Study plan

Name of study plan: Biomedical and Clinical Engineering

Faculty/Institute/Others:
Department:
Branch of study guaranteed by the department: Welcome page
Garantor of the study branch:
Program of study: Biomedical and Clinical Engineering
Type of study: Follow-up master full-time
Required credits: 120
Elective courses credits: 0
Sum of credits in the plan: 120
Note on the plan:

Name of the block: Compulsory courses
Minimal number of credits of the block: 99
The role of the block: Z

Code of the group: F7AMB POV 20
Name of the group: Biomedical and Clinical Engineering compulsory course
Requirement credits in the group: In this group you have to gain 99 credits
Requirement courses in the group: In this group you have to complete 16 courses
Credits in the group: 99
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
F7AMBAF	**Applied Physics** *Milan Šiňor* ***Milan Šiňor*** *Milan Šiňor (Gar.)*	Z,ZK	5	2P+2C	Z	z
F7AMBAM	**Applied Mathematics** *Karel Roubík, Martin Rožánek, Jiří Hozman, Ondřej Fišer* ***Ondřej Fišer*** *Martin Rožánek (Gar.)*	KZ	4	2P+1C	Z	z
17ABOZP	**Occupational Safety and Health, Fire Protection and First Aid** *Petr Kudrna* ***Petr Kudrna*** *Petr Kudrna (Gar.)*	Z	0	1P	Z	z
F7AMBBB	**Biomechanics and Biomaterials** *Matej Daniel, Martin Otáhal* ***Martin Otáhal*** *Matej Daniel (Gar.)*	Z,ZK	5	2P+2L	Z	z
F7AMBCZS	**Digital Signal Processing** *Marek Piorecký, Václava Piorecká, Jan Štrobl* ***Václava Piorecká*** *Václava Piorecká (Gar.)*	Z,ZK	5	2P+2C	Z	z
F7AMBDP	**Diploma Thesis** *Jakub Ráfl, Jan Vrba* ***Jakub Ráfl***	Z	30	364ZP	L	z
F7AMBSDP	**Diploma Seminar** *Jakub Ráfl* ***Martin Rožánek*** *Martin Rožánek (Gar.)*	Z	4	4C	Z	z
F7AMBELEG	**European Legislation and Management in Health Care** *Peter Kneppo, Vojtěch Kamenský, Ondřej Gajdoš* ***Vojtěch Kamenský*** *Peter Kneppo (Gar.)*	Z,ZK	5	2P+2C	Z	z
F7AMBLPT	**Medical Devices and Equipment** *Martin Rožánek, Petr Kudrna* ***Petr Kudrna*** *Martin Rožánek (Gar.)*	Z,ZK	5	2P+2L	L	z
F7AMBLZS	**Imaging Systems in Medicine** *Martin Rožánek, Jiří Hozman, Tomáš Dřížďal* ***Martin Rožánek*** *Martin Rožánek (Gar.)*	Z,ZK	5	2P+2C	L	z
F7AMBMPV	**Mathematical Methods in Research** *Jakub Ráfl* ***Jakub Ráfl*** *Karel Roubík (Gar.)*	Z,ZK	6	2P+2C	Z	z
F7AMBMAR	**Measurement and Control in Biomedicine** *Peter Kneppo, Jana Matějková, Roman Matějka* ***Roman Matějka*** *Peter Kneppo (Gar.)*	Z,ZK	5	2P+2L	L	z
F7AMBPIZ	**Methodology of Research and Information Sources** *Jakub Ráfl, Šimon Walzel* ***Jakub Ráfl*** *Jakub Ráfl (Gar.)*	KZ	5	2P+2C	L	z
F7AMBSPMM	**Software for Mathematical Modeling** *Bartoloměj Biskup* ***Bartoloměj Biskup*** *Bartoloměj Biskup (Gar.)*	Z,ZK	5	2P+2C	Z	z
F7AMBSF	**Systemic Physiology** *Ian Azarov, Ksenia Sedova* ***Pavel Kučera*** *Pavel Kučera (Gar.)*	Z,ZK	5	2P+2L	Z	z

F7AMBTANP	**Equipment for Anesthesia and Critical Care** *Karel Roubík, Václav Ort **Jakub Ráfl** Karel Roubík (Gar.)*	Z,ZK	5	2P+2L	Z	z

Characteristics of the courses of this group of Study Plan: Code=F7AMB POV 20 Name=Biomedical and Clinical Engineering compulsory course

F7AMBAF	Applied Physics	Z,ZK	5
Fundamentals of thermodynamics, the kinetic theory of gases. Transport phenomena in gases and in liquids. Electromagnetic field and interaction with matter. Electronic structure of atoms and molecules. Physics of low temperatures and superconductivity. Magnetic resonance and its application. Foundations of X-rays diffraction and X-ray structure analysis.			
F7AMBAM	Applied Mathematics	KZ	4
The course deals with the practical applications of mathematics and its demonstration with examples from the field of biomedical engineering.			
17ABOZP	Occupational Safety and Health, Fire Protection and First Aid	Z	0
F7AMBBB	Biomechanics and Biomaterials	Z,ZK	5
The aim of the course is to introduce students to the areas of biomechanics. These are circuits of clinical, sports and orthopaedic biomechanics. In particular, the students will be introduced to methods of measurement in experimental biomechanics, biomechanics of the musculoskeletal system, assessment of movement in biomechanics and rehabilitation, assessment of gait and standing still, assessment of work and performance, force and moment effects, anthropometry, material properties, loading methods, deformation and modelling of biomaterials, rheological models of tissues. Students will also learn about the areas of orthosis and prosthesis design and ergonomics in relation to biomechanics.			
F7AMBCZS	Digital Signal Processing	Z,ZK	5
The course deals with the following topics - characteristics of signals, linear time invariant systems (LTI), stationary, non-stationary signals, deterministic, ergodic and stochastic processes, description of signals in continuous and discrete domains, A/D conversions and converters, sampling and quantization problems, aliasing and Nyquist's theorem, noise suppression and data preprocessing, fast and discrete Fourier transforms, efficient FFT estimation methods, other discrete transforms: z-transform, its properties and applications in DSP, inverse transforms, poles and zeros of the system, frequency response, correlation and convolution, introduction to digital filter design, FIR and IIR filters and adaptive filters, spectral analysis and spectrum estimation methods, current methods of analysis in time and frequency domain, coherence and phase characteristics, parametric and non-parametric methods, periodogram and AR spectrum.			
F7AMBDP	Diploma Thesis	Z	30
Independent work of the student at the end of the study, when the student has to demonstrate the ability to independently and comprehensively process the given topic using the knowledge acquired during the study. The student chooses the topic of the thesis from the topics offered by the department that guarantees the study programme. The student is obliged to write the thesis at the beginning of the 4th semester. In this semester the thesis is submitted and defended. The student defends his/her thesis in front of the SZZ committee. This thesis is evaluated by the supervisor and the opponent according to the ECTS grading scale. Subsequently, the evaluation and the result of the final state examination from the thematic areas are included in one final evaluation.			
F7AMBSDP	Diploma Seminar	Z	4
The diploma seminar serves as a support for the start of work on the diploma thesis. During the semester, students present the intended aims and methods of their thesis and the partial results of their work.			
F7AMBELEG	European Legislation and Management in Health Care	Z,ZK	5
The course focuses on an overview of legislative regulations in the healthcare sector with a subsequent focus on medical devices. The course will cover theoretical and practical issues of patients' rights in healthcare, ethics in biomedicine, healthcare systems, marketing of medical devices, technical standardization systems and industrial property protection.			
F7AMBLPT	Medical Devices and Equipment	Z,ZK	5
The course develops the initial knowledge in the field of biophysics and human physiology and applies it to the problems of instrumental medical technology. In particular, the course deals with the principles of operation and current possibilities of technology in medicine. The content is chosen to be sufficient for understanding and mastering the issues in subsequent courses. The course deals with diagnostic devices, devices for monitoring and evaluation of vital functions, therapeutic devices, including equipment for specialized departments such as ICU, operating rooms, etc.			
F7AMBLZS	Imaging Systems in Medicine	Z,ZK	5
The course deals with advanced imaging techniques, which are used mainly for diagnostic purposes in clinical practice. Emphasis will be placed on the technical principle of the devices, on the possibilities and limitations of individual modalities. The issue of image reconstruction in tomographic imaging systems will also be addressed.			
F7AMBMPV	Mathematical Methods in Research	Z,ZK	6
The course deals with the following topics: methods of statistical analysis intended primarily for medical research - clinical, biological, biochemical, biophysical and other studies, methods of descriptive and inductive statistics, statistical epidemiological methods, hypothesis testing, group comparison (parametric and non-parametric methods), ANOVA, correlation and simple regression analysis, multivariate regression models, multivariate linear models, logistic regression, discriminant analysis, survival analysis etc., model calculations and interpretation of results.			
F7AMBMAR	Measurement and Control in Biomedicine	Z,ZK	5
The course deals with the following topics - measurement of electrical and non-electrical quantities using conventional laboratory instruments, industrial A/D converters and digitizing cards such as DAQ, low-cost solutions with MCUs such as Arduino, as well as factors affecting the accuracy and stability of measurements both at the level of the sensors and converters themselves, as well as the correct interpretation of these data and the expression of measurement uncertainty and calibration, Machine vision, with a focus on camera systems and standards, and the basics of image recognition, control will include the fundamentals of automation, design of state and sequential automata, addressing transport delay and design of threshold and proportional controllers, demonstrations on biomedical applications, and new trends in measurement, control and automation using FPGA and real-time gate array technology.			
F7AMBPIZ	Methodology of Research and Information Sources	KZ	5
The course deals with the following topics: characteristics of research and science, types of research, links to legislation and financial resources, research projects, grant applications and grant process; basic characteristics and specifics of a scientific text, content of individual sections; publishing practices, publication ethics, citations sources, information sources; typographic rules, mathematical typesetting, text corrections; principles for creating presentations, presentation of results in the form of tables, graphs and diagrams.			
F7AMBSPMM	Software for Mathematical Modeling	Z,ZK	5
F7AMBSF	Systemic Physiology	Z,ZK	5
The course deals with the following themes: functional organisation of living systems, basic concepts of system approach to integrated functions of the human organism, importance of systems offering the use for biomedical technicians and engineers, examples of some experimental and investigative methods and modern technologies used in physiology and medicine. Lectures contain also problem solving.			
F7AMBTANP	Equipment for Anesthesia and Critical Care	Z,ZK	5
Basic concept or resuscitation. Importance of circulation, respiration, consciousness and internal environment, their control. Equipment overview, common requirements. Specific requirements for equipment at intensive care units (ICU) and departments of anaesthesia and critical care medicine (ACCM). Blood gases, their measurement and interpretation. Modelling of the fluidic systems, parameters and properties of the fluidic models. Principles and adverse effects of artificial lung ventilation (ALV). Conventional and unconventional lung ventilation, corresponding ventilators. Equipment for anaesthesia. Anaesthetic vaporisers, their thermodynamic principles. Humidification of ventilatory gases. Equipment for monitoring and support of blood circulation. Dilution methods. Bed-side monitors. Other diagnostic and therapeutic equipment at ICU and ACCM. Design of ICU and ACCM.			

Name of the block: Compulsory elective courses

Minimal number of credits of the block: 21
The role of the block: S

Code of the group: F7AMB PV 2S 20
Name of the group: Biomedical and Clinical Engineering compulsory optional course
Requirement credits in the group: In this group you have to gain at least 10 credits (at most 18)
Requirement courses in the group: In this group you have to complete at least 3 courses (at most 5)
Credits in the group: 10
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
F7AMBBLS	**Biological Signals** *Marek Piorecký, Václava Piorecká **Václava Piorecká** Marek Piorecký (Gar.)*	ZK	3	2P	L	S
F7AMBDAE	**Design and Ergonomics of the Medical Products** *Václava Piorecká **Václava Piorecká** Václava Piorecká (Gar.)*	Z	4	4C	L	S
F7AMBKB	**Clinical Biochemistry and Laboratory Examination Methods**	Z,ZK	4	2P+2L	L	S
F7AMBPOD	**Entrepreneurship**	KZ	4	2P+2C	L	S
F7AMBTTZS	**Television, Termovision and Endoscopy Systems** *Jiří Hozman, Tomáš Dřížďal **Jiří Hozman** Jiří Hozman (Gar.)*	Z	3	1P+1L	L	S

Characteristics of the courses of this group of Study Plan: Code=F7AMB PV 2S 20 Name=Biomedical and Clinical Engineering compulsory optional course

F7AMBBLS | Biological Signals | ZK | 3

The subject deals with origins and description of the most important electric and non-electric biological signals. The principles of generation, recording and basic properties are studied in all the signals. The studied signals involve native and evoked biosignals, including biological signals of the heart, brain, muscles, nervous system, auditory signals, visual system, signals from the gastro-intestinal system etc.

F7AMBDAE | Design and Ergonomics of the Medical Products | Z | 4

The subject deals with the following topics - the concept of design and its definition, basic concepts of design theory, design classification, function of design. Design as a science, design process, design approaches, design methods. Design analysis. Design and marketing, brand policy. Perspective view, geometric forms, problems of shape perception and composition. Ergonomics - definitions, terms. The role and place of ergonomics in design. Ergonomics in the workplace. Human (patient) - its physical characteristics, dimensions, human body, sensations and perceptions, reflexes, human psychological characteristics, interpersonal relationships, voluntary act, motivation, efficiency, work organization. Handicap. Human and medical product. Aids, instruments and tools. Climate conditions. Lighting. Noise. Vibration and shock. Safety. Interior of medical facility (color, lighting, materials). Universal design / Design for all, 7 basic principles. Design of medical devices, principles of design in healthcare.

F7AMBKB | Clinical Biochemistry and Laboratory Examination Methods | Z,ZK | 4

The course deals with the following topics - biochemistry of the human organism, important metabolic and regulatory pathways and disorders of these processes, possibilities of diagnosis of these disorders and procedures of relevant laboratory tests, activities of the clinical laboratory, processing of data from methods used in clinical laboratories.

F7AMBPOD | Entrepreneurship | KZ | 4

Students will get a general overview of the company and its key functional areas. Students will be able to identify the elements of success of entrepreneurial ventures, consider the legal and financial conditions for starting a business venture, also evaluate the effectiveness of different entrepreneurial strategies. Finally students will be able to specify the basic performance indicators of entrepreneurial activity and explain the importance of marketing and management in businesses. At the end of the course students will interpret their own business plan.

F7AMBTTZS | Television, Termovision and Endoscopy Systems | Z | 3

History of television systems. Overview of television systems. Scene representation (linear transformation in 3D space, lens representation as collineation, projection). Image information (light, photometry, colorimetry, light sources, vision, quantitative description of image information, image spectrum). Television system. Physical limitations of resolution and correlation of image characteristics and system characteristics. TV system resolution. Creating video signal. Non-standard TV shooting. Black and white versus color TV system. Application of TV imaging systems in medicine. Physical quantities describing radiation and light. Physical laws for heat emitter. Principle of the operation of infrared imaging system and its diagnostic importance. Specifics of thermal imaging systems. Block diagram. Description of individual blocks and circuits. History of endoscopes. Types of endoscopes. Fundamentals of theory and practice of optical fibers. Flexible fibroscopes. Flexible video endoscopes. Light sources for flexible endoscopes. Image sensors used for endoscopes. Image processors. Monitors for video endoscopes. Endosonographic systems. Sterilization equipment. Automatic disinfectors for endoscopes. Standard procedures. Possible problems. Capsule imaging. Principle. Block arrangement. Wireless transmission and data processing. Possible complications.

Code of the group: F7AMB PV 3S 20
Name of the group: Biomedical and Clinical Engineering compulsory optional course
Requirement credits in the group: In this group you have to gain at least 11 credits (at most 32)
Requirement courses in the group: In this group you have to complete at least 3 courses (at most 9)
Credits in the group: 11
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
F7AMBAEM	**Electromagnetic Field in Medicine** *Jan Vrba, David Vrba, Tomáš Pokorný **Jan Vrba** Jan Vrba (Gar.)*	Z,ZK	3	1P+1L	Z	S
F7AMBEKH	**Economical-clinical Assessment**	Z,ZK	5	2P+2C	Z	S

F7AMBKHZP	**Clinical Trials and Assessment of Medical Devices** ***Vojtěch Kamenský***	Z,ZK	3	1P+1C	Z	S
F7AMBMTV	**Management of Hospital Technical Infrastructure** ***Petr Kudrna***	Z,ZK	4	2P+1C	Z	S
F7AMBMTB	**Fluid Mechanics in Biomedicine** ***Karel Roubík***	Z,ZK	5	2P+1C+1L	Z	S
F7AMBMZOS	**Methods and Devices for Processing, Compression and Recording of Image Signal** *Jiří Hozman, Tomáš Dřížďal, Marek Novák* ***Tomáš Dřížďal*** *Tomáš Dřížďal (Gar.)*	Z	3	1P+1C	Z	S
F7AMBPMZD	**Advanced Methods of Data Analysis and Processing** *Marek Piorecký, Václava Piorecká, Jan Štrobl* ***Václava Piorecká*** *Václava Piorecká (Gar.)*	KZ	3	1P+1C	Z	S
F7AMBRT	**Respiratory Care** *Václav Ort, Lenka Horáková* ***Lenka Horáková***	KZ	3	1P+1L	Z	S
F7AMBZMR	**Magnetic Resonance Imaging and Electrical Impedance Tomography** *Tomáš Dřížďal, David Vrba* ***David Vrba***	Z	3	1P+1L	Z	S

Characteristics of the courses of this group of Study Plan: Code=F7AMB PV 3S 20 Name=Biomedical and Clinical Engineering compulsory optional course

F7AMBAEM	Electromagnetic Field in Medicine	Z,ZK	3

The major aim of these lectures is to explain to students the present and probable future possibilities of microwave medical applications. Biological thermal and non-thermal effects of electromagnetic field as well as safety limits are discussed. Microwave thermotherapy applied to cancer and other diseases is described. Details of microwave thermotherapy apparatus are given, especially from the point of view of applicators for local, intracavitary and regional treatment.

F7AMBEKH	Economical-clinical Assessment	Z,ZK	5

In this course students will learn about the issues of economic and clinical evaluation. Students will theoretically get acquainted with cost analyses and all inputs necessary for their processing. All knowledge will be practically tested on practical examples in the exercises. The final part of the course will be devoted to the field of Health Technology Assessment and students will learn practically the structure of studies prepared in the framework of HTA.

F7AMBKHZP	Clinical Trials and Assessment of Medical Devices	Z,ZK	3

The course focuses on the process of clinical evaluation of medical devices when placing a medical device on the market. The course covers theoretical and practical issues of clinical trials, clinical evaluation using literature searches, and preclinical trials.

F7AMBMTV	Management of Hospital Technical Infrastructure	Z,ZK	4

The aim of the course is to teach students how to formulate and solve requirements in terms of ensuring the operation of technologies used in healthcare, explain the applicable legislation and manage their quality selection and service. In addition, the student will learn the principles of acquiring technologies, both medical and non-medical. In practical exercises, the learned knowledge of HB HTA will be verified by creating a simulated example of a healthcare facility to which technologies will be procured. In two term papers, students first design the technology to be acquired using HB HTA and then "tender" it in a selection process.

F7AMBMTB	Fluid Mechanics in Biomedicine	Z,ZK	5

The course deals with the following topics - modelling and measurement of fluid flow in respiratory care and cardiovascular system, creation of models of respiratory and cardiovascular system, application of fluid mechanics principles in research and development as well as in clinical practice.

F7AMBMZOS	Methods and Devices for Processing, Compression and Recording of Image Signal	Z	3

The course deals with the following topics: general image processing system, basics of image acquisition using image sensors, sampling, quantization and representation of digital images, aliasing, transfer properties of the imaging system, color image acquisition, overview of image formats, digitizing rasters, video signal, A/D video signal converters, frame-grabber. HW and SW for image processing, compression methods, compression standards, signal recording methods, digital signal recording, selected recording standards for image recording, specifics for applications in clinical practice.

F7AMBPMZD	Advanced Methods of Data Analysis and Processing	KZ	3

This course comprehends/deals methods of biosignal generation, biosignal acquisition and basic parameters of biosignals required for diagnostics. Methods and algorithms for biosignal processing, analysis and evaluation used for biological signals, mainly electrophysiological signals. Preprocessing, filtering, time and frequency analysis. Use of modern spectral analysis methods. Visualisation of results, topographic mapping, method of compressed spectral arrays (CSA). Adaptive segmentation of non-stationary signals is discussed. Application of methods using artificial intelligence. Methods of automated signal classification - supervised/unsupervised, cluster analysis, learning classifier. Artificial neural networks (ANN). Practical application of biosignal processing. Case studies of ANN application on epileptogenic recordings and neural recordings in general. Genetic algorithms and simulated annealing is presented.

F7AMBRT	Respiratory Care	KZ	3

The aim of the course is to provide students with a comprehensive knowledge of the technical provision of respiratory therapy, current protective ventilation modes and techniques and unconventional techniques of artificial lung ventilation. Attention is also given to monitoring artificial pulmonary ventilation and the use of respiratory system models in ventilators and ventilation monitors.

F7AMBZMR	Magnetic Resonance Imaging and Electrical Impedance Tomography	Z	3

The course deals with the following topics: nuclear magnetic resonance and electrical impedance tomography, theoretical foundations, principles of imaging methods and their use in clinical practice with respect to the limitations of technical parameters.

List of courses of this pass:

Code	Name of the course	Completion	Credits
17ABOZP	Occupational Safety and Health, Fire Protection and First Aid	Z	0
F7AMBAEM	Electromagnetic Field in Medicine	Z,ZK	3

The major aim of these lectures is to explain to students the present and probable future possibilities of microwave medical applications. Biological thermal and non-thermal effects of electromagnetic field as well as safety limits are discussed. Microwave thermotherapy applied to cancer and other diseases is described. Details of microwave thermotherapy apparatus are given, especially from the point of view of applicators for local, intracavitary and regional treatment.

F7AMBAF	Applied Physics	Z,ZK	5
Fundamentals of thermodynamics, the kinetic theory of gases. Transport phenomena in gases and in liquids. Electromagnetic field and interaction with matter. Electronic structure of atoms and molecules. Physics of low temperatures and superconductivity. Magnetic resonance and its application. Foundations of X-rays diffraction and X-ray structure analysis.			
F7AMBAM	Applied Mathematics	KZ	4
The course deals with the practical applications of mathematics and its demonstration with examples from the field of biomedical engineering.			
F7AMBBB	Biomechanics and Biomaterials	Z,ZK	5
The aim of the course is to introduce students to the areas of biomechanics. These are circuits of clinical, sports and orthopaedic biomechanics. In particular, the students will be introduced to methods of measurement in experimental biomechanics, biomechanics of the musculoskeletal system, assessment of movement in biomechanics and rehabilitation, assessment of gait and standing still, assessment of work and performance, force and moment effects, anthropometry, material properties, loading methods, deformation and modelling of biomaterials, rheological models of tissues. Students will also learn about the areas of orthosis and prosthesis design and ergonomics in relation to biomechanics.			
F7AMBBLS	Biological Signals	ZK	3
The subject deals with origins and description of the most important electric and non-electric biological signals. The principles of generation, recording and basic properties are studied in all the signals. The studied signals involve native and evoked biosignals, including biological signals of the heart, brain, muscles, nervous system, auditory signals, visual system, signals from the gastro-intestinal system etc.			
F7AMBCZS	Digital Signal Processing	Z,ZK	5
The course deals with the following topics - characteristics of signals, linear time invariant systems (LTI), stationary, non-stationary signals, deterministic, ergodic and stochastic processes, description of signals in continuous and discrete domains, A/D conversions and converters, sampling and quantization problems, aliasing and Nyquist's theorem, noise suppression and data preprocessing, fast and discrete Fourier transforms, efficient FFT estimation methods, other discrete transforms: z-transform, its properties and applications in DSP, inverse transforms, poles and zeros of the system, frequency response, correlation and convolution, introduction to digital filter design, FIR and IIR filters and adaptive filters, spectral analysis and spectrum estimation methods, current methods of analysis in time and frequency domain, coherence and phase characteristics, parametric and non-parametric methods, periodogram and AR spectrum.			
F7AMBDAE	Design and Ergonomics of the Medical Products	Z	4
The subject deals with the following topics - the concept of design and its definition, basic concepts of design theory, design classification, function of design. Design as a science, design process, design approaches, design methods. Design analysis. Design and marketing, brand policy. Perspective view, geometric forms, problems of shape perception and composition. Ergonomics - definitions, terms. The role and place of ergonomics in design. Ergonomics in the workplace. Human (patient) - its physical characteristics, dimensions, human body, sensations and perceptions, reflexes, human psychological characteristics, interpersonal relationships, voluntary act, motivation, efficiency, work organization. Handicap. Human and medical product. Aids, instruments and tools. Climate conditions. Lighting. Noise. Vibration and shock. Safety. Interior of medical facility (color, lighting, materials). Universal design / Design for all, 7 basic principles. Design of medical devices, principles of design in healthcare.			
F7AMBDP	Diploma Thesis	Z	30
Independent work of the student at the end of the study, when the student has to demonstrate the ability to independently and comprehensively process the given topic using the knowledge acquired during the study. The student chooses the topic of the thesis from the topics offered by the department that guarantees the study programme. The student is obliged to write the thesis at the beginning of the 4th semester. In this semester the thesis is submitted and defended. The student defends his/her thesis in front of the SZZ committee. This thesis is evaluated by the supervisor and the opponent according to the ECTS grading scale. Subsequently, the evaluation and the result of the final state examination from the thematic areas are included in one final evaluation.			
F7AMBEKH	Economical-clinical Assessment	Z,ZK	5
In this course students will learn about the issues of economic and clinical evaluation. Students will theoretically get acquainted with cost analyses and all inputs necessary for their processing. All knowledge will be practically tested on practical examples in the exercises. The final part of the course will be devoted to the field of Health Technology Assessment and students will learn practically the structure of studies prepared in the framework of HTA.			
F7AMBELEG	European Legislation and Management in Health Care	Z,ZK	5
The course focuses on an overview of legislative regulations in the healthcare sector with a subsequent focus on medical devices. The course will cover theoretical and practical issues of patients' rights in healthcare, ethics in biomedicine, healthcare systems, marketing of medical devices, technical standardization systems and industrial property protection.			
F7AMBKB	Clinical Biochemistry and Laboratory Examination Methods	Z,ZK	4
The course deals with the following topics - biochemistry of the human organism, important metabolic and regulatory pathways and disorders of these processes, possibilities of diagnosis of these disorders and procedures of relevant laboratory tests, activities of the clinical laboratory, processing of data from methods used in clinical laboratories.			
F7AMBKHZP	Clinical Trials and Assessment of Medical Devices	Z,ZK	3
The course focuses on the process of clinical evaluation of medical devices when placing a medical device on the market. The course covers theoretical and practical issues of clinical trials, clinical evaluation using literature searches, and preclinical trials.			
F7AMBLPT	Medical Devices and Equipment	Z,ZK	5
The course develops the initial knowledge in the field of biophysics and human physiology and applies it to the problems of instrumental medical technology. In particular, the course deals with the principles of operation and current possibilities of technology in medicine. The content is chosen to be sufficient for understanding and mastering the issues in subsequent courses. The course deals with diagnostic devices, devices for monitoring and evaluation of vital functions, therapeutic devices, including equipment for specialized departments such as ICU, operating rooms, etc.			
F7AMBLZS	Imaging Systems in Medicine	Z,ZK	5
The course deals with advanced imaging techniques, which are used mainly for diagnostic purposes in clinical practice. Emphasis will be placed on the technical principle of the devices, on the possibilities and limitations of individual modalities. The issue of image reconstruction in tomographic imaging systems will also be addressed.			
F7AMBMAR	Measurement and Control in Biomedicine	Z,ZK	5
The course deals with the following topics - measurement of electrical and non-electrical quantities using conventional laboratory instruments, industrial A/D converters and digitizing cards such as DAQ, low-cost solutions with MCUs such as Arduino, as well as factors affecting the accuracy and stability of measurements both at the level of the sensors and converters themselves, as well as the correct interpretation of these data and the expression of measurement uncertainty and calibration, Machine vision, with a focus on camera systems and standards, and the basics of image recognition, control will include the fundamentals of automation, design of state and sequential automata, addressing transport delay and design of threshold and proportional controllers, demonstrations on biomedical applications, and new trends in measurement, control and automation using FPGA and real-time gate array technology.			
F7AMBMPV	Mathematical Methods in Research	Z,ZK	6
The course deals with the following topics: methods of statistical analysis intended primarily for medical research - clinical, biological, biochemical, biophysical and other studies, methods of descriptive and inductive statistics, statistical epidemiological methods, hypothesis testing, group comparison (parametric and non-parametric methods), ANOVA, correlation and simple regression analysis, multivariate regression models, multivariate linear models, logistic regression, discriminant analysis, survival analysis etc., model calculations and interpretation of results.			
F7AMBMTB	Fluid Mechanics in Biomedicine	Z,ZK	5
The course deals with the following topics - modelling and measurement of fluid flow in respiratory care and cardiovascular system, creation of models of respiratory and cardiovascular system, application of fluid mechanics principles in research and development as well as in clinical practice.			

F7AMBMTV	Management of Hospital Technical Infrastructure	Z,ZK	4
The aim of the course is to teach students how to formulate and solve requirements in terms of ensuring the operation of technologies used in healthcare, explain the applicable legislation and manage their quality selection and service. In addition, the student will learn the principles of acquiring technologies, both medical and non-medical. In practical exercises, the learned knowledge of HB HTA will be verified by creating a simulated example of a healthcare facility to which technologies will be procured. In two term papers, students first design the technology to be acquired using HB HTA and then "tender" it in a selection process.			
F7AMBMZOS	Methods and Devices for Processing, Compression and Recording of Image Signal	Z	3
The course deals with the following topics: general image processing system, basics of image acquisition using image sensors, sampling, quantization and representation of digital images, aliasing, transfer properties of the imaging system, color image acquisition, overview of image formats, digitizing rasters, video signal, A/D video signal converters, frame-grabber. HW and SW for image processing, compression methods, compression standards, signal recording methods, digital signal recording, selected recording standards for image recording, specifics for applications in clinical practice.			
F7AMBPIZ	Methodology of Research and Information Sources	KZ	5
The course deals with the following topics: characteristics of research and science, types of research, links to legislation and financial resources, research projects, grant applications and grant process; basic characteristics and specifics of a scientific text, content of individual sections; publishing practices, publication ethics, citations sources, information sources; typographic rules, mathematical typesetting, text corrections; principles for creating presentations, presentation of results in the form of tables, graphs and diagrams.			
F7AMBPMZD	Advanced Methods of Data Analysis and Processing	KZ	3
This course comprehends/deals methods of biosignal generation, biosignal acquisition and basic parameters of biosignals required for diagnostics. Methods and algorithms for biosignal processing, analysis and evaluation used for biological signals, mainly electrophysiological signals. Preprocessing, filtering, time and frequency analysis. Use of modern spectral analysis methods. Visualisation of results, topographic mapping, method of compressed spectral arrays (CSA). Adaptive segmentation of non-stationary signals is discussed. Application of methods using artificial intelligence. Methods of automated signal classification - supervised/unsupervised, cluster analysis, learning classifier. Artificial neural networks (ANN). Practical application of biosignal processing. Case studies of ANN application on epileptogenic recordings and neural recordings in general. Genetic algorithms and simulated annealing is presented.			
F7AMBPOD	Entrepreneurship	KZ	4
Students will get a general overview of the company and its key functional areas. Students will be able to identify the elements of success of entrepreneurial ventures, consider the legal and financial conditions for starting a business venture, also evaluate the effectiveness of different entrepreneurial strategies. Finally students will be able to specify the basic performance indicators of entrepreneurial activity and explain the importance of marketing and management in businesses. At the end of the course students will interpret their own business plan.			
F7AMBRT	Respiratory Care	KZ	3
The aim of the course is to provide students with a comprehensive knowledge of the technical provision of respiratory therapy, current protective ventilation modes and techniques and unconventional techniques of artificial lung ventilation. Attention is also given to monitoring artificial pulmonary ventilation and the use of respiratory system models in ventilators and ventilation monitors.			
F7AMBSDP	Diploma Seminar	Z	4
The diploma seminar serves as a support for the start of work on the diploma thesis. During the semester, students present the intended aims and methods of their thesis and the partial results of their work.			
F7AMBSF	Systemic Physiology	Z,ZK	5
The course deals with the following themes: functional organisation of living systems, basic concepts of system approach to integrated functions of the human organism, importance of systems offering the use for biomedical technicians and engineers, examples of some experimental and investigative methods and modern technologies used in physiology and medicine. Lectures contain also problem solving.			
F7AMBSPMM	Software for Mathematical Modeling	Z,ZK	5
F7AMBTANP	Equipment for Anesthesia and Critical Care	Z,ZK	5
Basic concept or resuscitation. Importance of circulation, respiration, consciousness and internal environment, their control. Equipment overview, common requirements. Specific requirements for equipment at intensive care units (ICU) and departments of anaesthesia and critical care medicine (ACCM). Blood gases, their measurement and interpretation. Modelling of the fluidic systems, parameters and properties of the fluidic models. Principles and adverse effects of artificial lung ventilation (ALV). Conventional and unconventional lung ventilation, corresponding ventilators. Equipment for anaesthesia. Anaesthetic vaporisers, their thermodynamic principles. Humidification of ventilatory gases. Equipment for monitoring and support of blood circulation. Dilution methods. Bed-side monitors. Other diagnostic and therapeutic equipment at ICU and ACCM. Design of ICU and ACCM.			
F7AMBTTZS	Television, Termovision and Endoscopy Systems	Z	3
History of television systems. Overview of television systems. Scene representation (linear transformation in 3D space, lens representation as collineation, projection). Image information (light, photometry, colorimetry, light sources, vision, quantitative description of image information, image spectrum). Television system. Physical limitations of resolution and correlation of image characteristics and system characteristics. TV system resolution. Creating video signal. Non-standard TV shooting. Black and white versus color TV system. Application of TV imaging systems in medicine. Physical quantities describing radiation and light. Physical laws for heat emitter. Principle of the operation of infrared imaging system and its diagnostic importance. Specifics of thermal imaging systems. Block diagram. Description of individual blocks and circuits. History of endoscopes. Types of endoscopes. Fundamentals of theory and practice of optical fibers. Flexible fibroscopes. Flexible video endoscopes. Light sources for flexible endoscopes. Image sensors used for endoscopes. Image processors. Monitors for video endoscopes. Endosonographic systems. Sterilization equipment. Automatic disinfectors for endoscopes. Standard procedures. Possible problems. Capsule imaging. Principle. Block arrangement. Wireless transmission and data processing. Possible complications.			
F7AMBZMR	Magnetic Resonance Imaging and Electrical Impedance Tomography	Z	3
The course deals with the following topics: nuclear magnetic resonance and electrical impedance tomography, theoretical foundations, principles of imaging methods and their use in clinical practice with respect to the limitations of technical parameters.			

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