BRNO UNIVERSITY OF TECHNOLOGY

Experience the happiness from researching and develop your talent for exploration of technical principles and natural phenomena. Study in modern laboratories supervised by excited teachers.

Study biomedical courses

ERASMUS

on **Department of Biomedical Engineering**
at Brno University of Technology,
Czech Republic

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Biomedical engineering
courses for Erasmus

Study the courses which makes sense!

Become bioengineers and bioinformaticians who understand the principles of life.

Biomedicine obtained the attention of researchers as well as the recognition of society. Bioengineering, biomedical engineering, bioinformatics, biomedical informatics – excel at all of these when designing modern technologies in health care. Be able to repeat the ancient success of a prehistoric scientist who 3000 years ago created the first prosthetic aid – an artificial toe from leather and wood and enabled a woman with diabetes to walk again. Be ready for work in perspective interdisciplinary areas on the border of biology and medicine.

Prof. Ivo Provazník, Ph.D.
Head of department

Career paths for bioengineers

Biomedical graduates are respected specialists in science, industry and health care.

Biomedical technicians in health care guarantee cardiostimulators setting, analyse genomic sequences and images from computer tomographs and MRI, develop medical technology and PACS systems. Their responsible work influences directly human health in hospitals.

Graduates with scientific ambitions dedicate their effort in research centers to bioinformatics, development of hardware, sample testing, and a research of brain activities with the use of MRI. Their results form the future of the science. They regularly return to our institute to share their expert know-how with students within the alumni talk series Konektor.

Bright ideas in mind
Top technology in hand

Modern facilities and laboratories

The state-of-the-art laboratories at Department of Biomedical Engineering are an incubator of success!

Laboratory facilities allow our researchers not only to work on innovative projects, but also to create strategic partnerships with external researchers and the commercial sphere.

In addition, they are a background for the training and development of leading biomedical technicians and engineers.

Genomic
Proteomic
Cell cultivation
Real-time PCR
DNA analysis

3D print
Prototyping
Project realization
3D modeling
Bioprinting

Microscopy
Dark-field imaging
Ophtalmoscopy
Optical components
Spectrophotometry

Electroencephalography
Biosignal analysis
Cardiac activity
Muscle recording
Thermography

Excellence in Teaching and Research

Why study biomedicine?

What is biomedicine?

Become bioengineers and bioinformaticians who understand the basic principles of functioning of living systems and are ready to work in promising interdisciplinary areas on the border of biology, technology and medicine.

What will you do?

Develop personalized medicine technologies that can quickly read a patient's genome at low cost. Develop an application that monitors the patient's medical condition. Understand the principles of imaging technologies that can look inside the human body in real time and diagnose diseases with the help of artificial intelligence. Find the connection between the causes, course and consequences of diseases, and design new drugs as bioinformatics using a huge database of conducted clinical studies. Modern medicine relies on technology - be the one to push the boundaries of modern medical care!

Selected courses
for Erasmus students

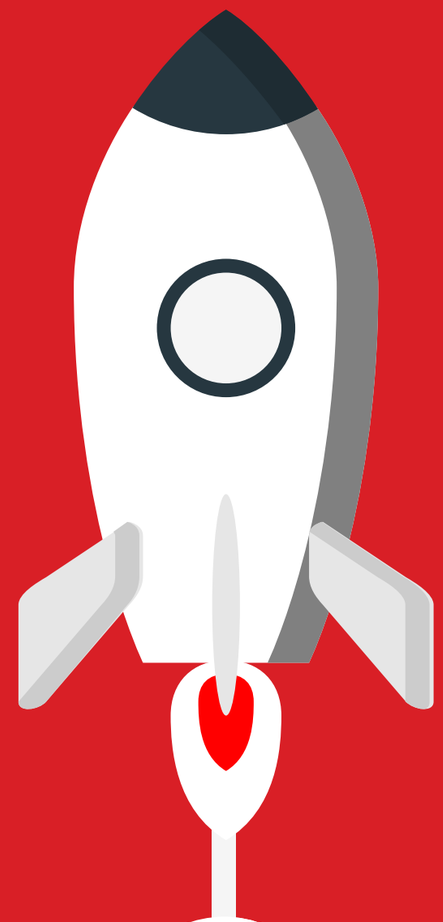
For international students (i.e. Erasmus+, Freemovers) we offer a selection of the English courses from our two Master's degree programs.

Biomedical Engineering and Bioinformatics

You will learn to design advanced algorithms for medical devices and modern diagnostics of various diseases as well as methods for analyzing the genetic code and cellular systems. In our laboratories you will discover how the modern microscopes work or how to enhance biomedical images from magnetic resonance and ultrasound.

Bioengineering

You will learn to design electronic devices and develop software applications for medicine and biology. You can look forward to the analysis of biomedical images, machine learning, engineering applied physics and nanotechnology. You will also expand your knowledge portfolio in the area of methodology of scientific work and culture of speech. See programme details. This study program is offered also as a double-degree with The University of Applied science, Technikum Wien.



Boost your knowledge with us!

A full list of courses open for the upcoming academic year is available at DBME website

www.ubmi.fekt.vut.cz/en

English courses
Winter semester
(September - January)

Advanced Analysis of Biomedical Signal MPA-ACS

5 credits
lectures 26 hours
laboratories 26 hours

The course is oriented to multirate signal processing, time-frequency analysis focused particularly on the different types of wavelet transform, parametric methods for power spectrum estimation, principal component analysis (PCA), and data compression.

Machine Learning MPA-MLR

5 credits
lectures 26 hours
laboratories 26 hours

Students will gain insight into advanced machine learning methods. They will be able to describe and compare the properties of individual approaches to data classification. They will be able to select and apply a specific approach to a given problem. They will also gain practical experience with current implementations of machine learning methods including deep learning.

Computer-Aided Medical Diagnostics MPA-PRM

5 credits
lectures 26 hours
laboratories 26 hours

The course is oriented on the use of artifficial intelligence in medicine. It is focused on computer-aided medical diagnostics, principles of decision making in medicine, work with uncertainty in medical data, reasoning under uncertainty, principles of fuzzy representation of uncertain information, and structure of expert systems. Students will get experimental knowledge in programming of expert systems.

Molecular Biology MPA-MOL

6 credits
lectures 26 hours
laboratories 39 hours

Molecular biology is an interdisciplinary branch of science (with biological, chemical, physical, medical, genetic overlaps). The aim of the course is to understand the structure and function of biological macromolecules and their mutual relationships in living organisms (prokaryotic vs eukaryotic organisms vs viruses), especially with respect to physiological and pathophysiological processes. Based on the knowledge of molecular biology, novel cutting-edge technologies, such as DNA and/or RNA technologies, have been developed.

Cardiac Diagnostics MPA-DVK

5 credits
lectures 26 hours
laboratories 26 hours

The course will guide students through the methods and techniques used in cardiac diagnostics. Students will gain insight into the anatomy and physiology of the heart and learn to record, filter and then interpret the manifestations of cardiac activity. The course is designed with emphasis on the interconnectedness of selected topics including heart anatomy, electrical and mechanical activity, ECG acquisition and processing, ECG waveform evaluation, and heart rate variability assessment.

Imaging Systems with Ionizeing Radiation MPA-ZIZ

5 credits
lectures 26 hours
laboratories 26 hours

This course is focused to using of ionizing radiation in medical imaging. First part of the course is dedicated to basics of atomic physics which are necessary for understanding of physical principles of X-ray and gamma rays. In the next part we focus to projection X-ray systems in different applications. We continue with using of X-ray in computed tomography (CT) - definition of Radon's transform as basic concept of image reconstruction, constructional aspects of CT systems. Third part of this course is focused to medical imaging in nuclear medicine. The last part deals with hybrid imaging systems which combines two imaging modalities into single system. Image quality and achievable parameters are discussed for all imaging systems.

Programming in Bioinformatics MPA-PRG

5 credits
lectures 13 hours
laboratories 39 hours

The course is oriented to programming in bioinformatics area. It studies introduction to programming and alghoritms used for DNA and protein sequence analysis.

We are the largest engineering university in the Czech Republic.

English courses
Spring semester
(February - June)

Analysis of Biomedical Images MPA-ABO

6 credits
lectures 26 hours
laboratories 26 hours

The subject is oriented towards providing overview of the methods of biomedical image analysis, and a good insight into their concepts, as related to the properties of the medical image data obtained by individual imaging modalities used in medicine and biology.

System Biology MPA-SYS

5 credits
lectures 26 hours
laboratories 26 hours

The course is oriented to gain knowledge of methods used in systems biology, creating models of cellular organisms and possibilities of their usage. It aims on computational methods used to describe behaviour of living organisms on molecular level that are utilizable in cellular biology, biochemistry, and biotechnology. Studied models are represented by extensive network graphs. Special attention is paid to both methodologies of model analysis, static as well as dynamic, especially using quantitative ODE models. The concept of hierarchy is followed and all functional layers, from gene regulatory network to signaling pathways and metabolic networks, are presented. Examples of models are given on systems of particular, especially unicellular, organisms.

Chemoinformatics MPA-CHM

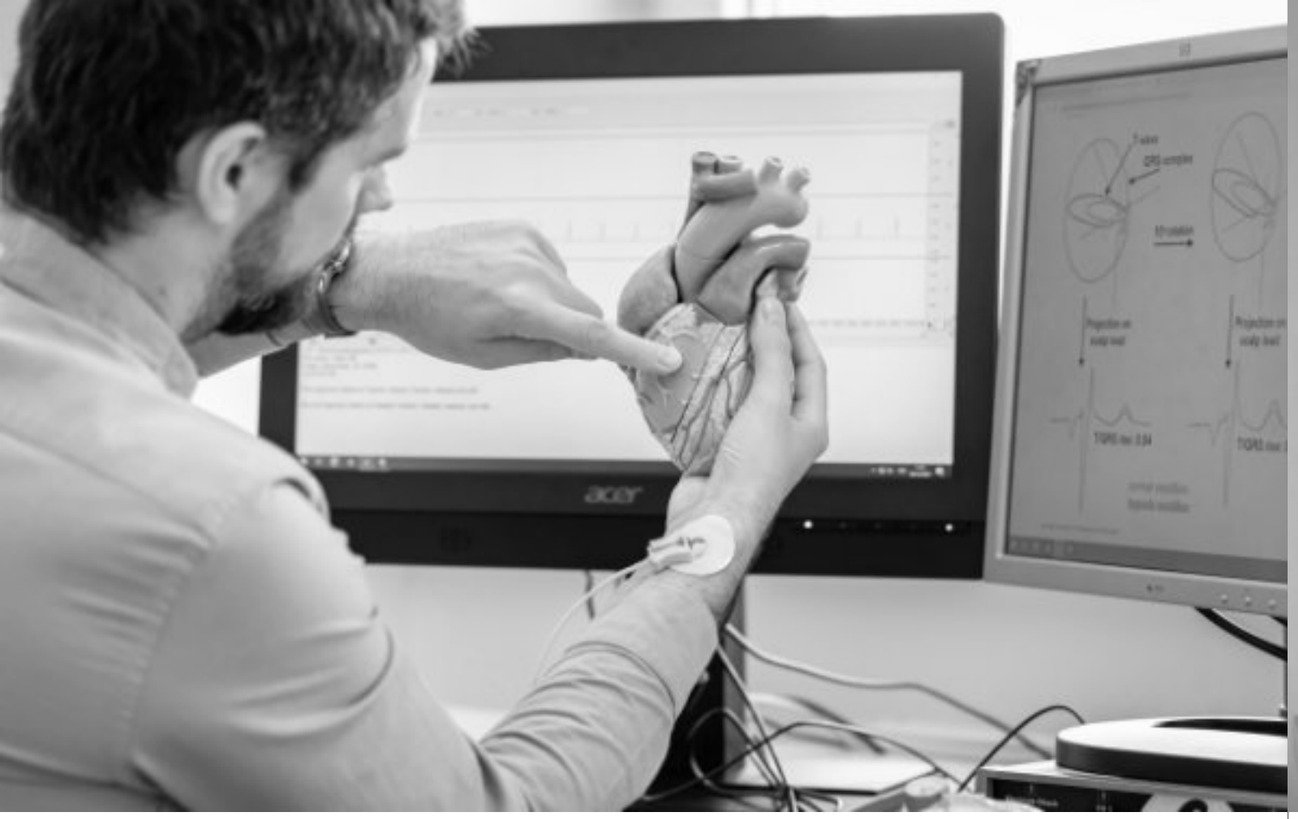
5 credits
lectures 26 hours
laboratories 26 hours

The course is focused on obtaining an overview of data sets in chemoinformatics, molecular structure of drugs, molecular descriptors, properties of molecules, data analysis in chemoinformatics and good understanding of chemoinformatics applications in drug research.

Imaging Systems with Nonionizeing Radiation MPA-ZSZ

5 credits
lectures 26 hours
laboratories 26 hours

This course focuses on the application of non-ionizing radiation in medical imaging. The first part of the course discusses the fundamentals of the magnetic resonance phenomenon and its application to medical imaging. Basic experiments in this area, basic and extended pulse sequences, principles of positional information encoding, and hardware requirements for imaging are discussed. The principles of contrast agents, functional and diffusion imaging are also discussed. The second part of the course discusses the principles of using ultrasound waves for imaging. In the last part of the course, thermal imaging using thermal cameras is discussed. The principles of microbolometer detectors, the use of 2D detectors, and the representation of the resulting information are explained. Furthermore, the parameters of the imaging process as such and the quality assessment of imaging systems are discussed.



Imaging Method Practice in Biomedicine MPA-ZBM

3 credits
laboratories 26 hours

The course is aimed at deepening theoretical knowledge and practical skills in selected imaging methods. In particular, emphasis is placed on optical imaging, focusing on the study of the properties of scientific and industrial cameras and their applications including stereovision, laser speckle contrast imaging, CMOS sensor properties, MTF measurement or deep learning.

Technology in Cellular Engineering MPA-TBI

5 credits
lectures 26 hours
laboratories 26 hours

This course introduces students to methods, technologies and instrumentation used in the fields of cell and tissue engineering in laboratories and research. The main topics covers: cultivation and preparation of cells and tissue, technologies for cell counting and sorting, cell mechanical properties and methods of their measurement, basic and advanced microscopic techniques, microelectrode arrays for cell electrical activity measurement, nanotechnology in regenerative and cancer medicine, 3D bioprinting and its application in regenerative medicine, technologies and methods used in optogenetics, microfluidic systems and their use in cell engineering.

Advanced Methods in Image Processing MPA-AB2

5 credits
lectures 26 hours
laboratories 26 hours

This course introduces students to selected advanced methods in image processing that are applicable to a variety of applications. Students will gain an appropriate theoretical foundation and apply this knowledge practically in team projects. The main solved topics are: noise suppression and deconvolution using regularization, image feature extraction, stereoscopy, image registration, optical flow and image segmentation based on graph theory and Markov random fields.

Insights in

Biomedical science

Biomedical topics

Thanks to the combination of life sciences and modern technologies, bioengineering is a fast-growing field that is fundamentally changing the concept of medical care. The unique ideas of our researchers at BUT help companies with the development of new devices and doctors in the introduction of advanced treatment methods. We can therefore boast not only a number of awards, but mainly a positive impact on the health. In addition to developing new computational tools for annotation and functional description of non-model organisms, our research team also focuses on advanced analysis of molecular biology data. Emphasis is placed primarily on the research of bacterial organisms utilizable in bio-based engineering and industrial biotechnology. The aim is to obtain a systems description of organisms with maximum use of lab data, besides genomic, transcriptomic, and epigenomic sequencing tools also high pressure liquid chromatography, quantitative polymerase chain reaction and many other techniques.

Functional Genomics and Systems Biology

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Microscopic Image Processing

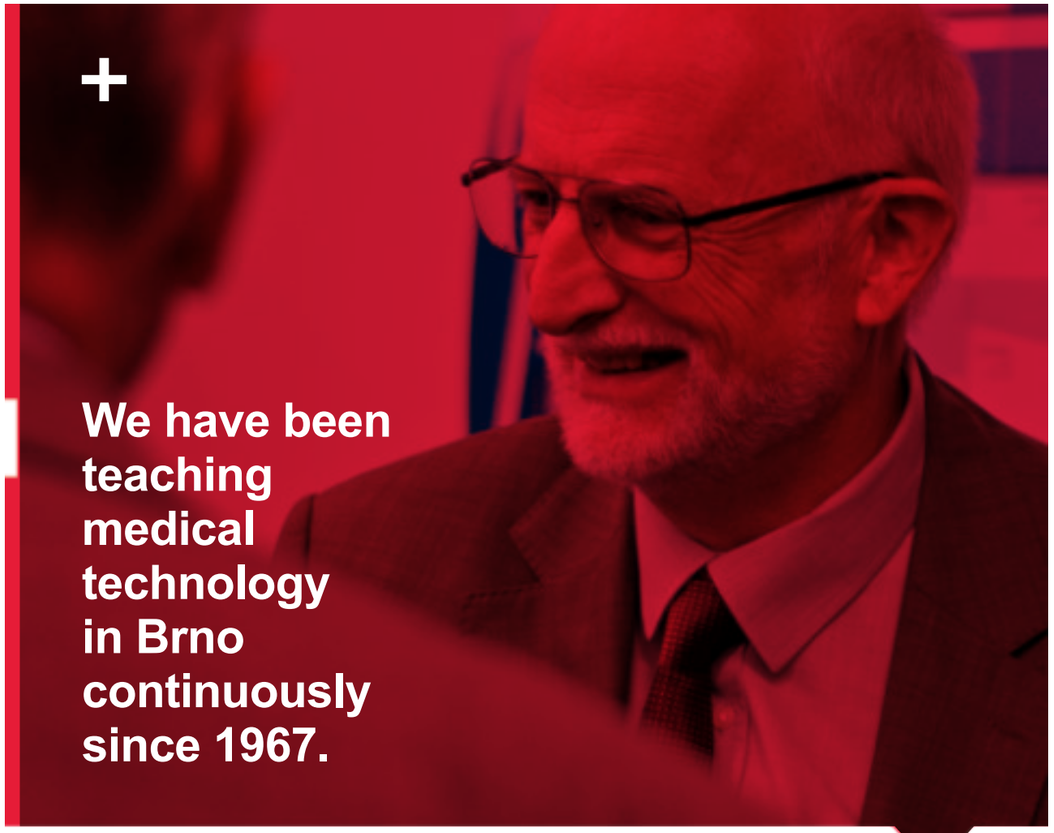
The research group is focused on the development of microscopy image processing methods and their application to various image data acquired during specific experiments. Typical applications cover cell segmentation, cell tracking during long-term experiments, cell classification, etc. The most commonly processed modalities include (quantitative) phase microscopy, widefield and confocal fluorescence microscopy.

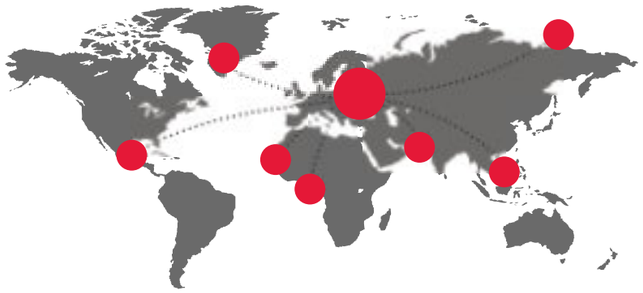
Ophthalmic Imaging and Image Processing

This research group is focused on the development of new diagnostic approaches in ophthalmology with a focus on retinal diseases. This mainly involves the application of advanced image processing and machine or deep learning methods. The activity also includes the experimental development of new devices for ophthalmology such as the video-ophthalmoscope or the camera for pupillometry.

Experimental Microscopy Techniques for Cell Engineering Group

The research group works mainly in the areas of cell and tissue engineering with the aim of applying the results in regenerative medicine. In research on living cells and tissue samples, technologically demanding measurement and imaging methods are applied to monitor and measure electrical, mechanical and fluorescence phenomena, together with the use of nanoparticles and bioprinting. Research is supported by the use of fluorescence, confocal and holographic microscopy or advanced microfluidic and incubation techniques. Typical applications include monitoring the migration of cells in the extracellular matrix in 2D and 3D space using confocal fluorescence microscopy, monitoring changes in their motility due to mechanical/electrical or chemical stimuli, as well as monitoring mitochondrial function and activity. Another area of activity is the electrophysiology of excitable cells and tissue, where microelectrode arrays or fast fluorescence cameras are applied to map the electrical activity of cardiac cells or neurons. Bioprinting and optogenetic facilities allow to follow current trends in cell engineering.





We were the first university center in Czechoslovakia with a focus on medical technology and biomedical fields. With a history of more than 50 years, we are one of the leading educational and scientific institutions, and thanks to the long-term transfer of know-how, we have a strong and experienced cantor team.

Our effort led not only to the expansion of teaching, but above all to the development of strong research teams and prestigious grant projects.

Take a step towards Erasmus study just now!

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