DEPARTMENT OF ELECTROMAGNETIC AND BIOMEDICAL ENGINEERING

General Information

The Department of Electromagnetic and Biomedical Engineering (DEBE) guaranties Biomedical Engineering (BME) bachelor and master study programs in cooperation with the Jessenius Faculty of Medicine in Martin of the Comenius University in Bratislava and the Faculty Hospital with Policlinics in Žilina. The study programs were officially accredited in 2000 for the first-time at the Faculty of Electrical Engineering and Information Technology (FEIT), University of Žilina (UNIZA) and the rights were repeatedly approved within the last accreditation at the UNIZA in 2022. The BME study programs gained considerable popularity during the last decades both in Slovakia and abroad.

The DEBE guarantees the Biomedical Engineering study program in the 3rd level of study. It has been accredited several times at FEIT UNIZA as Theory of Electrical Engineering in the past, and the processes to change its name took place in 2025.

The DEBE provides courses Electric Circuits 1, 2 and Seminars from Electric Circuits 1, 2 for all students at the FEIT UNIZA. Main mission of the department is to realise specific interdisciplinary courses for the BME study programmes: Acquisition and analysis of biopotentials, Sensors in BME, Design and construction of medical devices, Microcontrollers in BME, Bioelectromagnetism, Signal Processing in Medicine, Wave Processes in Biomedicine, Medical Electronics, Modelling and Simulation in Biomedicine, Display Systems and Image Processing in Medicine, Compatibility of Biological and Technical Systems, Instrumentation in Medical Praxis, Artificial Intelligence in Biomedicine, etc.

Research and innovation activities are at the department oriented towards: 1) biomedical sensors, wearable electronics, intelligent textiles; 2) advanced processing of biomedical information; 3) electromagnetic biocompatibility; 4) non-destructive evaluation of biomaterials.

Staff of the Department

Head of the Department:	Ladislav Janoušek
Vice-head of the Department:	Mariana Beňová
Administrative Support:	Jana Zlatohlavá
Professors:	Ladislav Janoušek, Milan Smetana
Associate Professors:	Branko Babušiak, Mariana Beňová, Štefan Borik, Milan Šebök
Research Fellows:	Ján Barabáš (1/5), Zuzana Judáková (maternity leave), Michal Labuda
Senior Lecturers (with PhD):	Michal Gála, Zuzana Pšenáková, Roman Radil, Maroš Šmondrk

Postgraduate Students

Internal (full-time):	Ľudmila Králiková (from September 2025), Soňa Šikyňová (from September 2025), Juraj Špánik (from September 2025), Ján Šeleng, Ľubomír Trpiš, Veronika Wohlmuthová, Nicole Kmec Bedri (until August 2025)
External (part-time):	Alek Tropp

Education

Courses in Bachelor, Master and Doctoral Degree Programmes

Bachelor Degree Programmes

Course ID	Name	Sem.	Hours/Week
			L-E-Ls*
Courses at the Faculty of Electrical Engineering and Information Technology			
3B00102	Electrical Circuits 1	1	2 - 2 - 1
3B00106	Seminar of Electrical Circuits 1	1	1 - 1 - 0
3B0B101	Fundamentals of Anatomy 1	1	2 - 1 - 0
3B0B102	Introduction to BME Study	1	2 - 0 - 0
3B00202	Electrical Circuits 2	2	2 - 2 - 1
3B00206	Seminar of Electrical Circuits 2	2	0 - 2 - 0
3B0E201	Electrical Circuits	2	2 - 2 - 1
3B0E205	Electrical Circuits for Information and Communication Technology 2	2	0 - 2 - 0
3B0B201	Medical Biophysics	2	2 - 0 - 2
3B0B202	Fundamentals of Anatomy 2	2	2 - 1 - 0
3B0B203	Professional Practice for BME	2	0 - 0 - 0
3B0B301	Biochemistry	3	2 - 0 - 1
3B0B302	Acquisition and Analysis of Biopotentials	3	2 - 0 - 2
3B0B303	Tasks Algorithmization in BME	3	1 - 0 - 2
3B0B401	Design and Construction of Medical Devices	4	2 - 0 - 2
3B0B402	Sensors in BME	4	2 - 0 - 1
3B0B403	Fundamentals of Physiology and Pathological Physiology 1	4	3 - 0 - 1
3B0B404	Fundamentals of Signals Processing in BME	4	1 - 0 - 2
3B0B405	Professional Practice for BME	4	0 - 0 - 0
3B0B407	Fundamentals of 3D Printing in BME	4	1 - 0 - 2
3B0B503	Microcontrollers in BME	5	2 - 0 - 2
3B0B504	Fundamentals of Physiology and Pathological Physiology 2	5	3 - 0 - 1
3B0B505	Bachelor Project BME 1	5	0 - 3 - 0
3B0B601	Bachelor Project BME 2	6	0 - 5 - 0
3B0B602	Professional Practice and Trends in BME	6	0 - 0 - 4
3B0B603	Elaboration and Defence of the Bachelor Thesis	6	0 - 20 - 0
3B0B604	State Examination Course	6	0 - 4 - 0
3B0B605	Professional Practice for BME	6	0 - 0 - 0

*(L) lectures - (E) exercises - (Ls) labs

Master Degree Programmes

Course ID	Name	Sem.	Hours/Week
			L-E-Ls*
Courses at the Faculty of Electrical Engineering and Information Technology			
3I0D101	Bioelectromagnetics	1	2 - 2 - 0

3I0D102	Signal Processing in Medicine	1	2 - 2 - 1
3I0D103	Medical Electronics 1	1	2 - 0 - 4
3I0D104	Wave Processes in Medicine	1	2 - 0 - 3
3I0D105	Modelling and Simulation in Biomedicine	1	2 - 0 - 2
3I0D201	Management of Health Services	2	2 - 2 - 0
3I0D202	Display Systems and Image Processing in Medicine	2	2 - 0 - 2
3I0D203	Medical Electronics 2	2	2 - 0 - 3
3I0D204	Artificial intelligence in Biomedicine	2	2 - 0 - 2
3I0D205	Compatibility of Biological and Technical systems	2	3 - 0 - 2
3I0D207	Professional Practice for BME	2	0 - 0 - 0
3I0D301	Applied Optoelectronics in Medicine	3	2 - 0 - 3
3I0D302	Information Systems in Medicine	3	2 - 0 - 2
3I0D303	Instrumentation in Medical Praxis	3	3 - 0 - 0
3I0D304	Professional Practice in Medicine	3	0 - 0 - 2
3I0D305	Diploma Projects in BME 1	3	4 - 0 - 0
3I0D308	Ionizing radiation in biomedicine	3	2 - 0 - 3
3I0D401	Bioethics and Medical Ethics	4	2 - 2 - 0
3I0D402	Diploma Projects in BME 2	4	4 - 0 - 0
3I0D403	Elaboration and Defence of the MSc Thesis	4	0 - 20 - 0
3I0D404	State Examination Course	4	0 - 4 - 0
3I0D405	Professional Practice for BME	4	0 - 0 - 0

*(L) lectures - (E) exercises - (Ls) labs

Doctoral Degree Programmes

Course ID	Name	Sem.	Hours/Week
			L-E-Ls*
Courses at the Faculty of Electrical Engineering and Information Technology			
3D00001	World Language	2	2 - 0 - 0
3D00002	Basics of Research Practice	2	2 - 0 - 0
3D0F003	Analysis and Processing of Signal in BME	2	0 - 2 - 0
3D0F004	Applied Electromagnetism	2	0 - 2 - 0
3D0F005	Electromagnetic Methods of Non-Destructive Material Evaluation	2	0 - 2 - 0
3D0F006	Electromagnetic Field and Biological Systems	2	0 - 2 - 0
3D0F007	Electromagnetic Waves Propagation in Bounded and Unbounded Media	2	0 - 2 - 0
3D0F008	Special Electromagnetic Measuring Methods in BME	2	0 - 2 - 0
3D0F009	Theory of Electromagnetic Circuits	2	0 - 2 - 0
3D0F010	Theory of Electromagnetic Field	2	0 - 2 - 0
3D0F011	Wave Processes in Materials	2	0 - 2 - 0
3D0F001	Written Work for the Dissertation Exam and Defence of the Written Work for the Dissertation Exam	3	0 - 0 - 0
3D0F002	Dissertation and Defence of Dissertation	6	0 - 0 - 0

*(L) lectures - (E) exercises - (Ls) labs

Research & Development

Research and Development activities are at the department directed towards areas where the common factors are electromagnetic field and human body. The department has modern research infrastructure and means for realizing numerical simulation, measurements, and experimental analyses. A part of the scientific activities is focused on the electromagnetic non-destructive evaluation of biomaterials. Research methodology in this area combines numerical simulations and experimental investigations. The activities are oriented towards new excitation and detection of signals together with innovative approaches for signal processing and evaluation for the inspection of implants used in medical practice.

The human resources and the research infrastructure of the department create unique basis for the innovation activities in the field of technical and ICT support in medicine. The activities are focused on: electromagnetic biocompatibility, innovative biopotential sensing, photoplethysmography imaging, processing and evaluation of biomedical signals including graphical information and numerical modelling and simulations of dynamical physiological systems. In collaboration with partner institutions research in the field of design and implementation of intelligent textiles, with the system for data collection and processing and their implementation in specific industries, is realized.

Electromagnetic Biocompatibility Laboratory (EMCare Lab)

The Electromagnetic Biocompatibility Laboratory is specialized on research of the non-thermal effects of low-frequency electromagnetic fields on microbiological systems. The scientific research activity is primarily focused on monitoring of the non-thermal effects of an exogenous low-frequency electromagnetic field on the growth dynamics of cell cultures, which is also connected to the research of progressive quantification methods for the biological response evaluation. The laboratory also provides the possibility of measuring the bio-electrodynamic properties of individual cells using patch-clamp techniques. Its specialized instrumentation also corresponds to the laboratory's research focus: Q-cell 240 incubator, ESCO PCR box, Hubert A1110-16 broadband excitation signal amplifier, Taitec OD evaluation system optical density evaluation system, digital multimeters, signal generator and complex equipment for electrophysiological measurements (Faraday cage, TMC Air table 900 x 1200 mm, inverted microscope with ZEISS Primo Vert camera, automated system for measuring electrophysiological properties of cells ChannelMAX 100A Mini, micromanipulator, Sutter Instruments P-30 vertical micropipette puller and other laboratory equipment). The laboratory is used for scientific and research purposes by the department's employees, doctoral students, as well as bachelor's and master degree students of the Biomedical Engineering study programmes as part of their final theses.

Non-invasive Cardiovascular Diagnostics Laboratory (HemodynamiX Lab)

The Non-invasive Cardiovascular Diagnostics Laboratory focuses on the use of visible, near-infrared and infrared electromagnetic radiation spectra for the investigation of changes in hemodynamic parameters, with a focus on multi-modality imaging of cardiovascular functions of the human body. Unique instrumentation includes state-of-the-art camera systems for photoplethysmography imaging, modular infrared cameras, machine vision cameras, cameras with implemented artificial intelligence algorithms, an innovative device that allows detection of hemodynamic changes through magnetic induction, multi-channel EMG, and a multi-wavelength illumination system.

Medical Electronics and 3D Printing Laboratory (MedVeT Lab)

The laboratory primarily serves students in the final years of bachelor's and master degrees, doctoral students and employees of the department. The main focus of the laboratory is in the field of design, development,

and testing of electronic devices in the area of diagnostic devices and sensor systems for biomedical applications. The laboratory is according to its purpose equipped with high-quality soldering stations with accessories, oscilloscopes, laboratory sources, a signal generator and multimeters. The laboratory also includes a Prusa MK3S+ 3D printer designed primarily for printing unique packaging and mechanical parts for electronic devices and sensor systems being developed.

Information Systems and Medical Data Processing Laboratory (MedSoft Lab)

The Information Systems and Medical Data Processing Laboratory is a state-of-the-art research and development centre focused on innovations in the field of information technology and its applications in medicine. Its main focus is the research, design and implementation of advanced information systems to improve the management and analysis of medical data to support more accurate diagnostic and therapeutic decision-making. The goal of the laboratory is to create innovative information systems and technology solutions that enable the efficient collection, storage, processing and interpretation of medical data. The laboratory's equipment includes cutting-edge data processing technologies, software development and testing environments to simulate various situations in the medical environment. Software facilities include the CADSOFT EAGLE printed circuit design tool, MATLAB computational software, and EMC CST Studio numerical simulation software.

Innovative Medical Technology Laboratory (MedIno Lab)

The Innovative Medical Technology Laboratory is a leading research and development centre dedicated to disruptive innovation in the field of medical technology development. Its main mission is to identify, develop and implement cutting-edge technology solutions to improve diagnosis, treatment and the overall quality of healthcare delivery. The lab's equipment includes an extensive range of hardware components, such as brain-computer interface (BCI) equipment, ultrasonic device SC2000 Siemens Healthineers with probes and phantoms, and software tools, including a virtual CT scanner from Siemens Healthineers. These devices are characterised by their high quality and sensitivity for the acquisition, simulation, processing and analysis of biosignals. In addition, the laboratory has a universal patient simulator (Hal® Gaumard), which is used for multi-purpose simulation purposes.

Non-Destructive Investigation Laboratory (DEFECTO Lab)

The Non-Destructive Investigation Laboratory is a purpose-built laboratory designed mainly for the fulfilment of the objectives of the scientific research activities of the department through the use of known electromagnetic phenomena. The primary focus is on electromagnetic methods of non-destructive investigation of electrically conductive biomaterials, mainly using the eddy current method. The laboratory is equipped with the necessary instrumentation and software resources for this purpose. In particular, eddy-current measuring probes of commercial (Rohmann GmbH, Germany; Indetec, Czech Republic) and own production, professional instruments (Olympus Omniscan MX with ECA module, Rohmann ECT Elotest B300) and instruments for processing of valuable signals (lock-in amplifier Signal Recovery DSP 7280; Krohn-Hite 7500 broadband power amplifier, National Instruments PCI-6255 data acquisition and processing recording cards, Agilent 33521A, 33220A signal generators) and a three-axis computer-controlled positioning system with linear displacement. The control system for the entire measurement chain is based on the LabVIEW virtual instrumentation platform, National Instruments. Professional software tools (OPERA, Vector Fields, England; CIVA NDE, France) are available for numerical simulations of electromagnetic fields in conjunction with powerful computing and display technology.

Experimental Electrical Engineering Laboratory (MedHard Lab)

The Experimental Electrical Engineering Laboratory provides a basis for studying the basic principles and properties of analogue and digital electronic circuits. The laboratory is also designed for the development, construction and testing of electronic devices and sensors used in the field of medicine. For this purpose, the laboratory is equipped with a large number of measuring devices (multimeters, oscilloscopes), electrical elements, sources of electrical energy (laboratory sources, signal generators) and soldering stations. The laboratory is also equipped with modern measuring devices that use PC support and thus enable computer analysis of the measured quantities.

Electrical Circuit and Simulation Laboratory (EOS Lab)

The Electrical Circuit and Simulation Laboratory is especially utilised for the experimental education of electric circuits. The laboratory is equipped with plenty of measuring instruments (multimeters, oscilloscopes), electrical elements and laboratory sources for this purpose. It is also equipped with computers for development of simple virtual models for numerical simulations of circuits. The laboratory exercises including numerical simulations allows students to verify acquired theoretical knowledge and to bridge the gap between the theory and the practice. Interconnection between the theoretical knowledge and the practical experience in the field of electric circuits creates the cornerstone for consequential subjects.

Projects of International Programmes

ERASMUS Projects

Blended Intensive Programme: Robotics	
Summary:	The Blended Intensive Programme (BIP) "Robotics" is a joint initiative within the Erasmus+ program, organized by the Technical University of Liberec (Czech Republic) in cooperation with the University of Žilina (Slovakia) and the University of Cooperative Education in Bautzen (Germany). The program is intended for students of biomedical technology and biomedical engineering and combines the virtual part in March with the in-person part on 31.03.-04.04.2025, which took place in Liberec. Thirty students participated in workshops led by experts, where they explored modern technologies in robotics.
Realization:	03/2025 – 04/2025
Coordinator:	Josef Černohorský (TUL, CZ)
Coordinator for FEEIT:	Ladislav Janoušek
Co-operators:	Maroš Šmondrk

Projects of National Programmes

Research Projects Funded by the Slovak Research and Development Agency (APVV)

APVV-23-0162: Safe intErsections of Cycling commUnications with oveRhead Electric Lines (SECUREL)	
Summary:	The project concentrates on non-thermal biological effects of the grid frequency electromagnetic field (EMF) generated in vicinity of extra high voltage electric overhead lines. The thermal biological effects of EMF are regulated through the guidelines of the International Commission on Non-Ionizing Radiation Protection and reflected in national regulations. The non-thermal ones are still poorly accounted despite the growing scientific evidence, especially in areas where the EMF values, under certain circumstances, could exceed the given action values. The non-thermal short-term effects of EMF with elevated quantities are connected to reversible changes on excitable cells, electric charge effects at the skin surface, heart rate variation or a stimulation of nerves and muscles experienced as a tingling sensation. Cyclists crossing high voltage electric overhead lines usually undergo the risk of electroshock, which might lead to the loss of concentration or acute paralysis and secondary serious injuries. Development of a methodology for assessment of the intersections of cycling communications with extra high voltage electric overhead lines is the main project objective together with a setup of applicable and effective measures for minimization of associated health risks. Knowledge base gained through the project research activities is the key stone to reach the objective. It is supposed that the results gained within the project can be potentially applicable in the policy processes in this field.
Realization:	07/2024 – 06/2027
Coordinator:	Ladislav Janoušek
Co-operators:	Marek Bajtoš, Zuzana Pšenáková, Roman Radil, Milan Smetana, Maroš Šmondrk

APVV-22-0423: Development of a modular car system for monitoring the driver's health and fatigue	
Summary:	The main objective of the interdisciplinary project is applied research in developing a modular monitoring system in the form of a vehicle assistance system to detect driver

	fatigue and health status. The present project proposal is intended to contribute to the advancement of basic knowledge in the field of non-invasive sensing systems and advanced materials based on smart electrically conductive textiles, special textile materials, composite materials, and biomedical sensors capable of sensing the basic vital functions of the driver in order to improve road safety. The project will result in a working prototype of a modular monitoring system embedded in functional parts of the vehicle interior, which will be tested by conducting laboratory and road tests on the EDISON electric vehicle. The project responds to the increasing accident statistics in Slovakia and Europe due to driver fatigue and consequent loss of attention or micro-sleep.
Realization:	07/2023 – 12/2026
Coordinator:	Branko Babušiak
Co-operators:	Ladislav Janoušek, Štefan Borik, Maroš Šmondrk, Michal Labuda, Michal Gála

APVV-21-0449: The integrated system for analysis of transformer condition with regard to the effects of short-circuit and inrush currents	
Summary:	The project solves actual problems of analysis of short-circuit and inrush currents effects for power transformers, which is a key factor to reduce of unforeseen shutdowns of transmission and distribution of electricity to consumers. For this is necessary that in the project have first been analyzed the most important impacts of short-circuit inrush currents, which significantly impair the design and insulating state of transformers. Subsequently, there will be set out and verified current and new methods of measurement to detect possible failures and finally an integrated complex system of diagnostics for trouble-free operation of power transformers. In solving project uses the latest knowledge electrical power engineering, measurement techniques, diagnostics and ICT.
Realization:	07/2022 – 12/2025
Coordinator:	Miroslav Gutten (DME)
Co-operators:	Milan Šebök

APVV-21-0502: System for automatic detection of intracranial aneurysms (BrainWatch)	
Summary:	Aneurysm is a pathological dilation of the artery that affects about 5% of the population. The resulting bulge fills with blood, the artery weakens and can lead to rupture. It often occurs on the small arteries of the brain, and if it ruptures, the affected person often dies or has lifelong consequences. Early detection of intracranial aneurysms can save lives. For this reason, the main goal of the presented project is to create a tool capable of quickly detecting even small intracranial aneurysms. The developed tool using artificial intelligence methods will be based on deep learning neural network architectures, thus helping to increase the overall accuracy of aneurysm detection by doctors in their clinical practice.
Realization:	07/2022 – 12/2025
Coordinator:	Róbert Hudec (DMICT)
Co-operators:	Roman Radil

Projects of European Structural Funds

09I03-03-V06-00112: Expansion of Research Infrastructure for the Development of a Modular Vehicle System for Monitoring Driver Health and Fatigue

Summary:	The objective of the project is to co-finance tangible and intangible investment assets designated for research, which are ineligible under the general APVV call. This will enable recipients to more effectively implement both existing and new projects, maximizing outcomes and results in the execution of independent research and development.
Realization:	09/2024 – 08/2025
Coordinator:	Branko Babušiak
Co-operators:	Maroš Šmondrk, Tomáš Gajdošík, Igor Gajdáč

09I05-03-V02-00027: Research on inertial data analysis methods for patient stratification and personalization of assisted extracorporeal rehabilitation using a sensory network	
Summary:	The project focuses on the research and development of advanced methods for analyzing inertial data collected from a multimodal sensor network. The main goal is to design a personalized extracorporeal rehabilitation device that can adapt to the individual rehabilitation needs of patients regardless of their age, gender, or overall physical condition.
Realization:	01/2025 – 05/2026
Coordinator:	Juraj Ďuďák
Co-operators:	Ladislav Janoušek, Branko Babušiak, Maroš Šmondrk

FEEIT projects to support young researchers

17142: Research of progressive quantification methods for evaluation of biological effects of nonionizing electromagnetic field	
Summary:	The project focuses on the effects of non-ionizing electromagnetic fields (EMF) on biological objects. The main objective of the project is objectification of non-ionizing EMF biological effects quantification from the cellular level based on in-vitro conditions, up to the organ and tissue level, including the possible impact on implants or wearable electronics. The project proposal will address two main themes, which can be defined based on the frequency range of investigated EMF as: 1. Investigation of the effects of extremely low frequency (ELF) and low frequency (LF) EMF at the cellular level; 2. Investigation of the effects of radio frequency (RF) EMF on the human body and wearable electronics. Both themes involve the design and use of advanced quantification methods and experimental protocols that are capable to reasonably contribute to the problematics of objectification and evaluation of experimental results and increase the knowledge and information level regarding the potential risks associated with exposure to non-ionising EMF, for both the scientific and general public.
Realization:	02/2022 – 01/2025
Coordinator:	Roman Radil
Co-operators:	Zuzana Judáková, Zuzana Pšenáková

17149: Innovative sensors and methods of biological signal sensing	
Summary:	The project intention reflects long-term forecasts of demographic development and the health of the population in the Slovak Republic and the EU, from which it follows that due to the increasing proportion of seniors in the number of medical personnel and the growing trend of the prevalence of civilization diseases, there will be enormously increased demands on the capacities of medical facilities. Furthermore, current trends are towards relatively cheap sensor systems and intelligent IT solutions, which will significantly contribute to the development of personalized out-of-hospital medicine based on automated systems, through which it is possible

	to monitor the state of health regularly and systematically. The presented project builds on the long-term development activities of the research team in this area. It primarily focuses on innovative ways of sensing and monitoring health status, especially regarding longer-term records and their automated processing, aiming to identify problem sequences and anomalies in the context of prevention and prediction of chronic diseases.
Realization:	02/2022 – 01/2025
Coordinator:	Maroš Šmondrk
Co-operators:	Branko Babušiak, Štefan Borik

UNIZA grant system – projects of Doctoral (PhD.) students

21097: Study of mutual interactions and dynamics of physiological oscillators	
Summary:	The project is focused on investigating the interactions and dynamics of physiological oscillators, primarily of the cardiovascular and autonomic nervous systems. These phenomena will be investigated using the non-contact photoplethysmographic imaging (PPGI) technique in patients with impaired microcirculation (diabetic neuropathy, peripheral arterial disease) and healthy control subjects. The aim is to compare the response of the autonomic nervous system to a controlled deep breathing test. The resulting perfusion oscillations will be analyzed using artificial intelligence methods to identify differences between healthy and impaired microcirculatory regulation.
Realization:	10/2025 – 09/2026
Coordinator:	Ján Šeleng
Co-operators:	Štefan Borik, Ladislav Janoušek

21101: Compact biosensing solutions for non-invasive monitoring of mental fatigue	
Summary:	Mental fatigue is a significant factor affecting human cognitive functions. Early recognition of its manifestations is crucial for preventing errors and reducing the risk of accidents in demanding working conditions. The core of this project is the investigation of mental fatigue through non-invasive monitoring of physiological biosignals using compact wearable sensor devices.
Realization:	10/2025 – 09/2026
Coordinator:	Ľubomír Trpiš
Co-operators:	Branko Babušiak, Ladislav Janoušek

21073: Design and testing of a system for detecting direct magnetic fields and low-frequency magnetic fields for assessing the impact on implantable medical devices	
Summary:	The aim of the project is to design, develop and test a device for sensing extremely low frequency (ELF) and direct current (DC) magnetic fields in the home environment, where people with implantable medical devices (IMDs) such as pacemakers, insulin pumps or cochlear implants are commonly found. The device will be used to measure magnetic field levels near common electrical appliances and other sources of EM fields in order to identify potential risk exposures. The project includes the design of the hardware and software solution of the sensor, its calibration, laboratory testing and evaluation of the measurements. The result will be a prototype of a measurement system with documentation, suitable as a tool for further research and education in the field of electromagnetic compatibility of IMDs.
Realization:	10/2025 – 09/2026
Coordinator:	Veronika Wohlmuthová

Co-operators:	Michal Labuda, Ladislav Janoušek

UNIZA grant system – projects of young scientific-pedagogical employees under 35 years of age

20412: Seat Belt Cover for Monitoring the Driver's Physiological Functions	
Summary:	Contactless monitoring of vital signs represents a significant trend in the field of biomedical engineering. The use of a smart seatbelt cover with an integrated sensor for real-time health monitoring reflects current innovations in biomedical engineering and medicine. Monitoring the driver's heart activity is essential for assessing their fatigue and health status, while monitoring respiratory activity is equally important.
Realization:	10/2024 – 09/2025
Coordinator:	Michal Labuda
Co-operators:	Ladislav Janoušek

21074: The influence of selected factors on contactless evaluation of tissue perfusion using photoplethysmographic imaging	
Summary:	The project focuses on investigating the influence of selected factors, such as tattoos and changes in skin temperature, on the quality of signals obtained using contactless photoplethysmographic imaging (PPGI). This method is used for non-invasive monitoring of tissue perfusion, which is important for assessing microcirculation. The aim of the project is to experimentally verify the extent to which these factors distort the PPGI signal and to propose recommendations or corrections that enhance the reliability of measurements under real-world conditions. The results may be applied in clinical practice, sports, and further research in the field of contactless evaluation of perfusion using PPGI.
Realization:	10/2025 – 09/2026
Coordinator:	Michal Labuda
Co-operators:	Ladislav Janoušek

UNIZA grant system – projects of master (MSc.) students

21205/2025: Wearable EMG system for hand motor analysis	
Summary:	The aim of the project is to create a wearable EMG measuring device for sensing electrical muscle activity with an integrated gyroscope and accelerometer for sensory measurement of hand motor skills. The device will allow for the acquisition of data on muscle activity and hand movement, which will be processed in real time by software for analyzing movements and gestures.
Realization:	11/2025 – 12/2026
Coordinator:	Kolačkovský Pavol
Co-operators:	Martyn Oleksandr

Submitted Proposals of International Research Projects in 2025

Type/Call	**Project title**	**Outcome of evaluation**
DUT/15mC TP	Quality of Travel Time for Human-Centred Mobility Planning in 15-Minute Cities (F-DUT-2025-0069)	in the evaluation

Outputs from Solved Research Tasks

Publication activities at the department in 2025

Category	Category name	Number
V1	Scientific output of publication activity as a whole	0
V2	Scientific output of publication activity as part of an edited book or collection	3
V3	Scientific output of publication activity from the journal	18
O1	Professional output of publishing activity as a whole	0
O2	Professional output of publishing activity as part of a book publication or collection	0
O3	Professional output of publication activity from the journal	0
P1	Pedagogical output of publication activity as a whole	0
P2	Pedagogical output of publication activity as part of a textbook or a script	0
TOTAL (listed categories)		21
TOTAL (listed categories and other categories – U, D, I)		**21**

Patents, Industrial Designs, Author's Certificates and Discoveries

Submitted in 2025:

[1]	Category: Utility Model Application Number: 309-2025 (Date of filing: 24.11.2025) Authors: Maroš Šmondrk; Branko Babušiak; Anton Dzian; Marián Molnár Title: Pectus Excavatum Conservative Treatment Monitoring System
[2]	Category: EU design Design number: 015125962-0001 (Date of filing: 02.12.2025) Authors: Marián Molnár; Anton Dzian; Branko Babušiak; Maroš Šmondrk
[3]	Category: EU design Design number: 015125962-0002 (Date of filing: 02.12.2025) Authors: Marián Molnár; Anton Dzian; Branko Babušiak; Maroš Šmondrk
[4]	Category: EU design Design number: 015125962-0003 (Date of filing: 02.12.2025) Authors: Marián Molnár; Anton Dzian; Branko Babušiak; Maroš Šmondrk

Granted in 2025:

[1]	Category: EU design Design number: 015125962-0001 Date of entry into the register: 23.12.2025) Publication date: 07.01.2026 Authors: Marián Molnár; Anton Dzian; Branko Babušiak; Maroš Šmondrk
[2]	Category: EU design Design number: 015125962-0002 Date of entry into the register: 23.12.2025) Publication date: 07.01.2026 Authors: Marián Molnár; Anton Dzian; Branko Babušiak; Maroš Šmondrk
[3]	Category: EU design Design number: 015125962-0003 Date of entry into the register: 23.12.2025)

	Publication date: 07.01.2026 Authors: Marián Molnár; Anton Dzian; Branko Babušiak; Maroš Šmondrk

Co-operation

Co-operation Partners in Slovakia

- Technical University, Košice
- Slovak Technical University, Bratislava
- Medical Faculty of the Comenius University, Bratislava
- Jessenius Medical Faculty of the Comenius University (JMF), Martin
- Nuclear Medicine Clinic, Jessenius Medical Faculty of the Comenius University, Martin
- 2nd Internal Clinic, Medical Faculty of the Comenius University, Bratislava
- Hospital of Jessenius Medical Faculty of the Comenius University, Martin
- Hospital with Policlinic, Žilina
- Hospital of Medical Faculty of the Comenius University, II. Internal clinic, Bratislava
- Faculty of Health Care, Catholic University in Ružomberok, Ružomberok
- Central Military Hospital, Ružomberok
- University of A. Dubček, Trenčín
- Technical University in Zvolen, Zvolen
- Department of Electronics, Academy of Armed Forces, Liptovský Mikuláš
- Constantine the Philosopher University in Nitra, Nitra
- Institute of Measurement Science SAS, Bratislava
- Slovak Institute of Metrology, Bratislava
- ŽSR, Headquarters, Infrastructure Management Department, Bratislava
- Railway Institute for Research and Development, Žilina
- Slovcert, s.r.o., Bratislava
- VÚTCH-CHEMITEX, spol. s r.o., Žilina
- VÚJE, a.s., Trnava
- Research institute of posts and telecommunications, Institute of electronic communications, Banská Bystrica
- University of Ss. Cyril and Methodius in Trnava, Faculty of natural sciences
- Valicare s.r.o., Trenčianska Turná
- Technical testing institute Piešťany š.p.
- Siemens Healthcare s.r.o., Žilina, Košice

International Co-operation Partners

- Tokyo University, Tokyo, Japan
- Tohoku University, Tohoku, Japan
- IIU Corp., Tokyo, Japan
- University of Kanazawa, Kanazawa, Japan
- Technical University RWTH, Aachen, Germany
- University of Technology, Compiegne, France
- Technical University, Graz, Austria
- Institute of Photonics and Electronics of the CAS, Prague, Czech Republic
- Academy of Science, Prague, Czech Republic

- Czech Technical University, Prague, Czech Republic
- Technical University VŠB, Ostrava, Czech Republic
- Technical University, Brno, Czech Republic
- University of West Bohemia, Plzeň, Czech Republic
- Faculty of Education, University of Hradec Králové, Hradec Králové, Czech Republic
- Department of Physics, University of Hradec Králové, Czech Republic
- Faculty of Science, University of Ostrava, Ostrava, Czech Republic
- National University of Ireland, Dublin, Ireland
- Xi'an Jiaotong University, School of Aerospace, Xi'an, China
- Norwegian University of Science and Technology, Trondheim, Norway
- Politecnico di Milano, Dipartmento di Meccanica, Milan, Italy
- AGUSTAWESTLAND, Samarate, Italy
- VITROCISET, Rome, Italy
- Consorzio Milano Ricerche, Milan, Italy
- Department of Industrial Engineering, University of Catania, Sicily, Italy
- SINTEF ICT, Dept. for Optical Measurement Systems and Data Analysis, Trondheim, Norway
- AGH University of Science and Technology, Department of Telecommunications, Krakow, Poland
- Polytechnika Lublin, Poland
- University of Patras, Department of Mechanical Engineering and Aeronautics, Patras, Greece
- Department of Electrical and Computer Engineering, Michigan State University, East Lansing, USA
- Nondestructive Testing Department, National Institute of Research and Development for Technical Physics, Iasi, Romania
- Technical university in Liberec, Czech Republic

Non-contractual Cooperation with Academic Institutions

- Institute of Measurement Science of the Slovak Academy of Sciences, Bratislava, Slovakia
- VŠB-TU Ostrava, Czech Republic
- University of Hradec Králové, Czech Republic
- Institute of photonics and electronics, Academy of Sciences, Czech Republic
- RWTH Aachen, Germany
- Indian Institute of Technology Madras, Chennai, India
- TU Darmstadt, Germany
- Silesian University of Technology, Gliwice, Poland
- University of Colorado at Boulder, Colorado, USA
- Yale University, USA
- - Courant Institute of Mathematics, USA
- - IIT Madras, India

Visitors to the Department in the academic year 2024/2025

Name	Institution	Length of stay
Tomáš Souček	Faculty of Health Studies, Technical University of Liberec, Czech Republic	4 days

Visits to Foreign Institutions in the academic year 2024/2025

Name	Institution	Length of stay
Ladislav Janoušek	University of Catania, Italy	5 days
Ladislav Janoušek	VSB Technical University Ostrava, Czech Republic	3 days
Ladislav Janoušek	National University of Science and Technology POLITEHNICA Bucharest, Romania	5 days
Ladislav Janoušek	Silesian University of Technology, Biotechnology Center, Gliwice, Poland	1 day
Milan Smetana	National University of Science and Technology POLITEHNICA Bucharest, Romania	5 days
Mariana Beňová	University of Catania, Italy	5 days
Mariana Beňová	National University of Science and Technology POLITEHNICA Bucharest, Romania	5 days
Štefan Borik	RWTH Aachen, Germany	7 days
Štefan Borik	Yale University, New Haven, CT, USA	3 months
Zuzana Pšenáková	Silesian University of Technology, Gliwice, Poland	3 days
Roman Radil	Silesian University of Technology, Biotechnology Center, Gliwice, Poland	1 day
Maroš Šmondrk	University of Catania, Italy	5 days
Maroš Šmondrk	Faculty of Health Studies, Technical University of Liberec, Czech Republic	9 days

Contracts (Business Activities)

Order: Preparation of an expert opinion for the contract "CT devices"	
Customer:	University Hospital Bratislava
Coordinator:	Milan Smetana
Co-operators:	Ladislav Janoušek

Other Activities

Invited Lectures/Papers

Electromagnetic biocompatibility	
Lecturer:	Ladislav Janoušek
Where:	National University of Science and Technology POLITEHNICA Bucharest, Romania
Date:	10th April 2025

Numerical modelling of electromagnetic fields using steady state and transient solvers. Solutions of an inverse problems through neural networks	
Lecturer:	Milan Smetana
Where:	National University of Science and Technology POLITEHNICA Bucharest, Romania
Date:	10th April 2025

Electromagnetic compatibility of implantable devices	
Lecturer:	Mariana Beňová
Where:	National University of Science and Technology POLITEHNICA Bucharest, Romania
Date:	10th April 2025

Electromagnetic Biocompatibility: From Fundamental Research to Applications	
Lecturer:	Ladislav Janoušek
Where:	RWTH Aachen, Germany
Date:	25th September 2025

Applications of Photoplethysmography Imaging in Cardiovascular and Microcirculatory Research	
Lecturer:	Štefan Borik
Where:	RWTH Aachen, Germany
Date:	25th September 2025

Let There Be Light! And There Was Light – Diagnostics with Light in Medicine (as part of the event 'Visit Your School – Meet Your Scientist')	
Lecturer:	Michal Labuda, Veronika Wohlmuthová
Where:	Elementary school with kindergarten, Školská 49, Žilina, Slovak Republic
Date:	13th November 2025

Membership in International Institutions/Committees

Individual membership of employees of international organizations		Function
Ladislav Janoušek	Japan Society for Non-destructive Inspection, Tokyo, Japan	member
Štefan Borik	North American Artery Society, USA	member

Individual membership of employees in scientific committees of international journals		Function
Ladislav Janoušek	Elektryka, Silesian University of Technology, ISSN 1897-8827, Poland	member of editorial board
Ladislav Janoušek	Computational Problems of Electrical Engineering, ISSN 2224-0977, Ukraine	member of editorial board
Roman Radil	Applied Sciences, ISSN 2076-3417, Swiss	guest editor of special issue

Individual membership of employees in the scientific committees of international conferences		Function
Ladislav Janoušek	26th International conference "Computational Problems of Electrical Engineering", CPEE 2026, 10.-12.9.2025, Rašovice, Czech Republic	scientific committee member
Milan Smetana	26th International conference "Computational Problems of Electrical Engineering", CPEE 2026, 10.-12.9.2025, Rašovice, Czech Republic	scientific committee member
Mariana Beňová	26th International conference "Computational Problems of Electrical Engineering", CPEE 2026, 10.-12.9.2025, Rašovice, Czech Republic	scientific committee member

Individual membership of employees in scientific boards and trade committees abroad	Function

Ladislav Janoušek	Branch committee of PhD. programme: „Electrical Engineering“, FEE, University of West Bohemia, Pilsen, Czech Republic	member
Milan Smetana	Branch committee of PhD. programme: „Electrical Engineering“, FEE, University of West Bohemia, Pilsen, Czech Republic	member

Membership in National Institutions/Committees

Individual membership of employees in organizations of the SR		**Function**
Ladislav Janoušek	Slovak Medical Association – Slovak Society of Biomedical Engineers and Medical Computer Science	member of supervisory board
Branko Babušiak	Slovak Medical Association – Slovak Society of Biomedical Engineers and Medical Computer Science	vice president of society committee
Mariana Beňová	Slovak Medical Association – Slovak Society of Biomedical Engineers and Medical Computer Science	member of supervisory board
Štefan Borik	Slovak Medical Association – Slovak Society of Biomedical Engineers and Medical Computer Science	member
Milan Šebök	Scientific and Technical Society at the University of Žilina	member
Zuzana Pšenáková	Slovak Medical Association – Slovak Society of Biomedical Engineers and Medical Computer Science	member
Maroš Šmondrk	Slovak Medical Association – Slovak Society of Biomedical Engineers and Medical Computer Science	member

Individual membership of employees in scientific boards and trade committees outside of FEEIT UNIZA		**Function**
Ladislav Janoušek	Branch committee of the PhD. study programme: „Medical biophysics“, Jessenius Medical Faculty CU, Martin	member
Milan Smetana	Branch committee of the PhD. study programme: „Medical biophysics “, Jessenius Medical Faculty CU, Martin	member
Milan Smetana	Working Group for Periodic Approval of Study Programmes of the 3rd Degree of Study: Electronics and Photonics, Measurement Technology, Field of Study Electrical Engineering, FEI STU, Bratislava	member
Mariana Beňová	Branch committee of the PhD. study programme: „Medical biophysics“, Jessenius Medical Faculty CU, Martin	member

Contact Address

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Department of Electromagnetic and Biomedical Engineering
Faculty of Electrical Engineering and Information Technology
University of Žilina
Univerzitná 1
010 26 Žilina
Slovak Republic
Phone: +421 41 513 2101
E-mail: ktebi@feit.uniza.sk

www: https://ktebi.uniza.sk/#

SK

Katedra teoretickej elektrotechniky a biomedicínskeho inžinierstva
Fakulta elektrotechniky a informačných technológií
Žilinská univerzita v Žiline
Univerzitná 1
010 26 Žilina
Slovenská republika
Telefón: +421 41 513 2101
E-mail: ktebi@feit.uniza.sk
www: http://ktebi.uniza.sk/