Study plan

Name of study plan: Medical electronics and bioinformatics

Faculty/Institute/Others: Faculty of Electrical Engineering
Department:
Branch of study guaranteed by the department: Welcome page
Garantor of the study branch:
Program of study: Medical Electronics and Bioinformatics
Type of study: Follow-up master full-time
Required credits: 114
Elective courses credits: 6
Sum of credits in the plan: 120
Note on the plan: Specializace Bioinformatika

Name of the block: Compulsory courses in the program
Minimal number of credits of the block: 60
The role of the block: P

Code of the group: 2018_MBIODIP
Name of the group: Diploma Thesis
Requirement credits in the group: In this group you have to gain 30 credits
Requirement courses in the group: In this group you have to complete 1 course
Credits in the group: 30
Note on the group:

Code	Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors, **authors** and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
BDIP30	**Diploma Thesis**	Z	30	22s	L	P

Characteristics of the courses of this group of Study Plan: Code=2018_MBIODIP Name=Diploma Thesis

BDIP30	Diploma Thesis	Z	30
Independent final comprehensive work for the Master's degree study programme. A student will choose a topic from a range of topics related to his or her branch of study, which will be specified by branch department or branch departments. The diploma thesis will be defended in front of the board of examiners for the comprehensive final examination.			

Code of the group: 2018_MBIOP
Name of the group: Compulsory subjects of the programme
Requirement credits in the group: In this group you have to gain 30 credits
Requirement courses in the group: In this group you have to complete 5 courses
Credits in the group: 30
Note on the group:

Code	Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors, **authors** and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
BAM31BSG	**Biological signals** *Roman Čmejla **Roman Čmejla** Roman Čmejla (Gar.)*	Z,ZK	6	2P+2L	L	P
BMPROJ6	**Diploma Project** *Roman Čmejla, Jan Kybic, Vratislav Fabián, Petr Pošík **Petr Pošík** Roman Čmejla (Gar.)*	Z	6	0p+6s	Z,L	P
BAM31LET	**Medical Instrumentation and Devices** *Jan Havlík **Jan Havlík** Jan Havlík (Gar.)*	Z,ZK	6	2P+2L	Z	P
B4M36SAN	**Statistical Data Analysis** *Jiří Kléma **Jiří Kléma** Jiří Kléma (Gar.)*	Z,ZK	6	2P+2C	Z	P
BAM33ZSL	**Medical Imaging Systems** *Jan Kybic, Vít Herynek, André Sopczak **Jan Kybic** Jan Kybic (Gar.)*	Z,ZK	6	2P+2C	L	P

Characteristics of the courses of this group of Study Plan: Code=2018_MBIOP Name=Compulsory subjects of the programme

BAM31BSG	Biological signals	Z,ZK	6
BMPROJ6	Diploma Project	Z	6

BAM31LET	Medical Instrumentation and Devices	Z,ZK	6
Students will study fundamental principles applied within the modern medical devices and systems, esp. from the point of view of functional blocks and electronic circuits of diagnostical and therapeutical medical equipments including electrocardiographs, electroencephalographs, bedside and central monitors, equipments for anestesiology, intensive and critical healthcare, equipments for clinical laboratory, electrostimulators, cardiostimulators and defibrilators, blood pressure and flow measurement (including dilution) and pulse oxymetry.			
B4M36SAN	Statistical Data Analysis	Z,ZK	6
This course builds on the skills developed in introductory statistics courses. It is practically oriented and gives an introduction to applied statistics. It mainly aims at multivariate statistical analysis and modelling, i.e., the methods that help to understand, interpret, visualize and model potentially high-dimensional data. It can be seen as a purely statistical counterpart to machine learning and data mining courses.			
BAM33ZSL	Medical Imaging Systems	Z,ZK	6
The course covers the principles, design and properties of currently used medical imaging devices. We shall deal with 2D microscopic, X-ray and ultrasound imaging systems, including advanced topics such as Doppler ultrasound. We will also study tomographic (3D) imaging systems: computed tomography (CT), magnetic resonance imaging (MRI) including functional MRI (fMRI) and nuclear imaging methods (PET,SPECT). For more information see https://cw.fel.cvut.cz/wiki/courses/zsl			

Name of the block: Compulsory courses in the specialization
Minimal number of credits of the block: 30
The role of the block: PS

Code of the group: 2018_MBIOPS1
Name of the group: Compulsory subjects of specialization
Requirement credits in the group: In this group you have to gain 30 credits
Requirement courses in the group: In this group you have to complete 5 courses
Credits in the group: 30
Note on the group:

Code	**Name of the course / Name of the group of courses** ***(in case of groups of courses the list of codes of their members)*** *Tutors,* ***authors*** *and guarantors (gar.)*	**Completion**	**Credits**	**Scope**	**Semester**	**Role**
BAM36BIN	**Bioinformatics** *Jiří Kléma* ***Jiří Kléma*** *Jiří Kléma (Gar.)*	Z,ZK	6	2P+2C	L	PS
B4M35KO	**Combinatorial Optimization** *Zdeněk Hanzálek* ***Zdeněk Hanzálek*** *Zdeněk Hanzálek (Gar.)*	Z,ZK	6	3P+2C	L	PS
B4M36MBG	**Molecular Biology and Genetics** *Martin Pospíšek* ***Martin Pospíšek*** *Martin Pospíšek (Gar.)*	Z,ZK	6	3P+1C	L	PS
B4M33PAL	**Advanced algorithms** *Marko Genyk-Berezovskyj, Daniel Průša, Ondřej Drbohlav* ***Daniel Průša*** *Daniel Průša (Gar.)*	Z,ZK	6	2P+2C	Z	PS
BE4M33SSU	**Statistical Machine Learning** *Jan Drchal, Vojtěch Franc* ***Vojtěch Franc*** *Vojtěch Franc (Gar.)*	Z,ZK	6	2P+2C	Z	PS

Characteristics of the courses of this group of Study Plan: Code=2018_MBIOPS1 Name=Compulsory subjects of specialization

BAM36BIN	Bioinformatics	Z,ZK	6
B4M35KO	Combinatorial Optimization	Z,ZK	6
The goal is to show the problems and algorithms of combinatorial optimization (often called discrete optimization; there is a strong overlap with the term operations research). Following the courses on linear algebra, graph theory, and basics of optimization, we show optimization techniques based on graphs, integer linear programming, heuristics, approximation algorithms and state space search methods. We focus on application of optimization in stores, ground transportation, flight transportation, logistics, planning of human resources, scheduling in production lines, message routing, scheduling in parallel computers.			
B4M36MBG	Molecular Biology and Genetics	Z,ZK	6
B4M33PAL	Advanced algorithms	Z,ZK	6
Basic graph algorithms and graph representation. Combinatorial algorithms. Application of formal languages theory in computer science - pattern matching.			
BE4M33SSU	Statistical Machine Learning	Z,ZK	6
The aim of statistical machine learning is to develop systems (models and algorithms) for learning to solve tasks given a set of examples and some prior knowledge about the task. This includes typical tasks in speech and image recognition. The course has the following two main objectives 1. to present fundamental learning concepts such as risk minimisation, maximum likelihood estimation and Bayesian learning including their theoretical aspects, 2. to consider important state-of-the-art models for classification and regression and to show how they can be learned by those concepts.			

Name of the block: Compulsory elective courses
Minimal number of credits of the block: 24
The role of the block: PV

Code of the group: 2018_MBIOPPV1
Name of the group: Compulsory subjects of the programme
Requirement credits in the group: In this group you have to gain 24 credits
Requirement courses in the group: In this group you have to complete 4 courses
Credits in the group: 24
Note on the group:

Code	Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors,* ***authors*** *and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
BAM31ADA	**Adaptive signal processing** *Radoslav Bortel, Pavel Sovka* ***Radoslav Bortel*** *Radoslav Bortel (Gar.)*	Z,ZK	6	2P+2C	Z	PV
B2M31AEDA	**Experimental Data Analysis** *Jan Rusz* ***Jan Rusz*** *Jan Rusz (Gar.)*	Z,ZK	6	2P+2C	Z	PV
BAM17EPM	**Applications of Electromagnetic Fields in Medicine** *Jan Vrba, Ladislav Oppl* ***Jan Vrba*** *Jan Vrba (Gar.)*	Z,ZK	6	2P+2L	L	PV
BAM31AOL	**Applied optoelectronics in medicine** *Jan Havlík* ***Jan Havlík*** *Jan Havlík (Gar.)*	Z,ZK	6	2P+2L	L	PV
BAM02BIO	**Biosensors** *Bohuslav Rezek* ***Bohuslav Rezek*** *Bohuslav Rezek (Gar.)*	Z,ZK	6	2P+2L	Z	PV
BAM02FPT	**Physics for Diagnostics and Therapy** *Vratislav Fabián, Jan Vrba, Ladislav Oppl* ***Vratislav Fabián*** *Vratislav Fabián (Gar.)*	Z,ZK	6	2P+2L		PV
B0M37FAV	**Physiology and modeling of hearing and vision** *Miloš Klíma, Václav Vencovský, Petr Maršálek, Karel Fliegel* ***Karel Fliegel*** *Václav Vencovský (Gar.)*	Z,ZK	6	2P+2C+4D	Z	PV
B3M33HRO	**Humanoid robots** *Matěj Hoffmann, Lukáš Rustler* ***Matěj Hoffmann*** *Matěj Hoffmann (Gar.)*	Z,ZK	6	2P+2C	L	PV
B4B01JAG	**Languages, Automats and Gramatics** *Marie Demlová, Jiří Demel* ***Marie Demlová*** *Marie Demlová (Gar.)*	Z,ZK	6	2P+2S	Z	PV
B2M37KASA	**Compression of images and signals** *Václav Vencovský, Karel Fliegel, František Rund, Stanislav Vítek* ***Karel Fliegel*** *Stanislav Vítek (Gar.)*	Z,ZK	6	2P+2C	L	PV
BAM38KLS	**Construction of Medical Systems** *Jan Holub* ***Jan Holub*** *Jan Holub (Gar.)*	Z,ZK	6	2P+2L	Z	PV
B4M33MPV	**Computer Vision Methods** *Georgios Tolias, Jiří Matas, Jan Čech, Dmytro Mishkin* ***Ondřej Drbohlav*** *Jiří Matas (Gar.)*	Z,ZK	6	2P+2C	L	PV
B2M37MAM	**Microprocessors** *Stanislav Vítek, Petr Skalický* ***Stanislav Vítek*** *Stanislav Vítek (Gar.)*	Z,ZK	6	2P+2L	Z	PV
BAM31MOA	**Modeling and analysis of brain activity** *Jaroslav Hlinka* ***Jaroslav Hlinka*** *Jaroslav Hlinka (Gar.)*	Z,ZK	6	2P+2C	Z	PV
B2M37MOTA	**Advanced areas in image and video technology** *Karel Fliegel* ***Karel Fliegel*** *Karel Fliegel (Gar.)*	Z,ZK	6	2P+2L	Z	PV
B3M38MSE	**Modern Sensors**	Z,ZK	6	2P+2L	Z	PV
B2M34ZETA	**Custom Electronics Design** *Vít Záhlava* ***Vít Záhlava*** *Vít Záhlava (Gar.)*	KZ	6	2P+2L	Z	PV
BAM31NPG	**Neurophysiology** *Přemysl Jiruška, Helena Pivoňková* ***Přemysl Jiruška*** *Přemysl Jiruška (Gar.)*	Z,ZK	6	2P+2C	Z	PV
BAM33NIN	**Neuroinformatics** *Giulia D´Angelo, Jiří Hammer, Daniel Novák, Eduard Bakštein, Karla Štěpánová, Ján Antolík, David Kala* ***Daniel Novák*** *Daniel Novák (Gar.)*	Z,ZK	6	2P+2C	L	PV
B2M17OPM	**Optical Measurements** *Stanislav Vítek, Matěj Komanec, Stanislav Zvánovec* ***Matěj Komanec*** *Stanislav Zvánovec (Gar.)*	Z,ZK	6	2P+2L	L	PV
B2M31DSP	**Advanced DSP methods** *Pavel Sovka, Petr Pollák* ***Pavel Sovka*** *Pavel Sovka (Gar.)*	Z,ZK	6	2P+2C	Z,L	PV
B2M37SSPA	**Statistical Signal Processing** *Pavel Sovka, Jan Sýkora* ***Jan Sýkora*** *Jan Sýkora (Gar.)*	Z,ZK	6	4P+0C	L	PV
B4M36SMU	**Symbolic Machine Learning** *Filip Železný, Ondřej Kuželka, Gustav Šír* ***Ondřej Kuželka*** *Ondřej Kuželka (Gar.)*	Z,ZK	6	2P+2C	L	PV
BAM17EMC	**Introduction to electromagnetic compatibility** *Tomáš Kořínek* ***Tomáš Kořínek*** *Tomáš Kořínek (Gar.)*	Z,ZK	6	2P+2L	Z	PV
BAM31ZAS	**Analog Signal Processing** *Jiří Hospodka* ***Jiří Hospodka*** *Jiří Hospodka (Gar.)*	Z,ZK	6	2P+2L	L	PV
BAM33ZMO	**Medical Image Processing** *Jan Kybic, Oleksandr Shekhovtsov* ***Jan Kybic*** *Jan Kybic (Gar.)*	Z,ZK	6	2P+2C	Z	PV

Characteristics of the courses of this group of Study Plan: Code=2018_MBIOPPV1 Name=Compulsory subjects of the programme

BAM31ADA	Adaptive signal processing	Z,ZK	6
This course provides a basic discourse on adaptive algorithms for filtering, decorrelation, separation and beamforming.			
B2M31AEDA	Experimental Data Analysis	Z,ZK	6
In the course of subject "Experimental Data Analysis", students will acquire knowledge regarding fundamental methods for data analysis and machine learning for evaluation and interpretation of data. In the course of practical lectures, students will solve individual tasks using real data from signal processing in neuroscience research. In the course of semestral project, student will solve complex task and present obtained results. The aim of the subject is to introduce practical application of fundamental statistical methods as well as to teach students to use critical thinking and to acquire additional knowledge in solution of practical tasks.			
BAM17EPM	Applications of Electromagnetic Fields in Medicine	Z,ZK	6
The major aim of these lectures is to give to students a basic overview of biophysical aspects of EM fields in different biological systems, including an overview of microwave applications in medicine. Safety limits, clinical usage of EM field effects on biological systems, microwave hyperthermia, measurement of dielectric parameters of biological tissues, EM exposure of mobile phone users, magnetic resonance imaging, interaction of optical radiation with biological tissue.			
BAM31AOL	Applied optoelectronics in medicine	Z,ZK	6

BAM02BIO	Biosensors	Z,ZK	6
BAM02FPT	Physics for Diagnostics and Therapy	Z,ZK	6
In this course, students will be introduced to the problems of locomotive organs diseases and musculoskeletal pain in the first seven lectures. Great space is devoted to electrotherapeutic methods, therapeutic ultrasound and phototherapy. Furthermore, advanced neurorehabilitation methods, especially transcranial brain stimulation methods (repetitive transcranial magnetic stimulation of the brain - rTMS, transcranial electrical stimulation of the brain - tDCS and electroconvulsive therapy - ECT) are discussed. In the second half of the semester, attention is paid to the possibilities of using ionizing electromagnetic fields in medical diagnostics and therapy (eg X-ray, proton therapy, radiotherapy, etc.).			
B0M37FAV	Physiology and modeling of hearing and vision	Z,ZK	6
The primary aim of the course is to study the physiology of sensors and processes of perception of audio and visual information by human subjects as two central and most important communication channels, i.e., Human Auditory System (HAS) and Human Visual System (HVS). The course summarizes current knowledge in the field of human vision and hearing physiology and, at the same time, presents their description using mathematical models using the latest computational tools and procedures, including Machine Learning (ML), Deep Learning (DL) and Artificial Intelligence (AI). Emphasis is also placed on current and prospective applications of the mentioned knowledge. The main application area is the audiovisual technology related to human perception, but the direct employment of the acquired knowledge also includes the areas of multimedia technology, control systems, automation, robotics, safety and security technology, bioinspired systems, etc. At the same time, students gain a general overview of information processing in biological systems. A separate part is the objectification of audiovisual information perceived quality, i.e., Quality of Experience (QoE). The course is intended for students of master's degree in technical fields. The exercises will be devoted to fundamental experiments to determine the most important characteristics of HAS and HVS, including computational models and simulation of vision and hearing processes.			
B3M33HRO	Humanoid robots	Z,ZK	6
The course focuses on human-centered robotics: humanoid robots and human-robot interaction. Motivated by the vision of robot companions in our homes, this course introduces humanoid robot technology and its specific challenges and opportunities: (i) design, kinematics and inverse kinematics of humanoids, (ii) multimodal sensing - vision, touch, hearing, inertial sensing, etc., (iii) walking and balancing, and (ii) grasping. The second part of the course centers on human-robot interaction (HRI), which includes physical HRI (safety aspects, collaborative robots) and cognitive/social HRI - how to design robots and behaviors to be acceptable for people.			
B4B01JAG	Languages, Automats and Gramatics	Z,ZK	6
Basic notions of the theory of finite automata and grammars: deterministic and non deterministic finite automata, languages accepted by finite automata, regular expressions. Grammars and languages generated by grammars with emphasis to context free grammars. A very brief introduction of Turing machines.			
B2M37KASA	Compression of images and signals	Z,ZK	6
The subject deals with compression methods and techniques. Main goal is to introduce basic concepts of lossless and lossy compresion of audiovisual information (entropy, redundancy and irrelevancy). Within the laboratory exercises students will work with implementations of particular algorithms, including objective and subjective methods of quality evaluation.			
BAM38KLS	Construction of Medical Systems	Z,ZK	6
B4M33MPV	Computer Vision Methods	Z,ZK	6
The course covers selected computer vision problems: search for correspondences between images via interest point detection, description and matching, image stitching, detection, recognition and segmentation of objects in images and videos, image retrieval from large databases and tracking of objects in video sequences. This course is also part of the inter-university programme prg.ai Minor. It pools the best of AI education in Prague to provide students with a deeper and broader insight into the field of artificial intelligence. More information is available at https://prg.ai/minor.			
B2M37MAM	Microprocessors	Z,ZK	6
The aim is to make students acquainted with the properties of microprocessor systems, make students familiar with on-chip peripherals, connect external circuit to the processor bus, and with implementation of the memory or I/O space address extension. Next, taught the students to make simple program in the assembly language, C language and combination of both. After completion of this subject student should be able to design and implement simpler microprocessor system including connection of necessary peripherals and software design.			
BAM31MOA	Modeling and analysis of brain activity	Z,ZK	6
B2M37MOTA	Advanced areas in image and video technology	Z,ZK	6
This course focuses on the state-of-the-art techniques for digital image and video technology. These techniques and their applications cover almost all areas of technical professions dealing with human interaction. A significant part of the course is focused on the methods of image signal processing and main hardware and software functional blocks of related imaging systems. The aim of the laboratory exercises is to familiarize with advanced methods for capturing, processing and reproduction of image information. Due to the fast progress in this area, the content of the lectures and exercises is being continuously updated.			
B3M38MSE	Modern Sensors	Z,ZK	6
An overview of sensors of physical quantities used in industry and in research and methods of signal processing.			
B2M34ZETA	Custom Electronics Design	KZ	6
The course deals with the design methodology of advanced custom electronics. The aim is to convert theoretical knowledge of previous studies into specific proposals for practical applications. Student are getting familiar with the problems encountered in the professional electronic design and manufacturing. This course is based on real experience in development and production, showing the latest technological trends and component base.			
BAM31NPG	Neurophysiology	Z,ZK	6
BAM33NIN	Neuroinformatics	Z,ZK	6
The Neuroinformatics Course concentrates on modelling of neurons, stochastic learning on cellular level, information coding and decoding in brain and single unit processing. Examples from clinical practices are provided throughout the course. The labs focus on signal neuron analysis from human and animal brain.			
B2M17OPM	Optical Measurements	Z,ZK	6
B2M31DSP	Advanced DSP methods	Z,ZK	6
The course follows the basic course in signal processing and introduces advanced methods of analysis and digital signal processing. Graduates will learn the methods of digital signals analysis and be able to practically use them. They learn to know the conditions of use of correlation, spectral and coherent analysis of random signals. They will became familiar with methods of signal decomposition and independent component analysis and the time-frequency transformations. Emphasis will be placed on an ability to interpret the results of signal analyses.			
B2M37SSPA	Statistical Signal Processing	Z,ZK	6
The course provides fundamentals in three main domains of the statistical signal processing: 1) estimation theory, 2) detection theory, 3) optimal and adaptive filtering. The statistical signal processing is a core theory with many applications ranging from digital communications, audio and video processing, radar and radio navigation, measurement and experiment evaluation, etc.			
B4M36SMU	Symbolic Machine Learning	Z,ZK	6
This course consists of four parts. The first part of the course will explain methods through which an intelligent agent can learn by interacting with its environment, also known as reinforcement learning. This will include deep reinforcement learning. The second part focuses on Bayesian networks, specifically methods for inference. The third part will cover fundamental topics from natural language learning, starting from the basics and ending with state-of-the-art architectures such as transformer. Finally, the last part will provide an introduction to several topics from the computational learning theory, including the online and batch learning settings.			
BAM17EMC	Introduction to electromagnetic compatibility	Z,ZK	6
The subject dwells on problems of electromagnetic compatibility. Students obtain the basic knowledges in the field of electromagnetic compatibility - electromagnetic interference, susceptibility and testing methods. The subject leads to gain professional skills in the field of electrical engineering.			

BAM31ZAS	Analog Signal Processing	Z,ZK	6
The course deals with analog input-output blocks for signal transmission and processing. They discussed circuit solution of amplifiers and filters, including their design process, simulation and measurement. Students learn the circuit concepts and possibilities for solving the contemporary analogue structures. The second part of the course describes the design and implementation of analog filters, including discrete-time circuits. The conclusion is devoted to the possibilities of computer optimization of electronic circuits and filters.			
BAM33ZMO	Medical Image Processing	Z,ZK	6
This course covers the most used advanced image analysis methods, with emphasis on images from medical and biological modalities, from microscopy, to ultrasound, MRI, or CT, including time sequences.			

Name of the block: Elective courses
Minimal number of credits of the block: 0
The role of the block: V

Code of the group: 2018_MBIOH
Name of the group: Humanities subjects
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
Note on the group:

Code	Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors,* ***authors*** *and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
B0M16FIL	*Peter Zamarovský* ***Peter Zamarovský*** *Peter Zamarovský (Gar.)*	Z,ZK	5	2P+2S	Z,L	V
B0M16HVT	**History of science and technology 2** *Marcela Efmertová, Jan Mikeš* ***Marcela Efmertová*** *Marcela Efmertová (Gar.)*	Z,ZK	5	2P+2S	Z,L	V
B0M16HSD1	**History of economy and social studies** ***Marcela Efmertová***	Z,ZK	5	2P+2S	Z,L	V
B0M16PSM	**Psychology** *Jan Fiala* ***Jan Fiala*** *Jan Fiala (Gar.)*	Z,ZK	5	2P+2S	Z,L	V
A003TV	**Physical Education** ***Jiří Drnek***	Z	2	0+2	L,Z	V
B0M16TEO	**Theology** *Vladimír Slámečka* ***Vladimír Slámečka*** *Vladimír Slámečka (Gar.)*	Z,ZK	5	2P+2S	Z,L	V

Characteristics of the courses of this group of Study Plan: Code=2018_MBIOH Name=Humanities subjects

B0M16FIL		Z,ZK	5
B0M16HVT	History of science and technology 2	Z,ZK	5
This subject traces historical developments in electrical engineering branches in the world and in the Czech Lands. Its ultimate goal is to stimulate students' interest in the history and traditions of the subject, while highlighting the developments in technical education and professional organizations, the process of shaping scientific life and the influence of technical engineers			
B0M16HSD1	History of economy and social studies	Z,ZK	5
This subject deals with the history of the Czech society in the 19th - 21th centuries. It follows the forming of the Czech political representation, its aims and achieved results as well as the social and cultural development and coexistence of the various ethnical groups in the Czech countries.			
B0M16PSM	Psychology	Z,ZK	5
A003TV	Physical Education	Z	2
B0M16TEO	Theology	Z,ZK	5
This subject provides to students the basic orientation in christian theology and requires no special previous education. After short philosophic lecture the basic theologic disciplines are gone through. The subject is determined not only to believer students who want to know the reliable theologic grounding but also above all to ones who want to get know Christianity - religion from which graws our civilization up.			

Code of the group: 2018_MBIOVOL
Name of the group: Elective subjects
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
Note on the group: ~Nabídku volitelných předmětů uspořádaných podle kateder najdete na webových stránkách http://www.fel.cvut.cz/cz/education/volitelne-predmety.html\\

List of courses of this pass:

Code	Name of the course	Completion	Credits
A003TV	Physical Education	Z	2
B0M16FIL		Z,ZK	5
B0M16HSD1	History of economy and social studies	Z,ZK	5
	This subject deals with the history of the Czech society in the 19th - 21th centuries. It follows the forming of the Czech political representation, its aims and achieved results as well as the social and cultural development and coexistence of the various ethnical groups in the Czech countries.		
B0M16HVT	History of science and technology 2	Z,ZK	5
	This subject traces historical developments in electrical engineering branches in the world and in the Czech Lands. Its ultimate goal is to stimulate students' interest in the history and traditions of the subject, while highlighting the developments in technical education and professional organizations, the process of shaping scientific life and the influence of technical engineers		
B0M16PSM	Psychology	Z,ZK	5
B0M16TEO	Theology	Z,ZK	5
	This subject provides to students the basic orientation in christian theology and requires no special previous education. After short philosophic lecture the basic theologic disciplines are gone through. The subject is determined not only to believer students who want to know the reliable theologic grounding but also above all to ones who want to get know Christianity - religion from which graws our civilization up.		
B0M37FAV	Physiology and modeling of hearing and vision	Z,ZK	6
	The primary aim of the course is to study the physiology of sensors and processes of perception of audio and visual information by human subjects as two central and most important communication channels, i.e., Human Auditory System (HAS) and Human Visual System (HVS). The course summarizes current knowledge in the field of human vision and hearing physiology and, at the same time, presents their description using mathematical models using the latest computational tools and procedures, including Machine Learning (ML), Deep Learning (DL) and Artificial Intelligence (AI). Emphasis is also placed on current and prospective applications of the mentioned knowledge. The main application area is the audiovisual technology related to human perception, but the direct employment of the acquired knowledge also includes the areas of multimedia technology, control systems, automation, robotics, safety and security technology, bioinspired systems, etc. At the same time, students gain a general overview of information processing in biological systems. A separate part is the objectification of audiovisual information perceived quality, i.e., Quality of Experience (QoE). The course is intended for students of master's degree in technical fields. The exercises will be devoted to fundamental experiments to determine the most important characteristics of HAS and HVS, including computational models and simulation of vision and hearing processes.		
B2M17OPM	Optical Measurements	Z,ZK	6
B2M31AEDA	Experimental Data Analysis	Z,ZK	6
	In the course of subject "Experimental Data Analysis", students will acquire knowledge regarding fundamental methods for data analysis and machine learning for evaluation and interpretation of data. In the course of practical lectures, students will solve individual tasks using real data from signal processing in neuroscience research. In the course of semestral project, student will solve complex task and present obtained results. The aim of the subject is to introduce practical application of fundamental statistical methods as well as to teach students to use critical thinking and to acquire additional knowledge in solution of practical tasks.		
B2M31DSP	Advanced DSP methods	Z,ZK	6
	The course follows the basic course in signal processing and introduces advanced methods of analysis and digital signal processing. Graduates will learn the methods of digital signals analysis and be able to practically use them. They learn to know the conditions of use of correlation, spectral and coherent analysis of random signals. They will became familiar with methods of signal decomposition and independent component analysis and the time-frequency transformations. Emphasis will be placed on an ability to interpret the results of signal analyses.		
B2M34ZETA	Custom Electronics Design	KZ	6
	The course deals with the design methodology of advanced custom electronics. The aim is to convert theoretical knowledge of previous studies into specific proposals for practical applications. Student are getting familiar with the problems encountered in the professional electronic design and manufacturing. This course is based on real experience in development and production, showing the latest technological trends and component base.		
B2M37KASA	Compression of images and signals	Z,ZK	6
	The subject deals with compression methods and techniques. Main goal is to introduce basic concepts of lossless and lossy compresion of audiovisual information (entropy, redundancy and irrelevancy). Within the laboratory exercises students will work with implementations of particular algorithms, including objective and subjective methods of quality evaluation.		
B2M37MAM	Microprocessors	Z,ZK	6
	The aim is to make students acquainted with the properties of microprocessor systems, make students familiar with on-chip peripherals, connect external circuit to the processor bus, and with implementation of the memory or I/O space address extension. Next, taught the students to make simple program in the assembly language, C language and combination of both. After completion of this subject student should be able to design and implement simpler microprocessor system including connection of necessary peripherals and software design.		
B2M37MOTA	Advanced areas in image and video technology	Z,ZK	6
	This course focuses on the state-of-the-art techniques for digital image and video technology. These techniques and their applications cover almost all areas of technical professions dealing with human interaction. A significant part of the course is focused on the methods of image signal processing and main hardware and software functional blocks of related imaging systems. The aim of the laboratory exercises is to familiarize with advanced methods for capturing, processing and reproduction of image information. Due to the fast progress in this area, the content of the lectures and exercises is being continuously updated.		
B2M37SSPA	Statistical Signal Processing	Z,ZK	6
	The course provides fundamentals in three main domains of the statistical signal processing: 1) estimation theory, 2) detection theory, 3) optimal and adaptive filtering. The statistical signal processing is a core theory with many applications ranging from digital communications, audio and video processing, radar and radio navigation, measurement and experiment evaluation, etc.		
B3M33HRO	Humanoid robots	Z,ZK	6
	The course focuses on human-centered robotics: humanoid robots and human-robot interaction. Motivated by the vision of robot companions in our homes, this course introduces humanoid robot technology and its specific challenges and opportunities: (i) design, kinematics and inverse kinematics of humanoids, (ii) multimodal sensing - vision, touch, hearing, inertial sensing, etc., (iii) walking and balancing, and (ii) grasping. The second part of the course centers on human-robot interaction (HRI), which includes physical HRI (safety aspects, collaborative robots) and cognitive/social HRI - how to design robots and behaviors to be acceptable for people.		
B3M38MSE	Modern Sensors	Z,ZK	6
	An overview of sensors of physical quantities used in industry and in research and methods of signal processing.		

B4B01JAG	Languages, Automats and Gramatics	Z,ZK	6
Basic notions of the theory of finite automata and grammars: deterministic and non deterministic finite automata, languages accepted by finite automata, regular expressions. Grammars and languages generated by grammars with emphasis to context free grammars. A very brief introduction of Turing machines.			
B4M33MPV	Computer Vision Methods	Z,ZK	6
The course covers selected computer vision problems: search for correspondences between images via interest point detection, description and matching, image stitching, detection, recognition and segmentation of objects in images and videos, image retrieval from large databases and tracking of objects in video sequences. This course is also part of the inter-university programme prg.ai Minor. It pools the best of AI education in Prague to provide students with a deeper and broader insight into the field of artificial intelligence. More information is available at https://prg.ai/minor.			
B4M33PAL	Advanced algorithms	Z,ZK	6
Basic graph algorithms and graph representation. Combinatorial algorithms. Application of formal languages theory in computer science - pattern matching.			
B4M35KO	Combinatorial Optimization	Z,ZK	6
The goal is to show the problems and algorithms of combinatorial optimization (often called discrete optimization; there is a strong overlap with the term operations research). Following the courses on linear algebra, graph theory, and basics of optimization, we show optimization techniques based on graphs, integer linear programming, heuristics, approximation algorithms and state space search methods. We focus on application of optimization in stores, ground transportation, flight transportation, logistics, planning of human resources, scheduling in production lines, message routing, scheduling in parallel computers.			
B4M36MBG	Molecular Biology and Genetics	Z,ZK	6
B4M36SAN	Statistical Data Analysis	Z,ZK	6
This course builds on the skills developed in introductory statistics courses. It is practically oriented and gives an introduction to applied statistics. It mainly aims at multivariate statistical analysis and modelling, i.e., the methods that help to understand, interpret, visualize and model potentially high-dimensional data. It can be seen as a purely statistical counterpart to machine learning and data mining courses.			
B4M36SMU	Symbolic Machine Learning	Z,ZK	6
This course consists of four parts. The first part of the course will explain methods through which an intelligent agent can learn by interacting with its environment, also known as reinforcement learning. This will include deep reinforcement learning. The second part focuses on Bayesian networks, specifically methods for inference. The third part will cover fundamental topics from natural language learning, starting from the basics and ending with state-of-the-art architectures such as transformer. Finally, the last part will provide an introduction to several topics from the computational learning theory, including the online and batch learning settings.			
BAM02BIO	Biosensors	Z,ZK	6
BAM02FPT	Physics for Diagnostics and Therapy	Z,ZK	6
In this course, students will be introduced to the problems of locomotive organs diseases and musculoskeletal pain in the first seven lectures. Great space is devoted to electrotherapeutic methods, therapeutic ultrasound and phototherapy. Furthermore, advanced neurorehabilitation methods, especially transcranial brain stimulation methods (repetitive transcranial magnetic stimulation of the brain - rTMS, transcranial electrical stimulation of the brain - tDCS and electroconvulsive therapy - ECT) are discussed. In the second half of the semester, attention is paid to the possibilities of using ionizing electromagnetic fields in medical diagnostics and therapy (eg X-ray, proton therapy, radiotherapy, etc.).			
BAM17EMC	Introduction to electromagnetic compatibility	Z,ZK	6
The subject dwells on problems of electromagnetic compatibility. Students obtain the basic knowledges in the field of electromagnetic compatibility - electromagnetic interference, susceptibility and testing methods. The subject leads to gain professional skills in the field of electrical engineering.			
BAM17EPM	Applications of Electromagnetic Fields in Medicine	Z,ZK	6
The major aim of these lectures is to give to students a basic overview of biophysical aspects of EM fields in different biological systems, including an overview of microwave applications in medicine. Safety limits, clinical usage of EM field effects on biological systems, microwave hyperthermia, measurement of dielectric parameters of biological tissues, EM exposure of mobile phone users, magnetic resonance imaging, interaction of optical radiation with biological tissue.			
BAM31ADA	Adaptive signal processing	Z,ZK	6
This course provides a basic discourse on adaptive algorithms for filtering, decorrelation, separation and beamforming.			
BAM31AOL	Applied optoelectronics in medicine	Z,ZK	6
BAM31BSG	Biological signals	Z,ZK	6
BAM31LET	Medical Instrumentation and Devices	Z,ZK	6
Students will study fundamental principles applied within the modern medical devices and systems, esp. from the point of view of functional blocks and electronic circuits of diagnostical and therapeutical medical equipments including electrocardiographs, electroencephalographs, bedside and central monitors, equipments for anestesiology, intensive and critical healthcare, equipments for clinical laboratory, electrostimulators, cardiostimulators and defibrilators, blood pressure and flow measurement (including dilution) and pulse oxymetry.			
BAM31MOA	Modeling and analysis of brain activity	Z,ZK	6
BAM31NPG	Neurophysiology	Z,ZK	6
BAM31ZAS	Analog Signal Processing	Z,ZK	6
The course deals with analog input-output blocks for signal transmission and processing. They discussed circuit solution of amplifiers and filters, including their design process, simulation and measurement. Students learn the circuit concepts and possibilities for solving the contemporary analogue structures. The second part of the course describes the design and implementation of analog filters, including discrete-time circuits. The conclusion is devoted to the possibilities of computer optimization of electronic circuits and filters.			
BAM33NIN	Neuroinformatics	Z,ZK	6
The Neuroinformatics Course concentrates on modelling of neurons, stochastic learning on cellular level, information coding and decoding in brain and single unit processing. Examples from clinical practices are provided throughout the course. The labs focus on signal neuron analysis from human and animal brain.			
BAM33ZMO	Medical Image Processing	Z,ZK	6
This course covers the most used advanced image analysis methods, with emphasis on images from medical and biological modalities, from microscopy, to ultrasound, MRI, or CT, including time sequences.			
BAM33ZSL	Medical Imaging Systems	Z,ZK	6
The course covers the principles, design and properties of currently used medical imaging devices. We shall deal with 2D microscopic, X-ray and ultrasound imaging systems, including advanced topics such as Doppler ultrasound. We will also study tomographic (3D) imaging systems: computed tomography (CT), magnetic resonance imaging (MRI) including functional MRI (fMRI) and nuclear imaging methods (PET,SPECT). For more information see https://cw.fel.cvut.cz/wiki/courses/zsl			
BAM36BIN	Bioinformatics	Z,ZK	6
BAM38KLS	Construction of Medical Systems	Z,ZK	6
BDIP30	Diploma Thesis	Z	30
Independent final comprehensive work for the Master's degree study programme. A student will choose a topic from a range of topics related to his or her branch of study, which will be specified by branch department or branch departments. The diploma thesis will be defended in front of the board of examiners for the comprehensive final examination.			
BE4M33SSU	Statistical Machine Learning	Z,ZK	6
The aim of statistical machine learning is to develop systems (models and algorithms) for learning to solve tasks given a set of examples and some prior knowledge about the task. This includes typical tasks in speech and image recognition. The course has the following two main objectives 1. to present fundamental learning concepts such as risk minimisation,			

maximum likelihood estimation and Bayesian learning including their theoretical aspects, 2. to consider important state-of-the-art models for classification and regression and to show how they can be learned by those concepts.			
BMPROJ6	Diploma Project	Z	6

For updated information see http://bilakniha.cvut.cz/en/f3.html
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