam shall contribute to the grade by 50% at least and the mid-term tests by 50% at most.

8. Pre-degree certificate, final closing examination and degree certificate (diploma)

Pre-Degree Certificate (absolutorium):

After students have successfully passed the exams stipulated in the curriculum and fulfilled the other academic requirements - apart from passing the language exam and completing the bachelor or masterthesis and that they have obtained the necessary number of credits as set forth in the training and outcome requirements. It attests without assessment or evaluation that students have met all the study and exam requirements set in the curriculum.

Thesis (Diploma Work, Final Assignment):

The writing and successful defence of the thesis/diploma work/final assignment is the condition of the award of the diploma. The thesis / diploma work is a subject ending with a grade evaluation.

Final Closing Exam:

The final closing exam may be taken in the final closing examination period following the award of the pre-degree certificate and completing the Thesis.

Diploma, Diploma Supplement:

Successful completion of the final closing exam is the prerequisite to the award of the diploma certifying the accomplishment of academic studies.

On the basis of the average specified in the curriculum of the major the assessment of the diploma shall be as follows: outstanding (5.00), excellent (4.51-4.99), good (3.51-4.50), satisfactory (2.51-3.50), pass (2.00-2.50).

The qualification of the degree certificate (diploma) is calculated according to the following (D):

$$ZV = \frac{V + D + TA}{3}$$

The result of the final exam (ZV) was formed on the basis of the marks obtained for the oral part of the final exam (V), the diploma thesis (D) and the weighted study average (TA), according to the following formula. The grade of the dissertation is determined by the final examination committee on the basis of the grades proposed by the judges and the oral defense.

The results of the final examination are announced by the chairman of the committee.

Course Description:

Course title: Mathematics

Language of instruction: English
Form of teaching:2 lectures, 2 practices
Form of assessment: Examination grade
Course description: Medical students become familiar with the basic mathematical skills needed to understand engineering sciences. During the mathematical problem solving they get acquainted with the possibilities of applying the computer algebraic system.

- Functions with one variable. Derivatives of elementary functions. The concept of the Riemann integral
- Differential and integral calculus for two variables functions.
- Method of solution of first order separable and linear differential equations. Solution of second order linear differential equation with constant coefficient.
- Complex numbers.
- Operations on vectors and matrices.
- Linear space, independence, base, dimension. Concepts of eigenvalue and eigenvectors.
- Series. Series of functions. Fourier-series. Fourier transformation. Laplace transformation.
- Partial differential equation.

Class hours/week: 4
Credits (ECTS): 7
Semester: Fall 1st semester
Course director: Prof. Dr. Klincsik Mihály

Course title: Physics

Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Course description: The goal of the subject is to give the students (trained in a medical field) a comprehensive knowledge of the fundamentals of physics and its basic concepts used in their special subjects.
During the course the following knowledges are taught: General mechanics: basic concepts of kinematics, the description of the motion of ideal particles. The fundamentals of dynamics, force and mass, Newton laws, work, energy. Description of the motion of systems of groups of ideal particles, conservation laws. The fundamentals of thermodynamics: temperature, gas laws, kinetic theory of gases. Internal energy end heat, major laws of thermodynamics. The thermal ways of energy-transport. Phase transitions. The basic concepts of electricity and magnetism: the description of the electric field and its fundamental laws. The electric current. The description of the magnetic field and its fundamental laws. Nonstationary electromagnetic field. Vibrations: harmonic oscillation, evanescent oscillation, forced oscillation. Waves: harmonic wave. Wave propagation, interference, standing wave. Diffraction. Electromagnetic waves, electromagnetic spectrum. Wave optics, diffraction, polarization, dispersion, the fundamentals of spectroscopy. Wave-particle duality, the photon. Atomic models, atomic energy levels, emission, absorption. The fundamentals of nuclear physics, the components of the nucleus and its features.
Class hours/week: 4
Credits (ECTS): 5
Semester: Fall 1st semester
Course director: Dr. Nyitray Gergely

Course title: Functional Anatomy

Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Course description: The purpose of the course is to summarize the anatomical knowledge needed by students, who possess degree in engineering. Students are requred to learn the basics of human body structure and function.
Special emphasis is put on the active and passive elements of locomotor system. During the semester, bones, joints and muscles of the human body will be taught, focusing mainly on regional anatomy of the upper and lower limb. The theory sessions will be completed by lab classes in the dissection rooms and histology lab.

The course includes the following main topics:
- Bones and joints of the upper limb
- Muscles of the upper limb, structure and function
- Bones and joints of the lower limb
- Muscles of the lower limb, structure and function
- Anatomy of the spine, muscles of the trunk, structure and function
- Histologic basics: basic tissue types, focusing mainly on connective and supportive tissues and muscle tissue
- Basic knowledge about physiology of the circulatory, respiratory and locomotor systems
- Pathophysiology of the most important diseases of the locomotor system

Class hours/week: 4
Credits (ECTS): 6
Semester: Fall 1st semester
Course director: Dr. Kiss Péter

Course title: Physiology

Language of instruction: English
Form of teaching: 2 lectures, 2 practice
Form of assessment: Examination grade
Course description: The most important mission of the Physiology Course is to familiarize the students with the attributes of healthy functions of the living organism. While acquiring knowledge about the most important functional characteristics of the human body, the students can rely on their prior studies in biology, biophysics, chemistry-biochemistry and anatomy. During the semester we introduce the most important elements of functioning of the organs and organ systems, as well as their cooperation which is also required to adapt to the environment, and the factors affecting these processes. Special emphasis is placed on the neural and humoral regulatory processes of these life-long acive functions, which are vital to maintain and preserve the homeostasis of the organism. With the transfer of all this knowledge, we would like to mould a holistic attitude and thinking of students, which will enable them to better understand the functions of the now healthy, however, later dysfunctional human organism.
Class hours/week: 4
Credits (ECTS): 6
Semester: Spring 2nd semester
Course director: Dr. Péczely László Zoltán

Course title: Biophysics

Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Course description: Students will be familiar with the basic laws of physics, the physical background of some organ systems and certain biological processes. In addition, understanding the physical background of diagnostic and imaging procedures.
Introductory; The place of biophysics among the sciences; Basic Concepts I; Basic concepts II; Basic concepts III; Biophysics of respiration; Biophysics of the circulation; Physical background of perception; Biophysics of hearing; Biophysics of vision; Physics of transport processes; Radiations; Electrical signals and their measurement; Imaging diagnostic procedures; Physics of therapeutic procedures.
Class hours/week: 4
Credits (ECTS): 4
Semester: Fall 1st semester
Course director: Dr. Lukács András

Course title: Biomechanics

Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade

Course description: The goal of the course is to introduce the basic concepts of statics and strengths of materials, like force systems, resultant, equalities, equilibrium, planar force systems, internal forces and moments, internal force diagrams and problems including friction. Further topics are the kinetic and kinematic foundations of Finite Element Method, and the principle of mimimum potencial energy.
Class hours/week: 4
Credits (ECTS): 4
Semester: Fall 1st semester
Course director: Dr. Csonka Dávid

Course title: Molecular cell biology and biotechnology
Language of instruction: English
Form of teaching: 1 lecture, 3 practices
Form of assessment: Examination grade
Course description: The aim of the course is to provide an overview of prokaryotic and eukaryotic including human genetics and molecular biology techniques. In association with genetics mathematical background of data handling and statistical analysis will be introduced that is relevant to all types of biological research. The students will learn genetic modelling and manipulation systems, their relevance to human studies. Basic understanding of genomix and proteomix, biochemical processes will be linked to practical applications. To aid application of genetic principles in molecular biology, the course introduces students in the joint use of various softwares and mathematical algorithms to enable them to perform data processing and basic statistical analysis task in genetic and other routine biotech research work. During the course students will learn the mathematical background to statistics essential in biology based research. The study will include data handling using computer softwares, data analysis, interpretation, graphical presentation. The main statistical and probability methods used in medical and pharmaceutical research.
Class hours/week: 4
Credits (ECTS): 4
Semester: Fall 1st semester
Course director: Prof. Dr. Pongrácz Judit

Course title: Ethical issues in medical research
Language of instruction: English
Form of teaching: 3 lectures
Form of assessment: Semester Mark
Course description: In the subject of Ethical issues in medical research, the students gain a comprehensive insight into the ethical issues of human clinical trials and the process of licensing research by regional/national ethics committee. Bioethics, basic medical ethical concepts, principles of medical ethics, Declaration of Helsinki. Ethical principles for informed consent for interventions in medical research. Ethical issues in scientific research.
Patient Rights. Ethical principles of genetic research. Types of ethical authorization and approval required for human research studies and the authorization process. Data management issues. Types and management of clinical research trials, steps of publication.
Class hours/week: 3
Credits (ECTS): 3
Semester: Spring 2nd semester
Course director: Dr. Szolcsányi Tibor

Course title: **Clinical research**
Language of instruction: English
Form of teaching: 3 lectures
Form of assessment: Semester Mark
Course description: The purpose of the course is for students to learn the theoretical principles of clinical research, how to plan a clinical research, the research's main types, literary research and the methods of clinical data collection. The development and principles of clinical research; Evidences in clinical research; Indicators used in clinical research; Indicators of the connections between diseases and risk factors, Cause-effect relations

in clinical research; The correct directives of clinical practice (GCP); The types and classification of clinical research I.; The types and classification of clinical research II.; The policy of clinical research; The planning of clinical research, preparation of research plan; The legal and ethical aspects of clinical research, roles of the participants; Medical devices in clinical research; The authorization process of clinical research with medical devices; The analytical stages of clinical research; Review of known medical clinical research.
Class hours/week: 3
Credits (ECTS): 3
Semester: Fall 1st semester
Course director: Dr. Stromájer-Rácz Tímea

Course title: Quality Assurance and Device Certification
Language of instruction: English
Form of teaching: 2 lectures, 1 practice
Form of assessment: Semester mark
Course description: The students must acquire quality assurance systems, a directives of quality guidelines, and steps of the standardization porcess of instruments. Basic definitions of quality assurance and quality guidelines; Legal background of quality assurance; Standrads-based control systems (MSZ EN ISO standards and latest versions); Formation of quality guideline systems; Tools and modes of quality development; Quality-control activities I.; Quality-control activities II.; Audits of quality guideline systems; Administrative background of quality assurance, legal measures; Standardization, management standards; EU certifications system, certification of products; Metrological knowledge, measuring, control; Calibration,validatition; Feautures and requisites of the quality assurance of medical instruments and tools.
Class hours/week: 3
Credits (ECTS): 4
Semester: Fall 3rd semester
Course director: Dr. habil Turcsán Judit

Course title: Basics of Anthropometry
Language of instruction: English
Form of teaching: 1 lecture, 2 practices
Form of assessment: Semester mark
Course description: Improving productive creativity through acquired 3D visualization skills. The content of the course material is the recognition of the components of spatial formation, to create them, to combine them with one another in order to create complex forms. Acquiring formal knowledge and formal analysis of objects. Having acquired visualization skills, designing an innovative subject that evolves from existing, yet unrelated elements through revealing new interconnections. Modelling of the planned object by 3D printing.
Class hours/week: 3
Credits (ECTS): 3
Semester: Fall 1st semester
Course director: Dr. Gasz Balázs

Course title: Biomedical Measurement Theory
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Semester mark
Course description: Basic concepts of measurement technology. Measurement uncertainty, accuracy, measurement error and their propagation. Evaluation methods for measurement series. Etalon System. Calibration methods, linearization. Data Filtering. Pressure, force, temperature, acceleration, radiation, mechanical properties measurement. Position mesurement. Acoustic and vibration measurements. Signal conditioning, sampling and pre-processing methods; Classification of signals; interference filtering, quantization; Basics of signal processing and their application in medical measurements. Averaging and properties of (moving window and recursive). Principle of linear procedures, superposition. Basics of nonlinerization, a median filtering. Representation of signals in frequency domain. Connection between time and frequency range. PC based

measuring systems. Signal generation with virtual devices. Industrial measurement systems, standards (PXI, VXI, MXI, GPIB). Measurement with microcomputers (Arduino, Raspberry PI). Communication protocols in measurement technology. Presentation and data evaluation of medical devices.
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 2nd semester
Course director: Dr. Schiffer Ádám

Course title: Medical image processing
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Prerequisites: Mathematics
Course description: Students learn the building blocks of medical imaging and learn about the basic physics of different imaging modalities. Students then learn the principles of image formation and the standard way to handle, store, print and transmit information in medical imaging using DICOM format and PACS medical imaging technology. The principles of image formation, sampling, coding and visualization will be also discussed. To get a deeper knowledge of advanced medical image processing, students learn about image intensity transformations, spatial filtering, segmentation algorithms and image (co)registration methods in theory and practice. Finally, students learn about advanced methods used in medical imaging, clinical research, image-guided and radiation therapy.
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 2nd semester
Course director: Dr. Nagy Szilvia

Course title: Medical Cybernetics
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Prerequisites: Biophysics
Course description: Cybernetics incorporating several disciplines deals with the control, regulation, and information flow as well as processing occuring in expediently working dinamical systems. The Medical Cybernetics is one of the most important basic cybernetic disciplines, which, in our view, is an integrative, holistic field of science and research providing an overall interpretation of the human biological system, the patient itself, the examining doctor and staff, the diagnostic and therapeutic technical apparatus and procedures, and the researcher who investigates these factors being in complex interaction. Within the framework of the subject our aim is to reinforce and invent the comprehensive and holistic scientific thinking of the students, furthermore, to provide them modern practical knowledge (diagnostic and therapeutic tools, equipments, system-level description and analysis of new medical procedures and methods). We do hope that this approach makes easier the understanding and recognition of the general principles and mechanisms which influence medical decision-making. Accordingly, the Medical Cybernetics possesses a scientific approach which utilises theoretical, methodological and technicaltechnological utilizations of Cybernetics in an integrative way and which is well-reflected in our practiceoriented education. Using the knowledge acquired previously in biophysical, biochemical, anatomical, physiological, immunological, pathophysiological, and engineering subject studies, students will be provided with related systems theory and specific mathematical knowledge. All of this makes it easier for them to understand the medical significance of even the most recent modern diagnostic tools and therapeutic procedures. Based on the research experience of the instructors, we also intend to pay an outstanding attention to acquiring measurement theory knowledge, as well as introducing new areas such as bioimpedance spectrum tomography, smart prosthesis production, problem of the prosthesis-embeddedness, or even cutting edge robotics applications.
Class hours/week: 4
Credits (ECTS): 4
Semester: Fall, 3rd semester
Course director: Dr. Péczely László Zoltán

Course title: System Theory
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Course description: The aim of the course is to introduce the student to the basic mathematical methods and tools of system description and characterization. The subject provides an insight into the basics of system modeling, system simulation, and control theory. The methods of system description in the time-, frequency and operator domain, the principles of control, the effect of feedback, the dynamic properties of the feedback systems will be discussed. Theoretical knowledge is supported by laboratory exercises where the student can get acquainted with the relevant topics of system theory through symbolic and numerical examination of case studies.
Class hours/week: 2
Credits (ECTS): 4
Semester: Fall, 3rd semester
Course director: Dr. Sári Zoltán

Course title: Human - Machine Interface
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Course description: In the course of Human-Machine Interface, students gain insight into development of systems implemented between human (man) - machine, machine – human (man), and how to use them, also the most important applications. Understand the detection and interpretation of neurophysiological signals for control, with particular interest to electroencephalography (EEG), electromyography (EMG), and electroneurography (ENG). Comprehesive knowledge of different control principles and sensors. Basics and application of brain - computer interface. Bionic devices and their significance in bioengineering. Robotic devices and their application. Implantable systems. Knowledge of the basic mechanisms of cerebral plasticity.
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 2nd semester
Course director: Dr. Tóth Luca

Course title: Engineering programming
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Semester mark
Course description: The main objective of the subject is to introduce the students into the various approaches and methods applied for the computer aided solution of problems from the ample field of engineering and science. In this course the students will get familiar with the most frequently applied mathematical methods, data representation, and programming techniques, and furthermore the integrated development environments utilized during the solution of practical problems. During the progress through the learning material the students gain insight into the application possibilities and limitations of special programming techniques and practices applied for the solution of problems with various levels of complexity. Several case studies help to understand the concepts behind efficient representation and storage methods of data (either from measurement or from simulation), and the algorithms and specific programming approaches used for the analysis, processing and meaningful visualization of information.
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 2nd semester
Course director: Dr. Sári Zoltán

Course title: Research Methodology
Language of instruction: English
Form of teaching: 3 lectures
Form of assessment: Semester mark

Course description: The aim of the course is to provide students the knowledge and skills required for research activities. During the semester the participants will learn the steps of professional literature research and get acquainted with the most important internet databases. Students will be introduced to the structure of scientific works, students will also obtain methodological knowledge, as well as the skills to evaluate and interpret data, preparing them for the critical, analytical thinking required for scientific work. Completion of the semester requires the preparation of an independent research plan by the end of the semester, which can serve as a basis for their later project work or thesis.
Class hours/week: 3
Credits (ECTS): 3
Semester: Fall 1st semester
Course director: Dr. Schiffer Ádám

Course title: Project work
Language of instruction: English
Form of teaching: 4 practices
Form of assessment: Semester mark
Course description: During the semester the students solve complex bioengineering tasks, which result in a product that clearly shows their contribution. In the course of this activity the students get acquainted with the substantial parts of the engineering work, while they accomplish the subtasks on their own. Duties are the followings: Chosing and specifying the task in detail; literature searching, processing and documentation; creating a system plan; progress at an adequate pace in the work.
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 2nd semester
Course director: Dr. Schiffer Ádám

Course title: Medical Imaging physics, tomographic algorithms, MRI physics
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Course description: An in-depth knowledge of diagnostic algorithms is a key objective of MSC training. Particular emphasis will be placed on a high level of understanding of the technical requirements, organizational frameworks, and expectations of applicable imaging protocols in teleradiology. Particular emphasis will be placed on practical issues of quality assurance. An important goal is the practical, independent use of computer image processing techniques.
Class hours/week: 4
Credits (ECTS): 4
Semester: Fall 3rd semester
Course director: Dr. Kovács Péter

Course title: Radiophysics / Radiobiology
Language of instruction: English
Form of teaching: 2 lecture, 2 practices
Form of assessment: Examination grade
Course description: Radiation protection, radiation biology curriculum. The aim of MSC training is to deepen and expand the knowledge acquired there. While the knowledge gained at the BSC level is intended to provide a general introduction to the fundamental relationships, the MSC course focuses on the details: specific examples, scientific findings, studies, protocols present the current issues and results of radiation protection, radiation biology.
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 4th semester
Course director: Dr. Kovács Árpád

Course title: Biomedical Material Science
Language of instruction: English
Form of teaching: 4 practices
Form of assessment: Semester mark
Course description: The course will give insight into the field of materials related to biomedical applications. During the semester, the students will get familiar with the characteristics of different polymers, composites, metals and their alloys. Presentation of medical (e.g. instruments in operating theatre, asssistive devices etc.) and biomedical devices (laboratory equipments, bioractors etc.) are also part of the subject. Beside the phyisical and structural characteristics, the course wll strongly focus on the aspects of biocompatibility, alongside with corresponding manufacturing technologies. Practical knowledge will be empahasised: practices with material testing devices (static and dynamic mechanical testing), composite extuders and 3D printers are in the curruculum. The students will obtain knowledge regarding international standards and protocols (e.g. ISO, ASTM).
Class hours/week: 4
Credits (ECTS): 4
Semester: Fall 3rd semester
Course director: Dr. Maróti Péter

Course title: Manufacturing technologies in medicine
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Course description: The aim of the course is to familiarize students with the design and manufacture of biomedical devices and implants. Get detailed knowledge of the design process, from creating 3D models using imaging techniques (MR, CT) to creating prototypes, to manufacturing implants and tools supported by 3D printing. It is also an aim of this course to provide insight in the further utilization of 3D models, which provides a basic knowledge necessary for performing finite element mechanical and computational fluid dynamics simulations.
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 4th semester
Course director: Dr. Cs. Nagy Géza

Course title: Practical Anthropometrical Modelling
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Prerequisites: Basics of Anthropometry
Course description: Improving productive creativity through practical use of 3D visualization skills. The content of the course material - through mastering the subject of Design Anthropometric Fundamentals - is the knowledge of product design required to carry out a design activity that meets real customer requirements. Innovative solution of the problems and tasks to be solved, search for more rational, innovative solutions. Visualization, 3D modeling and printing of the innovative product created as the final solution to the problem.
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 2nd semester
Course director: Dr. Gasz Balázs

Course title: Finite Element Modelling
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade

Course description: Basic concepts, steps of Finite Element Modelling, discretisation, polinomial approximations, creation of finite elements, boundary conditions, solution methods, integral and variational formulas and methods, Galerkin method, Rayleight-Ritz method. Numerical integration, solutions of 1D, 2D and 3D problems, examples: bars, truss structures, beams, solid body mechanics, heat transfer, computational fluid dynamics, error analysis, eigenvalue problems, iterative methods, non-linear problems, Newton method, computational methods.
Class hours/week: 4
Credits (ECTS): 4
Semester: Fall 3rd semester
Course director: Prof. Dr. Ivanyi Péter

Course title: CT / MR / PET / LINAC Systems
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Course description: Particular emphasis will be placed on the information content of each method of multimodal imaging, information on its additive nature, and the potential applications of image-guided therapeutic approaches. In addition, the principles of radiological finding and the theoretical and practical aspects of structured finding are discussed here. Emphasis will be placed on the practice of using multimodal imaging in therapeutic planning, as well as the practical presentation of image-guided therapeutic approaches.
Class hours/week: 4
Credits (ECTS): 4
Semester: Fall 3rd semester
Course director: Dr. Kovács Árpád

Course title: Data transfer, postprocessing, HIS systems
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Course description: The aim of MSC training is to deepen and broaden the knowledge acquired there. Particular emphasis is placed on data security, health standards and recommendations, data and entitlement management (legislative background). The history, principles, capabilities, and limitations of CAD systems and existing applications are described. Practices improve students' skills by reviewing diagnostic protocols and, in some areas, engaging in protocols themselves. In addition, the exercises will demonstrate the use of CAD systems.
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 2nd semester
Course director: Dr. Kovács Árpád

Course title: Medical Devices
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Examination grade
Course description: Students must have a thorough understanding of the function, structure, grouping, and risk of medical and semi-medical equipment used at different levels of care (basic, specialist and inpatient care) and in key areas. They should be familiar with the concept of medical devices, their role, the basics of the relevant Hungarian and EU legislation, and the essential elements of the relevant technical documentation. They must have a thorough knowledge of the entire life cycle of medical devices: design, certification, product launch (placing on the market), operation, review, record keeping, recall, etc.
Class hours/week: 4
Credits (ECTS): 4
Semester: Fall 3rd semester
Course director: Dr. Kovács Péter

Course title: Design- and tehcnical documentation
Language of instruction: English
Form of teaching: 4 practices
Form of assessment: Examination grade
Course description: In this course the students can get familiar with the various types of technical documentations, the roles, importance, use cases, hierarchical relations, and interdependecies of those. During the practice classes the students create the draft of the techical documentations required for the manufacturing of a product, applying the standards, regulations, taking into account the materials regarding IP protection, certificates and qualifications as well.
Class hours/week: 4
Credits (ECTS): 4
Semester: Fall 3rd semester
Course director: Dr. Ambrus Zoltán

Course title: Artifical Intelligence
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Semester mark
Course description: 1) Historical background of modern Artificial Intelligence (AI) systems; Fields of AI applications and the taxonomy of AI sytems; Machine perception, computer vision and hearing; Natural Language Processing; Integrated and General Intelligence systems a) Mathematical basics for AI; Linear algebra; Mathematical analysis; Probability theory b) AI related technologies; Programming basics (Python); Data structures, data preprocessing 2) Overview and comparison of modern AI frameworks 3) State of art application examples in machine learning, deep learning and AI
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 4th semester
Course director: Dr. Tukora Balázs

Course title: Neurorehabilitation
Language of instruction: English
Form of teaching: 4 practices
Form of assessment: Semester mark
Course description: The neurorehabilitation course introduces students to the basics of neuropathology. They gain an insight into the pathomechanism of the most common diseases (with special attention to the development of cerebrovascular diseases, as stroke and subarachnoid hemorrhage also to the mechanism, consequences and rehabilitation of traumatic head and spinal cord injuries). Students gain comprehensive knowledge of state-of-the-art rehabilitation tools and devices, also have an insight into application of diagnostic and intervention procedures in neurological disorders.
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 4th semester
Course director: Dr. Tóth Luca

Course title: Tissue engineering and bioprinting
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Semester mark
Course description: This course aims to provide students with thorough knowledge on the main aspects, phases and difficulties of tissue engineering processes. Students will be given the chance to create scaffolds - a 3D structure for cell implantation, in conjunction with the usage of bioreactors for cell proliferation. During laboratory rounds, students will be able to experiment with prepared samples of stem cells, in order to help them understand and facilitate mesenchymal cell differentiation in laboratory environments. Essential aspects

of scaffold aided, proliferation based prosthetics fabrication will also be shown.
Class hours/week: 4
Credits (ECTS): 4
Semester: Fall 3rd semester
Course director: Dr. Kvell Krisztián

Course title: Genetic modification and GMO
Language of instruction: English
Form of teaching: 2 lectures, 2 practices
Form of assessment: Semester mark
Course description: The subject aims to provide students with basic information on how to perform nucleic acid manipulation in both cells and animals (yielding genetically-modified organisms or GMOs). The curriculum covers methods of nucleic acid manipulation as well as the use of recombinant viral vectors. Classic examples of monogenic hematological disease treatments are also discussed as examples describing methods of intervention, therapeutic goals and achievements. Potential drawback and pitfalls are also highlighted during the course.
Class hours/week: 4
Credits (ECTS): 4
Semester: Spring 4th semester
Course director: Dr. Kvell Krisztián

Course title: Comprehensive exam
Language of instruction: English
Form of assessment: Examination grade
Course description: Students who possess a prior medical bachelor degree must take a comprehensive exam in engineering that consists of the topics of mathematics, physics and biophysics. Students with prior engineering degree must take a comprehensive exam in medical sciences: Functionalanatomy, physiology and biophysics.
Semester: Spring 4th semester
Course director: Dr. Schiffer Ádám

Course title: Diploma work 1.
Language of instruction: English
Form of teaching: 4 consultation
Form of assessment: Semester Mark
Prerequisite: Comprehensive exam
Course description: Every student has to create a plan of his/her diploma work in order to obtain an MSc degree. The plan is to prove that the graduating student is able to work individually, knows and applies the working methods, understands the problem, the student is able to do literature research on his/her own and he/she is able to progress in the research and development process with the help of a supervisor. The program of the first semester is literature searching, the student must reveal various solutions of the given problem. About the achievement a summary must be written. Furthermore, the aim is a proper progress during the semester. Starting of the individual work is required. The course ends with a presentation.
Class hours/week: 4
Credits (ECTS): 6
Semester: Fall 3rd semester
Course director: Dr. Schiffer Ádám

Course title: Diploma work 2.
Language of instruction: English
Form of teaching: consultation
Form of assessment: Semester Mark
Prerequisites: Diploma work 1.

Course description: Every student has to create a plan of his/her diploma work in order to obtain an MSc degree. The plan is to prove that the graduating student is able to work individually, knows and applies the working methods, understands the problem, the student is able to do literature research on his/her own and he/she is able to progress in the research and development process with the help of a supervisor. The program of the second semester is completing the problem solving and creating the plan of the diploma work.
Class hours/week: 16
Credits (ECTS): 24
Semester: Spring 4th semester
Course director: Dr. Schiffer Ádám