Study plan

Name of study plan: Biomedical Technician - full time study in English

Faculty/Institute/Others:
Department:
Branch of study guaranteed by the department: Welcome page
Garantor of the study branch:
Program of study: Biomedical and Clinical Technology (study in english language)
Type of study: Bachelor full-time
Required credits: 180
Elective courses credits: 0
Sum of credits in the plan: 180
Note on the plan:

Name of the block: Compulsory courses
Minimal number of credits of the block: 170
The role of the block: Z

Code of the group: 17ABB POV 17
Name of the group: Biomedical Technician AJ compulsory course 17
Requirement credits in the group: In this group you have to gain 170 credits
Requirement courses in the group: In this group you have to complete 52 courses
Credits in the group: 170
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
17ABBALP	**Algorithmic and Programming Theory** ***Pavel Smrčka***	KZ	4	2P+2C	Z	z
17ABBAF1	**Anatomy and Physiology I** ***Yulia Čuprová***	Z,ZK	5	2P+1S+1L	Z	z
17ABBAF2	**Anatomy and Physiology II** *Yulia Čuprová* ***Yulia Čuprová***	Z,ZK	5	2P+1S+1L	L	z
17ABBA3A	**English Language IIIA (part 1)** *Eva Motyčková* ***Eva Motyčková*** *Eva Motyčková (Gar.)*	KZ	2	2S	Z	z
17ABBA3B	**English III.** ***Eva Motyčková***	KZ	2	2S	L	z
17ABBBP	**Bachelor Thesis** ***Petr Kudrna***	Z	8	8L	L	z
17ABOZP	**Occupational Safety and Health, Fire Protection and First Aid** *Petr Kudrna* ***Petr Kudrna*** *Petr Kudrna (Gar.)*	Z	0	1P	Z	z
17ABBBCH	**Biochemistry** *Karel Kotaška, Iveta Horáčková* ***Iveta Horáčková*** *Iveta Horáčková (Gar.)*	KZ	2	1P+1L	L	z
17ABBBLS	**Biological Signals** *Marek Piorecký, Vladimír Krajča, Václava Piorecká* ***Václava Piorecká*** *Vladimír Krajča (Gar.)*	Z,ZK	4	2P+2C	L	z
17ABBBLG	**Biology**	Z,ZK	4	2P+2L	Z	z
17ABBBB	**Biomechanics and Biomaterials** *Patrik Kutílek, Petr Volf, Matej Daniel* ***Petr Volf*** *Matej Daniel (Gar.)*	Z,ZK	4	2P+2L	Z	z
17ABBBOZP	**Safety Regulations and Standards in Electrical Engineering** ***Petr Kudrna***	Z	1	1P	Z	z
17ABBCHM	**Chemistry** ***Iveta Horáčková***	Z,ZK	4	2P+1C+1L	L	z
17ABBEM	**Electrical Measurements** *Jan Vrba* ***Jan Vrba*** *Jan Vrba (Gar.)*	Z,ZK	4	2P+2L	Z	z
17ABBELFA	**Electrophysiology** *Ksenia Sedova* ***Ksenia Sedova*** *Ksenia Sedova (Gar.)*	Z,ZK	2	1P+1L	Z	z
17ABBEO	**Electronic Circuits** *Pavel Máša, Jan Uhlíř* ***Tomáš Dřížďal*** *Jan Uhlíř (Gar.)*	Z,ZK	4	2P+2C	Z	z
17ABBESL	**Electronic Elements and Sensors in Medicine** *David Vrba* ***David Vrba*** *David Vrba (Gar.)*	Z,ZK	4	2P+2L	L	z

17ABBEBI	**Ethics in Biomedical Engineering** ***Václav Navrátil***	KZ	2	2P	Z	z
17ABBFY1	**Physics I**	Z,ZK	5	2P+1S+1L	Z	z
17ABBFY2	**Physics II**	Z,ZK	5	2P+1S+1L	L	z
17ABBFCH	**Physical Chemistry** *Karel Roubík, Libor Holík* ***Iveta Horáčková*** *Karel Roubík (Gar.)*	Z,ZK	4	2P+1S+1L	Z	z
17ABBISZ	**Information Systems in Health Care** *Zoltán Szabó, David Jirsa, Michal Reimer* ***Zoltán Szabó*** *Zoltán Szabó (Gar.)*	Z,ZK	4	2P+2C	Z	z
17ABBITT	**Information Technology and Telemedicine**	ZK	2	2P	Z	z
17ABBITP	**Integral Calculus**	Z,ZK	5	2P+2C	L	z
17ABBKZS	**Conventional Imaging Systems** *Jiří Hozman, Tomáš Dřížďal, Martin Rožánek, Martin Čapek* ***Jiří Hozman*** *Jiří Hozman (Gar.)*	Z,ZK	4	2P+2C	L	z
17ABBLT	**Clinical Laboratory Instrumentation** *Iveta Horáčková, Martina Turchichová, Stanislav Gajdoš* ***Iveta Horáčková*** *Martina Turchichová (Gar.)*	Z,ZK	4	2P+2L	L	z
17ABBLTR	**Medical Terminology** ***Václav Navrátil***	Z	1	1P	Z	z
17ABBLPZ1	**Medical Devices & Equipment** *Petr Kudrna, Karel Roubík* ***Petr Kudrna*** *Karel Roubík (Gar.)*	Z,ZK	4	2P+2L	Z	z
17ABBLPZ2	**Medical Devices and Equipments (Therapeutical Devices)** *Petr Kudrna, Lenka Horáková* ***Petr Kudrna***	Z,ZK	4	2P+2L	L	z
17ABBLAD	**Linear Algebra and Differential Calculus**	Z,ZK	4	2P+2S	Z	z
17ABBMAZ	**Management and Administration in Healthcare** *Václav Navrátil* ***Václav Navrátil***	KZ	1	1P	L	z
17ABBMZT	**Management of Health Care Technology** *Jiří Hozman, Václav Bláha* ***Jiří Hozman*** *Jiří Hozman (Gar.)*	Z,ZK	2	1P+1S	L	z
17ABBMEC	**Mechanics** *Patrik Kutílek* ***Patrik Kutílek*** *Patrik Kutílek (Gar.)*	Z,ZK	4	2P+2L	L	z
17ABBMVP	**Research Methodology** ***Jakub Ráfl***	KZ	2	1P+1S	Z	z
17ABBMS	**Modelling and Simulation** *Václav Petrák* ***Václav Petrák*** *Václav Petrák (Gar.)*	Z,ZK	4	2P+2C	L	z
17ABBNMP	**Project Proposal and Management** *Václav Bláha* ***Václav Bláha***	KZ	2	1P+1C	L	z
17ABBOIZ	**Protection Against Effects of Ionizing Radiation** *Tomáš Veselský* ***Tomáš Veselský***	KZ	2	2P	L	z
17ABBPPSA	**Patient and Device Simulators and Testers** *Petr Kudrna, Jiří Hozman, Martin Rožánek, Lenka Horáková* ***Petr Kudrna*** *Petr Kudrna (Gar.)*	Z,ZK	4	2P+2L	Z	z
17ABBPPM	**Programming in Matlab** ***Zoltán Szabó***	KZ	2	2C	Z	z
17ABBPNK	**Design and Construction of Medical Devices/Practical Exercises** *Jana Štěpanovská, Roman Matějka* ***Roman Matějka*** *Roman Matějka (Gar.)*	KZ	2	2L	Z	z
17ABBPMS	**Probability and Mathematical Statistics** *Marek Piorecký, Filip Černý, Jan Štrobl* ***Filip Černý*** *Marek Piorecký (Gar.)*	Z,ZK	4	2P+2C	Z	z
17ABBPP	**First Aid** *Martin Staněk* ***Martin Staněk***	KZ	2	1P+1C	L	z
17ABBPSL	**Psychology** ***Jiří Hozman***	KZ	2	1P+1S	Z	z
17ABBROP	**Guided Practical Training** ***Petr Kudrna***	Z	0	100XH	L	z
17ABBSPR2	**Semestral Project II.** *Petr Kudrna* ***Hana Děcká*** *Petr Kudrna (Gar.)*	KZ	4	4S	Z	z
17ABBSEL	**Power Engineering** *David Vrba, Jiří Hozman* ***Jiří Hozman*** *Jiří Hozman (Gar.)*	Z,ZK	4	2P+2L	L	z
17ABBSPT	**Equipments for Anaesthesiology and Resuscitation** *Jakub Ráfl, Karel Roubík* ***Jakub Ráfl***	Z,ZK	4	1P+1L	L	z
17ABBTEL	**Theory of Electrical Engineering** *Pavel Máša* ***Pavel Máša*** *Pavel Máša (Gar.)*	Z,ZK	4	2P+2L	L	z
17ABBTZS	**Tomographical Imaging Systems** *Jiří Hozman, Tomáš Dřížďal, Martin Rožánek* ***Jiří Hozman*** *Jiří Hozman (Gar.)*	Z,ZK	4	2P+2C	Z	z
17ABBUSS	**Introduction to Signals and Systems** ***Jan Kauler***	Z,ZK	4	2P+2C	Z	z
17ABBZPD	**Fundamentals of Pathology, Hygiene and Epidemiology** *Leoš Navrátil, Richard Becke* ***Leoš Navrátil*** *Leoš Navrátil (Gar.)*	ZK	4	3P	L	z
17ABBZLN	**Legislation in Health Care and Technical Standards** *Ondřej Gajdoš, Vojtěch Kamenský, Peter Kneppo, Anna Erfányuková* ***Vojtěch Kamenský*** *Peter Kneppo (Gar.)*	KZ	2	1P+1S	Z	z

Characteristics of the courses of this group of Study Plan: Code=17ABB POV 17 Name=Biomedical Technician AJ compulsory course 17

17ABBALP	Algorithmic and Programming Theory	KZ	4
Algorithm, data structures. Identifiers, data types. assignment statement, conditional statement, cycles. Arithmetical and logical operations. Digital representation of numbers, numeration systems. Introduction to structured programming in C language - building and structure of simple programs, creating of the user functions, user input and output, file management, memory management. Practical overview of programming techniques and basic algorithms in C language. Recursive and iterative methods, measuring algorithm quality. Abstract data-types, data sorting and searching, implementation of basic numerical algorithms. Introduction to biomedical data processing - programmers view. Introduction to software engineering.			
17ABBAF1	Anatomy and Physiology I	Z,ZK	5
Anatomy and physiology I covers functional aspects of particular organs and their systems.			
17ABBAF2	Anatomy and Physiology II	Z,ZK	5
Anatomy and physiology II links to Anatomy and Physiology I. The subject covers functional aspects of particular organs and their systems.			
17ABBA3A	English Language IIIA (part 1)	KZ	2
The aim of the course is to increase students' language competence in academic English and professional vocabulary, along with common communication skills - writing summaries, preparing presentations for meetings. Students should be able to work actively with academic text, understand and be able to use basic terminology, be aware of the different stylistic levels of English and the associated syntactic and lexical devices.			
17ABBA3B	English III.	KZ	2
Academic and professional English			
17ABBBP	Bachelor Thesis	Z	8
Individual student projects at the end of bachelor studies. Topics are selected during the 5th term from a list. Bachelor thesis is defended at the end of the examination period. Bachelor thesis defence is a part of the state exam. Bachelor thesis can be written and defended either Czech or English. Students are supervised by a tutor during the above mentioned process.			
17ABOZP	Occupational Safety and Health, Fire Protection and First Aid	Z	0
17ABBBCH	Biochemistry	KZ	2
Course participants will be introduced to the basics of Biochemistry. The course builds on the knowledge gained in general chemistry and extends this knowledge about the chemistry of living systems. The interpretation goes through the basic building structures of biological systems (amino acids, peptides, proteins, lipids, carbohydrates, nucleic acids), biological membranes and molecular genetics to the most important metabolic processes. Particular attention is paid to the aspects necessary for understanding the methods of work in the biochemical and clinical laboratory, which are part of the follow-up chemical discipline. The laboratories are focused on broadening the topics discussed in the lectures and their practical training, especially on the determination of biomolecules and the verification of their properties. Students should become familiar with the basic laboratory techniques of Biochemistry.			
17ABBBLS	Biological Signals	Z,ZK	4
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. Advanced methods of digital biosignal processing,spectrum analysis, modern methods of artificial intelligence, features extraction, automatic classification, graphic presentation of results. Adaptive segmentation, artificial neural networks for signal procesing.			
17ABBBLG	Biology	Z,ZK	4
Basic information about the cellular level of organisms - from acelullar through prokaryotic to eukaryotic. The viruses. Prokaryotic cells. Bacteria. Bacterial diseases and their control. Eukaryotic cells. Plant and animal cell structure and function. Structure and conformation of biopolymers (nucleid acids and proteins). The nucleus, plastids, mitochondria. Cytoplasm. Endomembrane system: endoplasmic reticulum, the Golgi apparatus, lysosomes, vacuoles. Semiautonomic organelles: mitochondria, sites of respiration and chloroplasts, sites of photosynthesis. The origin of eukaryotes: endosymbiotic hypothesis. Ribosomes. The cytoskeleton: microtubules, microfilaments. The cell cycle: mitotic (M) phase and interphase (G1, S and G2 phases). The division of cell nucleus - amitosis, mitosis, phases of mitosis, the mitotic spindle; meiosis. The cell division - cytokinesis. Cell differentiation. Cell death. Apoptosis and necrosis. Mendelian and modern genetics: structure, function and inheritance of genes. Includes the chemistry and structure of chromatin and chromosomes. Animal tissue histology. Animal cells and tissues. Human genetics. Chromosomal aberrations, genetic disorders and diseases. Genetic engineering. GMO organisms.			
17ABBBB	Biomechanics and Biomaterials	Z,ZK	4
Introduce to biomechanics, Biomaterials, rheological models, Mechanic characteristic of bones, ligaments, tendons, muscles and cartilages, Endoprothesis and exoprotesis, Biomechanics of movement, gait mechanics, Kinematics and dynamics in biomechanics, Mechanical work an power of body, Stress and deformation, Finite element method. Intelligent prostheses.			
17ABBBOZP	Safety Regulations and Standards in Electrical Engineering	Z	1
Basic safety regulations, training and examinations from the sections of the regulation No. 50/1978 Coll. and instructions concerning the laboratory experiments based on the electrical devices. Factors determining electrical shock injury. Symbols and labeling in electrotechnology - safety colors importance, safety geometrical shape importance, examples of the safety legends, examples of the safety tables, graphical signs on the electrical devices, letter conductor labeling, AC nominal voltages, maximum values of the available current, short circuit and overloading protection, safety of the electrical devices - safety classes, periodical inspection and check of the electrical devices and hand tools, important norms, first aid in cases of electrical shock. Relationship of the law and safety regulations. Risk analysis in the field of electrotechnology. Special qualification in electrotechnology - regulation No. 50/1978 Coll. Validity based on the electrotechnology qualification and directive "B". Lasers safety regulations.			
17ABBCHM	Chemistry	Z,ZK	4
Introduction to chemistry, categorization and properties of substances, chemical bonds, chemical reactions, elements in periodic table, organic chemistry fundamentals, natural substances, polymers, analytical methods - instrumental analysis, chemical calculations, chemical equations			
17ABBEM	Electrical Measurements	Z,ZK	4
Measuring of electric values, principles, using, and parameters. Analogue measuring converters. Electromechanical measuring devices. Current and potential measuring. Frequency and shift phase measuring. Electric work and electric power measuring: direct current, single-phase and three-phase current. Electrical resistance and impedance measuring. Magnetic measuring. Analogue scope. Digitalization, digital signal processing, signal reconstruction. Electronic measuring devices: multimeter, digital scope. Optoelectronic measuring device.			
17ABBELFA	Electrophysiology	Z,ZK	2
The study subject links to Anatomy and Physiology II and is dedicated to excitable tissues (muscles and neural system) in the terms of signal generation, measuring possibilities and exploitation of changes in electrical parameters. Signal generation is explained at cellular and molecular levels, different software simulations are employed. From the methodological point of view, measurements of electrical parameters are described at all levels - cells, tissues, organs. Exploitation of electrical parameters of cells, tissues and organs is treated from both clinical and experimental points. Methods to use electrical field or stimulation for medical purposes are described. Besides lectures, practical classes focused on independent study of students are incorporated into the syllabus.			
17ABBEO	Electronic Circuits	Z,ZK	4
Amplifiers - basic concepts. Feedback networks. Ideal operational amplifier - important networks. Practical operational amplifier - DC parameters, frequency response, transient response. DC voltage sources - rectifiers and voltage regulators. DC/DC voltage converters - charge pump, inverting, buck, boost. Non-linear and regenerative circuits - comparators, flip-flops, multivibrators, oscillators. Combinational logic functions and logic gates. Karnaugh maps, logic tables. Sequential logic circuits. Logic integrated circuits (IC) - basic parameters, input and output characteristics, logic circuit families. Semiconductor memories. Digital signal processing - sampling theorem, quantization, number representation. A/D and D/A converters.			
17ABBESL	Electronic Elements and Sensors in Medicine	Z,ZK	4
This subject provides information about basic electronic devices - sensors, describes their operation principle, basic circuit configuration and application. The stress is aid mainly on clarifying of basic principles and practical utilization. Integral part of this course is basic information about sensors of non-electric quantities and their read-out circuits eg. strain related sensors (force, pressure, torque, vibration, displacement, acceleration etc.) magnetic field sensors, temperature sensors, chemical sensors, optical sensors and biosensors. The stress is aid on miniaturization, integration and application in biomedicine.			

17ABBEBI	Ethics in Biomedical Engineering	KZ	2
The course introduces students to basic ethical issues in applied ethics due to a future career orientation. It develops students' ability to think in ethical contexts, discuss, argue and defend their views in ethical dilemma situations which brings medical environment.			
17ABBFY1	Physics I	Z,ZK	5
Physics I course will allow students to acquire and strengthen knowledge in these branches of physics: mechanics, thermodynamics and solid state physics. We focus on solid theoretical bases, but independent work in student labs as well as solving practical examples are also important parts of the course. Through the course we also touch the limits of the classical Physics.			
17ABBFY2	Physics II	Z,ZK	5
The Physics II course introduces fundamentals and applications of electromagnetic fields. The covered topics include electromagnetic interaction, electric field, magnetic field, electromagnetic field, Maxwell's equations, electromagnetic radiation, fundamentals of quantum physics, atomic nucleus and elementary particles, and interaction of radiation with matter.			
17ABBFCH	Physical Chemistry	Z,ZK	4
Mixtures of compounds. Vapour and vaporisation. Electrodes. Electrochemical potential, electrodes. Referent and measuring electrodes, ECG, EEG and EMG electrodes. Redox potential. Inert electrodes. Membranes. Osmotic pressure. Ion-sensitive electrodes. Acidity. Measurement of pH, pO2, pCO2. Electrolysis and its application. Corrosion and protection of implants. Other amalytical methods based on principles of physical chemistry.			
17ABBISZ	Information Systems in Health Care	Z,ZK	4
Lectures are oriented on medical informatics definition and basic characteristic of the different specialized areas. The relations between IS and health care structure, financing and controlling are analyzed as well. Some basic information technology, HW and SW tools are described in relation to IS design. A special attention is paid to medical data coding and interpretation, data and communication standards. Different types and features of clinical and hospital IS, decision support systems and regional health care IS are analyzed and discussed. Methodology of IS development, implementation and support are presented as well.			
17ABBITT	Information Technology and Telemedicine	ZK	2
Computer history, structure of computers, motherboard, processors, memody, graphical card, computer buses, BIOS, I/O devices, server, desktop, notebook, pocket PC, data storage, mobile devices, memory card, OS, tasks and memory management, printers scanner, multimedial devices, mass data storage, multitasking, multiprocessoring, set of instruction, assembler, programming languages, power test, network, LAN, WAN, interner, TCP/IP, HTTP, FTP etc., client-server, gate, router, using IT in medicine and telemedicine.			
17ABBITP	Integral Calculus	Z,ZK	5
The subject is an introduction to integral calculus and integral transforms. Integral calculus: anti-derivative, indefinite integral, properties and methods of integration (integration by parts and by substitution, partial fractions), definite integral, properties, Newton-Leibnitz fundamental theorem, simple applications of both indefinite and definite integrals, improper integral, solving differential equations (ODEs) (1st order ODEs with separable variables, linear 1st order homogenous as well as non-homogenous ODEs, 2nd order linear homogenous and non-homogenous ODEs with constant coefficients),intro to multiple integrals, particularly double integral and applications. Integral transforms: Laplace transform and inverse Laplace transform and their application for solving nth order linear ODEs with constant coefficients. Z-transform and inverse Z-transform, their application for solving nth order linear difference equations.			
17ABBKZS	Conventional Imaging Systems	Z,ZK	4
Electromagnetic radiation spectrum and relationship to the modalities of medical diagnostic imaging systems. Fundamentals of imaging theory. Application of 2D FT. Transmission properties of imaging systems. Optical imaging systems including microscopic. Television imaging systems (including video endoscopic imaging systems). Basic digital image pre-processing methods. Infrared imaging systems (thermal imaging/IR imaging systems). X-ray imaging systems. Gamma imaging systems. Lectures and especially the laboratory exercises provide students with an overview of the principles of image formation in medicine for conventional imaging systems and methods. There are described methods for image data sensing, digitization and subsequent processing and principles of function and properties of sensing image devices in context, which is especially relevant from the interdisciplinary point of view of the whole course and study specialization. Knowledge, skills and competences: The student is able to explain the basic physical principle of the given modalities and knows its layout including the principle of image formation. The student is able to assess, on the basis of standard definition of technical parameters that imaging system meets the physician requirements for selected modality. Such knowledge is a prerequisite to the correct process technology selection and application of the modalities as well as the minimum necessary to ensure the required quality of the resulting image data.			
17ABBLT	Clinical Laboratory Instrumentation	Z,ZK	4
Clinical laboratory instrumentation introduces principles of bioanalytical methods used in clinical diagnostics. Emphasis is put on optical methods (UV-VIS spectrophotometry, IR spectroscopy, AAS, AES, fluorimetry), NMR and X-ray analysis, electrochemical and electromigration methods (ion electrodes, biosensors, electrophoresis, isoelectric focusing), imunoassays and genetic methods (ELISA, PCR) as well as on chromatography and mass spectrometry. Contribution of lab automation to clinical diagnostics will be also discussed. During the laboratory course students will be introduced into the basics of work in bioanalytical laboratory and lab data processing.			
17ABBLTR	Medical Terminology	Z	1
Attendants are made acquainted with particular terms flowing from latin but also greek expressions during their lectures. Students are continuously informed about terms of whole diagnosis and therapeutical procedures. Education is combined with continuous knowlegde check up through the use of tests.			
17ABBLPZ1	Medical Devices & Equipment	Z,ZK	4
Medical devices categories. Electrical safety of medical devices. Biopotentials amplifiers. Electrocardiographs, electromyographs and electroencephalographs. Dilution methods of blood flow and cardiac output measurement. Blood pressure measurement. Cardiac frequency measurement. Phonocardiography. Pulse oximetry. Medical monitors. Electrostimulation and electrosurgery medical devices. Therapeutic medical devices. Implantable medical devices. Telemetry. Medical devices for audiology.			
17ABBLPZ2	Medical Devices and Equipments (Therapeutical Devices)	Z,ZK	4
Medical devices categories. Electrical safety of medical devices. Artificial ventilation, introduction. Conventional ventilation. High frequency ventilation. Extracorporeal membrane oxygenation. Hemodialysis. Drug infusion pumps (volumetric, syringe). Artificial cardiac pacemaker. Defibrillators (external, implantable). Cochlear implant. Electro surgery units. Therapeutic ultrasound. Electro-therapy. Magneto-therapy.			
17ABBLAD	Linear Algebra and Differential Calculus	Z,ZK	4
The course is introduction to differential calculus and linear algebra. Differential calculus - sets of numbers, sequences of real numbers, real functions (function properties, limits, continuity and derivative of a function investigation of function behavior), Taylor's formula, real number series. Linear algebra - vector spaces, matrices and determinants, systems of linear algebraic equations (solvability and solution), eigenvalues and eigenvectors of matrices, applications.			
17ABBMAZ	Management and Administration in Healthcare	KZ	1
Getting to know the structure of the health sector and financing models Health. Zoom administrative management issues various types of medical workplaces, their necessary interconnection. Orientation in the specific features of health facilities and European systems of health care workplaces.			
17ABBMZT	Management of Health Care Technology	Z,ZK	2
Models for different health care facilities. Medical devices: their selection and purchase, safety and reliable operation, decommissioning and ecological liquidation. External maintenance based on agreements. Methodology of the internal maintenance. Safety risk assessment. Valid legislation and technical norms. Relationships technician-medical doctor, technician-nurse and technician-patient. Rights, duties and responsibilities of the technicians in medical health care.			
17ABBMEC	Mechanics	Z,ZK	4
Cross-section characteristics, body stress state (Cauchy, geometry, compatibility and physical equations), linear elasticity theory, reaction, beam bending, normal and tangential stresses, deformation, torsion influence.			

17ABBMVP	Research Methodology	KZ	2
Methodical starting points of research. Methods and technology of research. Logic of scientific research. Theoretical starting points of research. Scientific information as a fool for everyday work. Structure of scientific information, possibility for their acquisition, methods of processing and application in practice. Description of principles for searching for scientific information. Description of specific systems, namely from health service. Final report.			
17ABBMS	Modelling and Simulation	Z,ZK	4
Basic concepts. Aims and consequences of modeling and simulation. The methodology of modeling and simulation. Inverse problem. Proposal for a new, respectively. additional experiment. Compartmental models. Physiological models. Pharmacokinetics. Continuous and discrete models of population dynamics. Epidemiological models. Veneral disease models.			
17ABBNMP	Project Proposal and Management	KZ	2
Project management, definition of terms project, program portfolio, project life cycle, project goal and benefits, triple imperative, project success assessment. Project idea, opportunity study, feasibility study (purpose, content, processing), SMART objective, stakeholders. Project identification list, logical framework. Design of project structures, stakeholders. Planning of time, resources, costs, budget, changes, procurement and contractual relations, personnel management. Risk analysis and risk management, methods for risk analysis. Reporting on the project status, evaluation of the current project status. information and documentation, communication. Leadership and motivation of people, negotiation and discussion procedures. Project completion, final report.			
17ABBOIZ	Protection Against Effects of Ionizing Radiation	KZ	2
The aim of the course is to give students an overview of the issues related to protection against ionizing radiation and dosimetry. Characteristics of basic types of ionizing radiation sources of ionizing radiation and its sources, interactions of Ionising radiation with matter, quantities and units used in dosimetry and radiation protection, detection of ionizing radiation and biological effects of ionizing radiation.)			
17ABBPPSA	Patient and Device Simulators and Testers	Z,ZK	4
During the course attention will be given to the two large groups, i.e. patient simulators and instrumentation testers. The use of these two groups in clinical practice will also be part of the course. As an essential part of the teaching will be included laboratory exercises in the workplace simulated workplace intensive care unit, where all the samples are carried out with two groups of devices. The course has a direct relationship to future career opportunities. Great emphasis is placed on managing interdisciplinary teaching (especially linking physiology and engineering principles). Given the organization of teaching as a 2-hour blocks 1 for 14 days is shown below, only 7 lectures (there will be performed standard exercises or intensive/block instruction will be implemented due to the time of experiments and the limited possibilities in terms of number of students).			
17ABBPPM	Programming in Matlab	KZ	2
Basic description of MATLAB environment. Numerical formats. Variables and matrices. Complex numbers. Rounding numbers. Basic instructions. Matrices operations. Visualization. Simulink (basic description, exercise formulation, parameters entry). Conditional and cyclical instructions. Script creation, functions, debugging. Continuous and discrete processes. Symbolical solutions. Graphical user interface creation. Applications in MATLAB.			
17ABBPNK	Design and Construction of Medical Devices/Practical Exercises	KZ	2
This course will introduce students with basics of design, construction and development process of devices which are used in medical, clinical or laboratory practice. Subject will be divided in two parts. Theoretical part will that follow these topics: basic philosophy of device design and construction, materials, components, laws and standards, process of developments from blueprints and prototype to "ready to sell" device. Practical part will introduce students into blueprints designs, circuit and schematics drawing, PCB design and development, soldering THT and SMT components, signal conditioning and processing, data acquisition. Also students will develop their simple prototype device and create measuring application in LabVIEW.			
17ABBPMS	Probability and Mathematical Statistics	Z,ZK	4
Introduction to probability theory and mathematical statistics. Determinism and chance. Axiomatic definition. Random variable and its distribution function. Discrete and continuous distributions. Quintiles. Random vectors. Conditioning and independence. Functions of random variables. Characteristics of random variables, weak law of large numbers. The role of mathematical statistics, the population and sample. Random selection. Point and interval estimates. Hypothesis testing. Goodness. Non-parametric tests.			
17ABBPP	First Aid	KZ	2
The course gives a brief overview of the main principles and procedures for providing urgent first aid, with special attention to the failure of vital functions and immediately life-threatening conditions. In this course are also included situations of mass disability during crisis situations and emergency events including the CBRN phenomenon. After successful completion of this course students should be able to diagnose life threatening conditions and provide adequate urgent first aid.			
17ABBPSL	Psychology	KZ	2
Development, methodology and methods of psychology. Mental activities and psychic processes, psychology of personality, objects of psychology and their formation and development. Modern psychology; its concept and theory, psychic processes and stages. Psychological interpretation of personality. Application of knowledge in medical situations. Relation between technicians and medical doctors, technicians and patients, technicians and nurses. Communication as a tool for good cooperation amongst people and an aid to interactions. Basic expression and communication skills. Use of elocution and gestures in personal expression. Verbal and nonverbal communication. Dialogue; types of dialogue, questions during dialogue. Model situations. Communication process as part of economics - components, tools and functions.			
17ABBROP	Guided Practical Training	Z	0
17ABBSPR2	Semestral Project II.	KZ	4
Basic communication and presentation skills. Creation of presentations and written texts. Typography rules. Types, purpose and requirements of technical presentations and technical texts. Writing a commented bibliographic search.			
17ABBSEL	Power Engineering	Z,ZK	4
Basic power electronics, power supplies units including electrochemical supplies, rectifiers, stabilizers, common types of motors, basic distributions of electricity, types of electric systems and connecting of electric appliances with sight on medical purposes. The knowledge will be checked in the laboratory by mean of practical examples during the work in the laboratory.			
17ABBSPT	Equipments for Anaesthesiology and Resuscitation	Z,ZK	4
IN 2022/2023 THE SUBJECT IS MERGEDE WITH F7ABBSPT AND THE ACTUAL MATERIALS ARE AVAILABLE THERE. 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.			
17ABBTEL	Theory of Electrical Engineering	Z,ZK	4
Electric current, DC and AC currents. Electrical curcuits including R, L, C. Power of electric current, thermal effect of electric current. Distribution of electrical energy. Connection of the electrical systems. Input resistance and impedance, idle voltage, inner resistance and impedance of the source, mutual loading of the source and electrical appliance, impedance matching. Properties of circuits in time and frequency domain. Transient action in DC circuits, frequency characteristics of the L/C circuit. Electrical current in semiconductor, type of the conductivity, creation of the semiconductor crossing, properties in the forward and reverse direction. Bipolar transistor - transistor effect, basic principle in elementary circuit. Unipolar transistor. Unipolar transistors with complementary vodivosti (CMOS). Electromagnetic effects (induction, magnetization, force effect). Electromagnetic wave, spreading, interference, electromagnetic compatibility. Soft and hard magnetic materials. Transformers construction and parameters. Magnetic recording and reproduction of signals. Electromotors principles.			

17ABBTZS	Tomographical Imaging Systems	Z,ZK	4

Ultrasound medical imaging systems (US). Doppler systems. Computed tomography - CT (fundamental principle, system layout and arrangements, fundamental physical principle, development versions, reconstruction fundamental principles). Magnetic resonance imaging (MRI). Positron emission tomography (PET) and single photon emission computed tomography (SPECT). Specialized - hybride imaging systems. Lectures and especially the laboratory exercises provide students with an overview of the principles of image formation in medicine for tomographical and computed tomography based imaging systems and methods. There are described methods for image data sensing, digitization and subsequent processing and principles of function and properties of sensing image devices in context, which is especially relevant from the interdisciplinary point of view of the whole course and study specialization. Knowledge, skills and competences: The student is able to explain the basic physical principle of the given modalities and knows its layout including the principle of image formation. The student is able to assess, on the basis of standard definition of technical parameters that imaging system meets the physician requirements for selected modality. Such knowledge is a prerequisite to the correct process technology selection and application of the modalities as well as the minimum necessary to ensure the required quality of the resulting image data.

17ABBUSS	Introduction to Signals and Systems	Z,ZK	4

To introduce students to basics of theory of signals and systems. To explain main principles on applications from biology and medicine. To become acquainted with basic mutual relations in computer laboratories by means of MATLAB.

17ABBZPD	Fundamentals of Pathology, Hygiene and Epidemiology	ZK	4

The subject provides a brief, clear and integral concept of medical branches, particularly internal medicine. The purpose of the subject is to acquaint the students with basic diseases, primary and secondary prevention of internal diseases and to define terms associated with the consideration of the patient health condition. The student should be able to compare and differentiate from each other methods of health examination, described procedures for the basic clinical examination and understand its principle and importance. He/she is supposed to know methods of monitoring the patient health condition.

17ABBZLN	Legislation in Health Care and Technical Standards	KZ	2

Health Services Act. Act on Professional Qualification for the Pursuit of the Medical Profession and on Further Education in Health Care (the Act on Medical Professions) and its implementing decrees. EU directives on medical devices. Act on Technical Requirements for Products. Government Regulation to the Act on Technical Requirements for Products. Structure of institutions dealing with the creation of technical standards in the Czech Republic and in the world. Technical standards relating to medical devices. Atomic law. Procedures for placing new medical devices on the market. Clinical testing of instruments. The role of testing laboratories. Some facts and experiences from abroad. Legislation on Good Manufacturing, Laboratory and Clinical Practice (GMP, GLP and GCP).

Name of the block: Compulsory elective courses
Minimal number of credits of the block: 10
The role of the block: S

Code of the group: 17ABB PV 2S 17
Name of the group: Biomedical Technician AJ compulsory optional course 2nd semester 17
Requirement credits in the group: In this group you have to gain at least 2 credits (at most 8)
Requirement courses in the group: In this group you have to complete at least 1 course (at most 4)
Credits in the group: 2
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
17ABBBUI	**Biological Effects of Ionizing Radiation**	KZ	2	2P	L	S
17ABBEZP	**Economics of Health Services**	KZ	2	1P+1S	L	S
17ABBMAT	**Marketing of Medical Technology**	KZ	2	2P	L	S
17ABBPPP	**Programming Tools** ***Pavel Smrčka***	KZ	2	2C	L	S

Characteristics of the courses of this group of Study Plan: Code=17ABB PV 2S 17 Name=Biomedical Technician AJ compulsory optional course 2nd semester 17

17ABBBUI	Biological Effects of Ionizing Radiation	KZ	2

The lectures will give an overview of basic radiation biology. Students will become familiar with the biological effects of ionizing radiation: the physical and chemical processes by which radiation causes damage to the biological material; mechanisms of radiation action on the DNA and other constituents of the cell; types of damage and their repair; subcellular and cellular sensitivity and radiation response; physical, chemical and biological modifiers of radiation action; theories and models of cellular survival; and radiation biology of normal and neoplastic tissues.

17ABBEZP	Economics of Health Services	KZ	2

Introduction to Economics of medical facilities, main terms. Investments in healthcare - economic balance. Investment planning and management, interconnection between maintenance and investments, contracts. Costs incurred by legislation and mere operation of the technology. Return on investments, risk analysis. Commodity knowledge of consumables and spare parts. Prices of medical devices consumables and tools.

17ABBMAT	Marketing of Medical Technology	KZ	2

Marketing fundamentals, products management, basic knowledge concerning export activities in the field of marketing and commercial health care technology. Practical cases are presented including health care technology companies from the Czech Republic. Discussion and analysis of the real products are included in the exercises.

17ABBPPP	Programming Tools	KZ	2

Introduction to software tools on MS Windows platform and GNU/Linux platform. Problem of portability of data-files, standardized exchange formats - HTML, XML, PDF, ODF, PNG etc. Introduction to administartion and configuration of MS Windows and GNU/Linux, programming of scripts, connectivity and comaptibility of major operating systems. Multiplatform applications - WWW browsers, e-mail clients, Office toolboxes, Graphical and CAD programs.

Code of the group: 17ABB PV 3S 17
Name of the group: Biomedical Technician AJ compulsory optional course 3rd semester 17
Requirement credits in the group: In this group you have to gain at least 2 credits (at most 8)

Requirement courses in the group: In this group you have to complete at least 1 course (at most 4)
Credits in the group: 2
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
17ABBBFT	**Biophotonics**	KZ	2	2P	Z	S
17ABBFVP	**Multivariable Calculus**	KZ	2	1P+1C	Z	S
17ABBMFJ	**Physical Phenomena Modeling in COMSOL Multiphysics** ***David Vrba***	KZ	2	1P+1C	Z	S
17ABBPMP1A	**Devices, Methods and Procedures in Clinical Practice I** ***Iva Kotenová***	KZ	2	1P+1L	Z	S

Characteristics of the courses of this group of Study Plan: Code=17ABB PV 3S 17 Name=Biomedical Technician AJ compulsory optional course 3rd semester 17

17ABBBFT	Biophotonics	KZ	2

Overview of principles and applications in the interdisciplinary sphere, connecting physics, optics and biology. Interaction of laser radiation with matter, interaction of radiation with tissue, biology basics, photobiology, bioimaging, basics of lasers, laser safety, optical biosensors, photodynamical therapy, optical manipulation with cells, nanotechnology for biophotonics, biomaterials for photonics.

17ABBFVP	Multivariable Calculus	KZ	2

The course is focused at elements of calculus in two and more variables. Calculus in two variables: notion of a limit and continuity, partial derivative, differential and its applications. Derivative of a composed function, derivative of an implicit function. Higher order derivatives, local extremes. Constrained extremes, least squares method. Double and triple integrals, geometrical interpretation, Fubini theorem. Integration by substitution in double and triple integral.

17ABBMFJ	Physical Phenomena Modeling in COMSOL Multiphysics	KZ	2

Numerical simulations are increasingly being used to develop new and optimize existing products and devices. Numerical simulations can greatly reduce the number of prototypes needed and thus significantly accelerate and reduce development costs. Another sector where numerical simulations are used is a sector where it is difficult to verify ongoing physical processes (eg, heating the biological tissue under electrodes for direct brain simulation). Last but not least, based on numerical simulations, we can plan treatment where, based on knowledge of material properties, we can define the amount of power delivered to the device (eg radiofrequency ablation in oncology or cardiac surgery). Computer modeling involves the creation of geometry, setting of material properties and boundary conditions and, last but not least, the choice of differential equations, the method of discretization of the computing area and the processing of results. The accuracy of the results obtained, the length of calculations and the computational power requirements are very dependent on the numerical model setting. The lectures cover the most common problems in electrical engineering, thermics, mechanics, chemistry, acoustics and fluid dynamics. The acquired knowledge will be tested by the students when designing individual parts of devices and devices.

17ABBPMP1A	Devices, Methods and Procedures in Clinical Practice I	KZ	2

Hospital intro, Cardio US, department of anesthesiology and resuscitation, ICIP, Department of Anesthesiology - Adult Part, Emergency department, Pneumatic Post, Laboratories, Imunology, Technical department, Clinic of Imaging Methods, Central Operating Theatres - Paediatric Part (Neurosurgery, Stomatosurgery, Otorinolaryngology and head and neck surgery), EFA (database records of medical devices and their parameters), Neurophysiological laboratory, Technical Safety Check (ECG, Patient monitor) and Laser, marking of surgical tools.

Code of the group: 17ABB PV 4S 17
Name of the group: Biomedical Technician AJ compulsory optional course 4th semester 17
Requirement credits in the group: In this group you have to gain at least 2 credits (at most 10)
Requirement courses in the group: In this group you have to complete at least 1 course (at most 5)
Credits in the group: 2
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
17ABBDIZ	**Detectors of Ionizing Radiation**	KZ	2	2P	L	S
17ABBFY3	**Physics III**	KZ	2	1P+1L	L	S
17ABBMDT	**Microwave Diagnostics and Therapy** *David Vrba, Jan Vrba* ***David Vrba*** *Jan Vrba (Gar.)*	KZ	2	1P+1C	L	S
17ABBPMP2A	**Devices, Methods and Procedures in Clinical Practise II** ***Jiří Hozman***	KZ	2	1P+1L	L	S
17ABBSPR1	**Semestral Project I.** *Petr Kudrna* ***Petr Kudrna*** *Petr Kudrna (Gar.)*	KZ	2	2S	L	S

Characteristics of the courses of this group of Study Plan: Code=17ABB PV 4S 17 Name=Biomedical Technician AJ compulsory optional course 4th semester 17

17ABBDIZ	Detectors of Ionizing Radiation	KZ	2

Types of gas filled detectors, DC mode of IC, pulse mode of IC, proportional counters, pulse shape of proportional counter, neutron detection and spectrometry by means of nuclear reactions, principle of Geiger-Mueller counters, corona counter, preliminary of the scintillation detectors, exploitation of organic (solid and/or liquid) scintillators, Cerenkov detector, semiconductor detectors, Li compensated Ge detectors and HPGe detectors as photon detector.

17ABBFY3	Physics III	KZ	2

The course extends the previous courses Physics I. and Physics II. In this set of courses the main emphasis is placed on the understanding of priciples and the ability to solve standard physical examples. In Physics III. course we study waves, optics and lasers. We concentrate on practical examples and experiments.

17ABBMDT	Microwave Diagnostics and Therapy	KZ	2
Interaction of the EM field with biological tissues and its use in diagnostics and therapy. Numerical methods suitable for modeling these interactions. Basics of microwave imaging (MWI). Perspective application of microwave techniques in medical diagnostics: non-invasive monitoring of blood glucose concentration, microwave detection and classification of cerebral vascular events and early detection of breast cancer. Therapeutic systems and applicators for microwave and RF local and regional hyperthermia. Planning treatment. Design and testing of applicators.			
17ABBPMP2A	Devices, Methods and Procedures in Clinical Practise II	KZ	2
In this course will be applied focus on the following issues: operation and documentation of the results of imaging methods, the relationship between imaging methods and systems to the HIS, basic concepts and methods in various fields of diagnostic imaging, basic imaging systems from the perspective of interpretation and description of images, from the field of diagnostic imaging practice (radiology, ultrasonography, magnetic resonance imaging, nuclear medicine, endoscopy, PET, SPECT).			
17ABBSPR1	Semestral Project I.	KZ	2
Basic communication and presentation skills, including team work, team heading and project management. Creation of presentations and written texts. Typography rules. Types, purpose and requirements of technical presentations and technical texts. Writing a commented bibliographic search.			

Code of the group: 17ABB PV 5S 17
Name of the group: Biomedical Technician AJ compulsory optional course 5th semester 17
Requirement credits in the group: In this group you have to gain at least 2 credits (at most 8)
Requirement courses in the group: In this group you have to complete at least 1 course (at most 4)
Credits in the group: 2
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
17ABBAZD	**Biomedical Data Analysis and Processing** *Jan Kauler, Lucie Horáková* ***Jan Kauler*** *Jan Kauler (Gar.)*	KZ	2	1P+1C	Z	S
17ABBMTB	**Microprocessors in Biomedicine** *Pavel Smrčka, Lenka Hanáková, Jan Broulím* ***Pavel Smrčka*** *Pavel Smrčka (Gar.)*	KZ	2	1P+1L	Z	S
17ABBVBI	**Virtual Bioinstrumentation** *Roman Matějka* ***Roman Matějka*** *Roman Matějka (Gar.)*	KZ	2	1P+1L	Z	S
17ABBZOD	**Image Data Processing** ***Zoltán Szabó***	KZ	2	1P+1L	Z	S

Characteristics of the courses of this group of Study Plan: Code=17ABB PV 5S 17 Name=Biomedical Technician AJ compulsory optional course 5th semester 17

17ABBAZD	Biomedical Data Analysis and Processing	KZ	2
Time series analysis, trends, mutual dependency, stationarity. Correlation function and covariance function. Algorithms of correlation function estimation. Impact of removing trends to autocorrelation function. Periodogram - relationship between corellogram and periodogram. Frequency spectrum, spectrum of random signals. Linear frequency filtering. AR, ARMA, and MA processes. Spectral analysis. FFT algorithm. Non-parametric methods of the frequency spectrum estimation. Positives and negatives of the specteal analysis. Repeated measurements and analysis of their properties. AR a ARMA model parameter identification. Prediction. Bivariance analysis of time series - cross-correlation and cross-covariance and their estimation. Bispectrum.			
17ABBMTB	Microprocessors in Biomedicine	KZ	2
Introduction to embedded microprocessor systems in medicine, principles and structure of microcontrolers, logical circuits. Interconnection with common peripheral devices: AD and DA converters, serial communication, WIFI, Bluetooth a GPRS communication. Examples of embedded systems on architectures 8051, AVR, PIC and ARM. Introduction to multiplatform software development fo embedded systems.			
17ABBVBI	Virtual Bioinstrumentation	KZ	2
This subject deals with process of development of application in LabVIEW using Virtual Instrumentation concept. During the course will be explained basic concepts of programming like variables, data structures, cluster, loops, conditionals, typedefs, advanced coding concepts like event driven programming, multi-threaded application development, data queues and FIFOs, synchronisation, process of deployment, executable building, installer and upgrades. The students are able also to obtain the CLAD (Certificate LabVIEW Associate Developer) certificate. This certificate is first step in knowledge of VI.			
17ABBZOD	Image Data Processing	KZ	2
Continuous image representation, linear 2D systems, 2D spectrum, Digital representation of images, Basic image characteristics: brightness, contrast, resolution, noise, look up tables, histogram, Discrete Fourier transform, discrete cosine transform, image enhancement, geometric operations, image filtering, morphological operations, image restoration, image segmentation, basic principles of image compression.			

Code of the group: 17ABB PV 6S 17
Name of the group: Biomedical Technician AJ compulsory optional course 6th semester 17
Requirement credits in the group: In this group you have to gain at least 2 credits (at most 8)
Requirement courses in the group: In this group you have to complete at least 1 course (at most 4)
Credits in the group: 2
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
17ABBAZC	**Algorithms for Biosignal Processing in the C Language** ***Pavel Smrčka***	KZ	2	1P+1C	L	S

17ABBEMP	**Electromagnetic Fields of Living Organisms** *Jan Vrba, Peter Kneppo* ***Jan Vrba*** *Peter Kneppo (Gar.)*	KZ	2	1P+1S	L	S
17ABBRI	**Rehabilitation Engineering** *Jiří Hozman* ***Jiří Hozman***	KZ	2	1P+1L	L	S
17ABBRBL	**Robotics in Medicine** ***Jan Kauler***	KZ	2	1P+1L	L	S

Characteristics of the courses of this group of Study Plan: Code=17ABB PV 6S 17 Name=Biomedical Technician AJ compulsory optional course 6th semester 17

17ABBAZC	Algorithms for Biosignal Processing in the C Language	KZ	2
Algorithms for preprocessing and intelligent segmentation of the biological time-series in C and C++. Algorithms of FFT, SFFT and Wavelet Transform. Calculation of the cross-correlation and autocorrelation functions. Method of moving window, extraction of attributes. Example implementations of the fuzzy rules and neural network. Algorithms for design and realisation of the FIR a IIR filters. Methods of biosignal visualisation.			
17ABBEMP	Electromagnetic Fields of Living Organisms	KZ	2
Fundamental physical knowledge and electrostatic and magnetic field equations. Anatomical and physiological fundamentals of bioelectromagnetism. Bioelectric sources and conductive environment. Electrodynamics of bioelectrical fields, electrodynamic aspects of mathematical modeling of the electrocardiography and electroencephalography. Topographical concepts of bioelectrical and biomagnetical measurement. Measurement methods. Stimulation.			
17ABBRI	Rehabilitation Engineering	KZ	2
Physiotherapy, especially physical therapy, orthotics and prosthesis, selected parts of biomechanics and ergonomy. Physical therapeutic methods, technology in therapy (ultrasound apparatuses and technology for radiotherapy). Replacement by sensors and possibilities of communication with computer. Artificial organs and relevant circulatory confirmatory devices. Implantable medical devices - pacemakers, defibrilators, cardioverters.			
17ABBRBL	Robotics in Medicine	KZ	2
Principles of robotics in medicine and laboratory technics - what kind of task is solving, synthesis of kinematics according to the task processed by robot - operational (surgical room), handling (laboratory), kinematics a dynamics of robot arm - computing methodology, verification of obtained models in Matlab environment, sensors and drives used by robots applicable in medicine, possible robot control paradigms - according human (operator) task.			

List of courses of this pass:

Code	Name of the course	Completion	Credits
17ABBA3A	English Language IIIA (part 1)	KZ	2
The aim of the course is to increase students' language competence in academic English and professional vocabulary, along with common communication skills - writing summaries, preparing presentations for meetings. Students should be able to work actively with academic text, understand and be able to use basic terminology, be aware of the different stylistic levels of English and the associated syntactic and lexical devices.			
17ABBA3B	English III. Academic and professional English	KZ	2
17ABBAF1	Anatomy and Physiology I	Z,ZK	5
Anatomy and physiology I covers functional aspects of particular organs and their systems.			
17ABBAF2	Anatomy and Physiology II	Z,ZK	5
Anatomy and physiology II links to Anatomy and Physiology I. The subject covers functional aspects of particular organs and their systems.			
17ABBALP	Algorithmic and Programming Theory	KZ	4
Algorithm, data structures. Identifiers, data types. assignment statement, conditional statement, cycles. Arithmetical and logical operations. Digital representation of numbers, numeration systems. Introduction to structured programming in C language - building and structure of simple programs, creating of the user functions, user input and output, file management, memory management. Practical overview of programming techniques and basic algorithms in C language. Recursive and iterative methods, measuring algorithm quality. Abstract data-types, data sorting and searching, implementation of basic numerical algorithms. Introduction to biomedical data processing - programmers view. Introduction to software engineering.			
17ABBAZC	Algorithms for Biosignal Processing in the C Language	KZ	2
Algorithms for preprocessing and intelligent segmentation of the biological time-series in C and C++. Algorithms of FFT, SFFT and Wavelet Transform. Calculation of the cross-correlation and autocorrelation functions. Method of moving window, extraction of attributes. Example implementations of the fuzzy rules and neural network. Algorithms for design and realisation of the FIR a IIR filters. Methods of biosignal visualisation.			
17ABBAZD	Biomedical Data Analysis and Processing	KZ	2
Time series analysis, trends, mutual dependency, stationarity. Correlation function and covariance function. Algorithms of correlation function estimation. Impact of removing trends to autocorrelation function. Periodogram - relationship between corellogram and periodogram. Frequency spectrum, spectrum of random signals. Linear frequency filtering. AR, ARMA, and MA processes. Spectral analysis. FFT algorithm. Non-parametric methods of the frequency spectrum estimation. Positives and negatives of the specteal analysis. Repeated measurements and analysis of their properties. AR a ARMA model parameter identification. Prediction. Bivariance analysis of time series - cross-correlation and cross-covariance and their estimation. Bispectrum.			
17ABBBB	Biomechanics and Biomaterials	Z,ZK	4
Introduce to biomechanics, Biomaterials, rheological models, Mechanic characteristic of bones, ligaments, tendons, muscles and cartilages, Endoprothesis and exoprotesis, Biomechanics of movement, gait mechanics, Kinematics and dynamics in biomechanics, Mechanical work an power of body, Stress and deformation, Finite element method. Intelligent prostheses.			
17ABBBCH	Biochemistry	KZ	2
Course participants will be introduced to the basics of Biochemistry. The course builds on the knowledge gained in general chemistry and extends this knowledge about the chemistry of living systems. The interpretation goes through the basic building structures of biological systems (amino acids, peptides, proteins, lipids, carbohydrates, nucleic acids), biological membranes and molecular genetics to the most important metabolic processes. Particular attention is paid to the aspects necessary for understanding the methods of work in the biochemical and clinical laboratory, which are part of the follow-up chemical discipline. The laboratories are focused on broadening the topics discussed in the lectures and their practical training, especially on the determination of biomolecules and the verification of their properties. Students should become familiar with the basic laboratory techniques of Biochemistry.			
17ABBBFT	Biophotonics	KZ	2
Overview of principles and applications in the interdisciplinary sphere, connecting physics, optics and biology. Interaction of laser radiation with matter, interaction of radiation with tissue, biology basics, photobiology, bioimaging, basics of lasers, laser safety, optical biosensors, photodynamical therapy, optical manipulation with cells, nanotechnology for biophotonics, biomaterials for photonics.			

17ABBBLG	Biology	Z,ZK	4
Basic information about the cellular level of organisms - from acelullar through prokaryotic to eukaryotic. The viruses. Prokaryotic cells. Bacteria. Bacterial diseases and their control. Eukaryotic cells. Plant and animal cell structure and function. Structure and conformation of biopolymers (nucleid acids and proteins). The nucleus, plastids, mitochondria. Cytoplasm. Endomembrane system: endoplasmic reticulum, the Golgi apparatus, lysosomes, vacuoles. Semiautonomic organelles: mitochondria, sites of respiration and chloroplasts, sites of photosynthesis. The origin of eukaryotes: endosymbiotic hypothesis. Ribosomes. The cytoskeleton: microtubules, microfilaments. The cell cycle: mitotic (M) phase and interphase (G1, S and G2 phases). The division of cell nucleus - amitosis, mitosis, phases of mitosis, the mitotic spindle; meiosis. The cell division - cytokinesis. Cell differentiation. Cell death. Apoptosis and necrosis. Mendelian and modern genetics: structure, function and inheritance of genes. Includes the chemistry and structure of chromatin and chromosomes. Animal tissue histology. Animal cells and tissues. Human genetics. Chromosomal aberrations, genetic disorders and diseases. Genetic engineering. GMO organisms.			
17ABBBLS	Biological Signals	Z,ZK	4
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. Advanced methods of digital biosignal processing,spectrum analysis, modern methods of artificial intelligence, features extraction, automatic classification, graphic presentation of results. Adaptive segmentation, artificial neural networks for signal procesing.			
17ABBBOZP	Safety Regulations and Standards in Electrical Engineering	Z	1
Basic safety regulations, training and examinations from the sections of the regulation No. 50/1978 Coll. and instructions concerning the laboratory experiments based on the electrical devices. Factors determining electrical shock injury. Symbols and labeling in electrotechnology - safety colors importance, safety geometrical shape importance, examples of the safety legends, examples of the safety tables, graphical signs on the electrical devices, letter conductor labeling, AC nominal voltages, maximum values of the available current, short circuit and overloading protection, safety of the electrical devices - safety classes, periodical inspection and check of the electrical devices and hand tools, important norms, first aid in cases of electrical shock. Relationship of the law and safety regulations. Risk analysis in the field of electrotechnology. Special qualification in electrotechnology - regulation No. 50/1978 Coll. Validity based on the electrotechnology qualification and directive "B". Lasers safety regulations.			
17ABBBP	Bachelor Thesis	Z	8
Individual student projects at the end of bachelor studies. Topics are selected during the 5th term from a list. Bachelor thesis is defended at the end of the examination period. Bachelor thesis defence is a part of the state exam. Bachelor thesis can be written and defended either Czech or English. Students are supervised by a tutor during the above mentioned process.			
17ABBBUI	Biological Effects of Ionizing Radiation	KZ	2
The lectures will give an overview of basic radiation biology. Students will become familiar with the biological effects of ionizing radiation: the physical and chemical processes by which radiation causes damage to the biological material; mechanisms of radiation action on the DNA and other constituents of the cell; types of damage and their repair; subcellular and cellular sensitivity and radiation response; physical, chemical and biological modifiers of radiation action; theories and models of cellular survival; and radiation biology of normal and neoplastic tissues.			
17ABBCHM	Chemistry	Z,ZK	4
Introduction to chemistry, categorization and properties of substances, chemical bonds, chemical reactions, elements in periodic table, organic chemistry fundamentals, natural substances, polymers, analytical methods - instrumental analysis, chemical calculations, chemical equations			
17ABBDIZ	Detectors of Ionizing Radiation	KZ	2
Types of gas filled detectors, DC mode of IC, pulse mode of IC, proportional counters, pulse shape of proportional counter, neutron detection and spectrometry by means of nuclear reactions, principle of Geiger-Mueller counters, corona counter, preliminary of the scintillation detectors, exploitation of organic (solid and/or liquid) scintillators, Cerenkov detector, semiconductor detectors, Li compensated Ge detectors and HPGe detectors as photon detector.			
17ABBEBI	Ethics in Biomedical Engineering	KZ	2
The course introduces students to basic ethical issues in applied ethics due to a future career orientation. It develops students' ability to think in ethical contexts, discuss, argue and defend their views in ethical dilemma situations which brings medical environment.			
17ABBELFA	Electrophysiology	Z,ZK	2
The study subject links to Anatomy and Physiology II and is dedicated to excitable tissues (muscles and neural system) in the terms of signal generation, measuring possibilities and exploitation of changes in electrical parameters. Signal generation is explained at cellular and molecular levels, different software simulations are employed. From the methodological point of view, measurements of electrical parameters are described at all levels - cells, tissues, organs. Exploitation of electrical parameters of cells, tissues and organs is treated from both clinical and experimental points. Methods to use electrical field or stimulation for medical purposes are described. Besides lectures, practical classes focused on independent study of students are incorporated into the syllabus.			
17ABBEM	Electrical Measurements	Z,ZK	4
Measuring of electric values, principles, using, and parameters. Analogue measuring converters. Electromechanical measuring devices. Current and potential measuring. Frequency and shift phase measuring. Electric work and electric power measuring: direct current, single-phase and three-phase current. Electrical resistance and impedance measuring. Magnetic measuring. Analogue scope. Digitalization, digital signal processing, signal reconstruction. Electronic measuring devices: multimeter, digital scope. Optoelectronic measuring device.			
17ABBEMP	Electromagnetic Fields of Living Organisms	KZ	2
Fundamental physical knowledge and electrostatic and magnetic field equations. Anatomical and physiological fundamentals of bioelectromagnetism. Bioelectric sources and conductive environment. Electrodynamics of bioelectrical fields, electrodynamic aspects of mathematical modeling of the electrocardiography and electroencephalography. Topographical concepts of bioelectrical and biomagnetical measurement. Measurement methods. Stimulation.			
17ABBEO	Electronic Circuits	Z,ZK	4
Amplifiers - basic concepts. Feedback networks. Ideal operational amplifier - important networks. Practical operational amplifier - DC parameters, frequency response, transient response. DC voltage sources - rectifiers and voltage regulators. DC/DC voltage converters - charge pump, inverting, buck, boost. Non-linear and regenerative circuits - comparators, flip-flops, multivibrators, oscillators. Combinational logic functions and logic gates. Karnaugh maps, logic tables. Sequential logic circuits. Logic integrated circuits (IC) - basic parameters, input and output characteristics, logic circuit families. Semiconductor memories. Digital signal processing - sampling theorem, quantization, number representation. A/D and D/A converters.			
17ABBESL	Electronic Elements and Sensors in Medicine	Z,ZK	4
This subject provides information about basic electronic devices - sensors, describes their operation principle, basic circuit configuration and application. The stress is aid mainly on clarifying of basic principles and practical utilization. Integral part of this course is basic information about sensors of non-electric quantities and their read-out circuits eg. strain related sensors (force, pressure, torque, vibration, displacement, acceleration etc.) magnetic field sensors, temperature sensors, chemical sensors, optical sensors and biosensors. The stress is aid on miniaturization, integration and application in biomedicine.			
17ABBEZP	Economics of Health Services	KZ	2
Introduction to Economics of medical facilities, main terms. Investments in healthcare - economic balance. Investment planning and management, interconnection between maintenance and investments, contracts. Costs incurred by legislation and mere operation of the technology. Return on investments, risk analysis. Commodity knowledge of consumables and spare parts. Prices of medical devices consumables and tools.			
17ABBFCH	Physical Chemistry	Z,ZK	4
Mixtures of compounds. Vapour and vaporisation. Electrodes. Electrochemical potential, electrodes. Referent and measuring electrodes, ECG, EEG and EMG electrodes. Redox potential. Inert electrodes. Membranes. Osmotic pressure. Ion-sensitive electrodes. Acidity. Measurement of pH, pO2, pCO2. Electrolysis and its application. Corrosion and protection of implants. Other amalytical methods based on principles of physical chemistry.			

17ABBFVP	Multivariable Calculus	KZ	2
The course is focused at elements of calculus in two and more variables. Calculus in two variables: notion of a limit and continuity, partial derivative, differential and its applications. Derivative of a composed function, derivative of an implicit function. Higher order derivatives, local extremes. Constrained extremes, least squares method. Double and triple integrals, geometrical interpretation, Fubini theorem. Integration by substitution in double and triple integral.			
17ABBFY1	Physics I	Z,ZK	5
Physics I course will allow students to acquire and strengthen knowledge in these branches of physics: mechanics, thermodynamics and solid state physics. We focus on solid theoretical bases, but independent work in student labs as well as solving practical examples are also important parts of the course. Through the course we also touch the limits of the classical Physics.			
17ABBFY2	Physics II	Z,ZK	5
The Physics II course introduces fundamentals and applications of electromagnetic fields. The covered topics include electromagnetic interaction, electric field, magnetic field, electromagnetic field, Maxwell's equations, electromagnetic radiation, fundamentals of quantum physics, atomic nucleus and elementary particles, and interaction of radiation with matter.			
17ABBFY3	Physics III	KZ	2
The course extends the previous courses Physics I. and Physics II. In this set of courses the main emphasis is placed on the understanding of priciples and the ability to solve standard physical examples. In Physics III. course we study waves, optics and lasers. We concentrate on practical examples and experiments.			
17ABBISZ	Information Systems in Health Care	Z,ZK	4
Lectures are oriented on medical informatics definition and basic characteristic of the different specialized areas. The relations between IS and health care structure, financing and controlling are analyzed as well. Some basic information technology, HW and SW tools are described in relation to IS design. A special attention is paid to medical data coding and interpretation, data and communication standards. Different types and features of clinical and hospital IS, decision support systems and regional health care IS are analyzed and discussed. Methodology of IS development, implementation and support are presented as well.			
17ABBITP	Integral Calculus	Z,ZK	5
The subject is an introduction to integral calculus and integral transforms. Integral calculus: anti-derivative, indefinite integral, properties and methods of integration (integration by parts and by substitution, partial fractions), definite integral, properties, Newton-Leibnitz fundamental theorem, simple applications of both indefinite and definite integrals, improper integral, solving differential equations (ODEs) (1st order ODEs with separable variables, linear 1st order homogenous as well as non-homogenous ODEs, 2nd order linear homogenous and non-homogenous ODEs with constant coefficients),intro to multiple integrals, particularly double integral and applications. Integral transforms: Laplace transform and inverse Laplace transform and their application for solving nth order linear ODEs with constant coefficients. Z-transform and inverse Z-transform, their application for solving nth order linear difference equations.			
17ABBITT	Information Technology and Telemedicine	ZK	2
Computer history, structure of computers, motherboard, processors, memody, graphical card, computer buses, BIOS, I/O devices, server, desktop, notebook, pocket PC, data storage, mobile devices, memory card, OS, tasks and memory management, printers scanner, multimedial devices, mass data storage, multitasking, multiprocessoring, set of instruction, assembler, programming languages, power test, network, LAN, WAN, interner, TCP/IP, HTTP, FTP etc., client-server, gate, router, using IT in medicine and telemedicine.			
17ABBKZS	Conventional Imaging Systems	Z,ZK	4
Electromagnetic radiation spectrum and relationship to the modalities of medical diagnostic imaging systems. Fundamentals of imaging theory. Application of 2D FT. Transmission properties of imaging systems. Optical imaging systems including microscopic. Television imaging systems (including video endoscopic imaging systems). Basic digital image pre-processing methods. Infrared imaging systems (thermal imaging/IR imaging systems). X-ray imaging systems. Gamma imaging systems. Lectures and especially the laboratory exercises provide students with an overview of the principles of image formation in medicine for conventional imaging systems and methods. There are described methods for image data sensing, digitization and subsequent processing and principles of function and properties of sensing image devices in context, which is especially relevant from the interdisciplinary point of view of the whole course and study specialization. Knowledge, skills and competences: The student is able to explain the basic physical principle of the given modalities and knows its layout including the principle of image formation. The student is able to assess, on the basis of standard definition of technical parameters that imaging system meets the physician requirements for selected modality. Such knowledge is a prerequisite to the correct process technology selection and application of the modalities as well as the minimum necessary to ensure the required quality of the resulting image data.			
17ABBLAD	Linear Algebra and Differential Calculus	Z,ZK	4
The course is introduction to differential calculus and linear algebra. Differential calculus - sets of numbers, sequences of real numbers, real functions (function properties, limits, continuity and derivative of a function investigation of function behavior), Taylor's formula, real number series. Linear algebra - vector spaces, matrices and determinants, systems of linear algebraic equations (solvability and solution), eigenvalues and eigenvectors of matrices, applications.			
17ABBLPZ1	Medical Devices & Equipment	Z,ZK	4
Medical devices categories. Electrical safety of medical devices. Biopotentials amplifiers. Electrocardiographs, electromyographs and electroencephalographs. Dilution methods of blood flow and cardiac output measurement. Blood pressure measurement. Cardiac frequency measurement. Phonocardiography. Pulse oximetry. Medical monitors. Electrostimulation and electrosurgery medical devices. Therapeutic medical devices. Implantable medical devices. Telemetry. Medical devices for audiology.			
17ABBLPZ2	Medical Devices and Equipments (Therapeutical Devices)	Z,ZK	4
Medical devices categories. Electrical safety of medical devices. Artificial ventilation, introduction. Conventional ventilation. High frequency ventilation. Extracorporeal membrane oxygenation. Hemodialysis. Drug infusion pumps (volumetric, syringe). Artificial cardiac pacemaker. Defibrillators (external, implantable). Cochlear implant. Electro surgery units. Therapeutic ultrasound. Electro-therapy. Magneto-therapy.			
17ABBLT	Clinical Laboratory Instrumentation	Z,ZK	4
Clinical laboratory instrumentation introduces principles of bioanalytical methods used in clinical diagnostics. Emphasis is put on optical methods (UV-VIS spectrophotometry, IR spectroscopy, AAS, AES, fluorimetry), NMR and X-ray analysis, electrochemical and electromigration methods (ion electrodes, biosensors, electrophoresis, isoelectric focusing), imunoassays and genetic methods (ELISA, PCR) as well as on chromatography and mass spectrometry. Contribution of lab automation to clinical diagnostics will be also discussed. During the laboratory course students will be introduced into the basics of work in bioanalytical laboratory and lab data processing.			
17ABBLTR	Medical Terminology	Z	1
Attendants are made acquainted with particular terms flowing from latin but also greek expressions during their lectures. Students are continuously informed about terms of whole diagnosis and therapeutical procedures. Education is combined with continuous knowlegde check up through the use of tests.			
17ABBMAT	Marketing of Medical Technology	KZ	2
Marketing fundamentals, products management, basic knowledge concerning export activities in the field of marketing and commercial health care technology. Practical cases are presented including health care technology companies from the Czech Republic. Discussion and analysis of the real products are included in the exercises.			
17ABBMAZ	Management and Administration in Healthcare	KZ	1
Getting to know the structure of the health sector and financing models Health. Zoom administrative management issues various types of medical workplaces, their necessary interconnection. Orientation in the specific features of health facilities and European systems of health care workplaces.			
17ABBMDT	Microwave Diagnostics and Therapy	KZ	2
Interaction of the EM field with biological tissues and its use in diagnostics and therapy. Numerical methods suitable for modeling these interactions. Basics of microwave imaging (MWI). Perspective application of microwave techniques in medical diagnostics: non-invasive monitoring of blood glucose concentration, microwave detection and classification of cerebral vascular events and early detection of breast cancer. Therapeutic systems and applicators for microwave and RF local and regional hyperthermia. Planning treatment. Design and testing of applicators.			

17ABBMEC	Mechanics	Z,ZK	4
Cross-section characteristics, body stress state (Cauchy, geometry, compatibility and physical equations), linear elasticity theory, reaction, beam bending, normal and tangential stresses, deformation, torsion influence.			
17ABBMFJ	Physical Phenomena Modeling in COMSOL Multiphysics	KZ	2
Numerical simulations are increasingly being used to develop new and optimize existing products and devices. Numerical simulations can greatly reduce the number of prototypes needed and thus significantly accelerate and reduce development costs. Another sector where numerical simulations are used is a sector where it is difficult to verify ongoing physical processes (eg, heating the biological tissue under electrodes for direct brain simulation). Last but not least, based on numerical simulations, we can plan treatment where, based on knowledge of material properties, we can define the amount of power delivered to the device (eg radiofrequency ablation in oncology or cardiac surgery). Computer modeling involves the creation of geometry, setting of material properties and boundary conditions and, last but not least, the choice of differential equations, the method of discretization of the computing area and the processing of results. The accuracy of the results obtained, the length of calculations and the computational power requirements are very dependent on the numerical model setting. The lectures cover the most common problems in electrical engineering, thermics, mechanics, chemistry, acoustics and fluid dynamics. The acquired knowledge will be tested by the students when designing individual parts of devices and devices.			
17ABBMS	Modelling and Simulation	Z,ZK	4
Basic concepts. Aims and consequences of modeling and simulation. The methodology of modeling and simulation. Inverse problem. Proposal for a new, respectively. additional experiment. Compartmental models. Physiological models. Pharmacokinetics. Continuous and discrete models of population dynamics. Epidemiological models. Veneral disease models.			
17ABBMTB	Microprocessors in Biomedicine	KZ	2
Introduction to embedded microprocessor systems in medicine, principles and structure of microcontrolers, logical circuits. Interconnection with common peripheral devices: AD and DA converters, serial communication, WIFI, Bluetooth a GPRS communication. Examples of embedded systems on architectures 8051, AVR, PIC and ARM. Introduction to multiplatform software development fo embedded systems.			
17ABBMVP	Research Methodology	KZ	2
Methodical starting points of research. Methods and technology of research. Logic of scientific research. Theoretical starting points of research. Scientific information as a fool for everyday work. Structure of scientific information, possibility for their acquisition, methods of processing and application in practice. Description of principles for searching for scientific information. Description of specific systems, namely from health service. Final report.			
17ABBMZT	Management of Health Care Technology	Z,ZK	2
Models for different health care facilities. Medical devices: their selection and purchase, safety and reliable operation, decommissioning and ecological liquidation. External maintenance based on agreements. Methodology of the internal maintenance. Safety risk assessment. Valid legislation and technical norms. Relationships technician-medical doctor, technician-nurse and technician-patient. Rights, duties and responsibilities of the technicians in medical health care.			
17ABBNMP	Project Proposal and Management	KZ	2
Project management, definition of terms project, program portfolio, project life cycle, project goal and benefits, triple imperative, project success assessment. Project idea, opportunity study, feasibility study (purpose, content, processing), SMART objective, stakeholders. Project identification list, logical framework. Design of project structures, stakeholders. Planning of time, resources, costs, budget, changes, procurement and contractual relations, personnel management. Risk analysis and risk management, methods for risk analysis. Reporting on the project status, evaluation of the current project status. information and documentation, communication. Leadership and motivation of people, negotiation and discussion procedures. Project completion, final report.			
17ABBOIZ	Protection Against Effects of Ionizing Radiation	KZ	2
The aim of the course is to give students an overview of the issues related to protection against ionizing radiation and dosimetry. Characteristics of basic types of ionizing radiation sources of ionizing radiation and its sources, interactions of Ionising radiation with matter, quantities and units used in dosimetry and radiation protection, detection of ionizing radiation and biological effects of ionizing radiation.)			
17ABBPMP1A	Devices, Methods and Procedures in Clinical Practice I	KZ	2
Hospital intro, Cardio US, department of anesthesiology and resuscitation, ICIP, Department of Anesthesiology - Adult Part, Emergency department, Pneumatic Post, Laboratories, Imunology, Technical department, Clinic of Imaging Methods, Central Operating Theatres - Paediatric Part (Neurosurgery, Stomatosurgery, Otorinolaryngology and head and neck surgery), EFA (database records of medical devices and their parameters), Neurophysiological laboratory, Technical Safety Check (ECG, Patient monitor) and Laser, marking of surgical tools.			
17ABBPMP2A	Devices, Methods and Procedures in Clinical Practise II	KZ	2
In this course will be applied focus on the following issues: operation and documentation of the results of imaging methods, the relationship between imaging methods and systems to the HIS, basic concepts and methods in various fields of diagnostic imaging, basic imaging systems from the perspective of interpretation and description of images, from the field of diagnostic imaging practice (radiology, ultrasonography, magnetic resonance imaging, nuclear medicine, endoscopy, PET, SPECT).			
17ABBPMS	Probability and Mathematical Statistics	Z,ZK	4
Introduction to probability theory and mathematical statistics. Determinism and chance. Axiomatic definition. Random variable and its distribution function. Discrete and continuous distributions. Quintiles. Random vectors. Conditioning and independence. Functions of random variables. Characteristics of random variables, weak law of large numbers. The role of mathematical statistics, the population and sample. Random selection. Point and interval estimates. Hypothesis testing. Goodness. Non-parametric tests.			
17ABBPNK	Design and Construction of Medical Devices/Practical Exercises	KZ	2
This course will introduce students with basics of design, construction and development process of devices which are used in medical, clinical or laboratory practice. Subject will be divided in two parts. Theoretical part will that follow these topics: basic philosophy of device design and construction, materials, components, laws and standards, process of developments from blueprints and prototype to "ready to sell" device. Practical part will introduce students into blueprints designs, circuit and schematics drawing, PCB design and development, soldering THT and SMT components, signal conditioning and processing, data acquisition. Also students will develop their simple prototype device and create measuring application in LabVIEW.			
17ABBPP	First Aid	KZ	2
The course gives a brief overview of the main principles and procedures for providing urgent first aid, with special attention to the failure of vital functions and immediately life-threatening conditions. In this course are also included situations of mass disability during crisis situations and emergency events including the CBRN phenomenon. After successful completion of this course students should be able to diagnose life threatening conditions and provide adequate urgent first aid.			
17ABBPPM	Programming in Matlab	KZ	2
Basic description of MATLAB environment. Numerical formats. Variables and matrices. Complex numbers. Rounding numbers. Basic instructions. Matrices operations. Visualization. Simulink (basic description, exercise formulation, parameters entry). Conditional and cyclical instructions. Script creation, functions, debugging. Continuous and discrete processes. Symbolical solutions. Graphical user interface creation. Applications in MATLAB.			
17ABBPPP	Programming Tools	KZ	2
Introduction to software tools on MS Windows platform and GNU/Linux platform. Problem of portability of data-files, standardized exchange formats - HTML, XML, PDF, ODF, PNG etc. Introduction to administartion and configuration of MS Windows and GNU/Linux, programming of scripts, connectivity and comaptibility of major operating systems. Multiplatform applications - WWW browsers, e-mail clients, Office toolboxes, Graphical and CAD programs.			
17ABBPPSA	Patient and Device Simulators and Testers	Z,ZK	4
During the course attention will be given to the two large groups, i.e. patient simulators and instrumentation testers. The use of these two groups in clinical practice will also be part of the course. As an essential part of the teaching will be included laboratory exercises in the workplace simulated workplace intensive care unit, where all the samples are carried out			

with two groups of devices. The course has a direct relationship to future career opportunities. Great emphasis is placed on managing interdisciplinary teaching (especially linking physiology and engineering principles). Given the organization of teaching as a 2-hour blocks 1 for 14 days is shown below, only 7 lectures (there will be performed standard exercises or intensive/block instruction will be implemented due to the time of experiments and the limited possibilities in terms of number of students).

17ABBPSL	Psychology	KZ	2

Development, methodology and methods of psychology. Mental activities and psychic processes, psychology of personality, objects of psychology and their formation and development. Modern psychology; its concept and theory, psychic processes and stages. Psychological interpretation of personality. Application of knowledge in medical situations. Relation between technicians and medical doctors, technicians and patients, technicians and nurses. Communication as a tool for good cooperation amongst people and an aid to interactions. Basic expression and communication skills. Use of elocution and gestures in personal expression. Verbal and nonverbal communication. Dialogue; types of dialogue, questions during dialogue. Model situations. Communication process as part of economics - components, tools and functions.

17ABBRBL	Robotics in Medicine	KZ	2

Principles of robotics in medicine and laboratory technics - what kind of task is solving, synthesis of kinematics according to the task processed by robot - operational (surgical room), handling (laboratory), kinematics a dynamics of robot arm - computing methodology, verification of obtained models in Matlab environment, sensors and drives used by robots applicable in medicine, possible robot control paradigms - according human (operator) task.

17ABBRI	Rehabilitation Engineering	KZ	2

Physiotherapy, especially physical therapy, orthotics and prosthesis, selected parts of biomechanics and ergonomy. Physical therapeutic methods, technology in therapy (ultrasound apparatuses and technology for radiotherapy). Replacement by sensors and possibilities of communication with computer. Artificial organs and relevant circulatory confirmatory devices. Implantable medical devices - pacemakers, defibrilators, cardioverters.

17ABBROP	Guided Practical Training	Z	0
17ABBSEL	Power Engineering	Z,ZK	4

Basic power electronics, power supplies units including electrochemical supplies, rectifiers, stabilizers, common types of motors, basic distributions of electricity, types of electric systems and connecting of electric appliances with sight on medical purposes. The knowledge will be checked in the laboratory by mean of practical examples during the work in the laboratory.

17ABBSPR1	Semestral Project I.	KZ	2

Basic communication and presentation skills, including team work, team heading and project management. Creation of presentations and written texts. Typography rules. Types, purpose and requirements of technical presentations and technical texts. Writing a commented bibliographic search.

17ABBSPR2	Semestral Project II.	KZ	4

Basic communication and presentation skills. Creation of presentations and written texts. Typography rules. Types, purpose and requirements of technical presentations and technical texts. Writing a commented bibliographic search.

17ABBSPT	Equipments for Anaesthesiology and Resuscitation	Z,ZK	4

IN 2022/2023 THE SUBJECT IS MERGEDE WITH F7ABBSPT AND THE ACTUAL MATERIALS ARE AVAILABLE THERE. 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.

17ABBTEL	Theory of Electrical Engineering	Z,ZK	4

Electric current, DC and AC currents. Electrical curcuits including R, L, C. Power of electric current, thermal effect of electric current. Distribution of electrical energy. Connection of the electrical systems. Input resistance and impedance, idle voltage, inner resistance and impedance of the source, mutual loading of the source and electrical appliance, impedance matching. Properties of circuits in time and frequency domain. Transient action in DC circuits, frequency characteristics of the L/C circuit. Electrical current in semiconductor, type of the conductivity, creation of the semiconductor crossing, properties in the forward and reverse direction. Bipolar transistor - transistor effect, basic principle in elementary circuit. Unipolar transistor. Unipolar transistors with complementary vodivosti (CMOS). Electromagnetic effects (induction, magnetization, force effect). Electromagnetic wave, spreading, interference, electromagnetic compatibility. Soft and hard magnetic materials. Transformers construction and parameters. Magnetic recording and reproduction of signals. Electromotors principles.

17ABBTZS	Tomographical Imaging Systems	Z,ZK	4

Ultrasound medical imaging systems (US). Doppler systems. Computed tomography - CT (fundamental principle, system layout and arrangements, fundamental physical principle, development versions, reconstruction fundamental principles). Magnetic resonance imaging (MRI). Positron emission tomography (PET) and single photon emission computed tomography (SPECT). Specialized - hybride imaging systems. Lectures and especially the laboratory exercises provide students with an overview of the principles of image formation in medicine for tomographical and computed tomography based imaging systems and methods. There are described methods for image data sensing, digitization and subsequent processing and principles of function and properties of sensing image devices in context, which is especially relevant from the interdisciplinary point of view of the whole course and study specialization. Knowledge, skills and competences: The student is able to explain the basic physical principle of the given modalities and knows its layout including the principle of image formation. The student is able to assess, on the basis of standard definition of technical parameters that imaging system meets the physician requirements for selected modality. Such knowledge is a prerequisite to the correct process technology selection and application of the modalities as well as the minimum necessary to ensure the required quality of the resulting image data.

17ABBUSS	Introduction to Signals and Systems	Z,ZK	4

To introduce students to basics of theory of signals and systems. To explain main principles on applications from biology and medicine. To become acquainted with basic mutual relations in computer laboratories by means of MATLAB.

17ABBVBI	Virtual Bioinstrumentation	KZ	2

This subject deals with process of development of application in LabVIEW using Virtual Instrumentation concept. During the course will be explained basic concepts of programming like variables, data structures, cluster, loops, conditionals, typedefs, advanced coding concepts like event driven programming, multi-threaded application development, data queues and FIFOs, synchronisation, process of deployment, executable building, installer and upgrades. The students are able also to obtain the CLAD (Certificate LabVIEW Associate Developer) certificate. This certificate is first step in knowledge of VI.

17ABBZLN	Legislation in Health Care and Technical Standards	KZ	2

Health Services Act. Act on Professional Qualification for the Pursuit of the Medical Profession and on Further Education in Health Care (the Act on Medical Professions) and its implementing decrees. EU directives on medical devices. Act on Technical Requirements for Products. Government Regulation to the Act on Technical Requirements for Products. Structure of institutions dealing with the creation of technical standards in the Czech Republic and in the world. Technical standards relating to medical devices. Atomic law. Procedures for placing new medical devices on the market. Clinical testing of instruments. The role of testing laboratories. Some facts and experiences from abroad. Legislation on Good Manufacturing, Laboratory and Clinical Practice (GMP, GLP and GCP).

17ABBZOD	Image Data Processing	KZ	2

Continuous image representation, linear 2D systems, 2D spectrum, Digital representation of images, Basic image characteristics: brightness, contrast, resolution, noise, look up tables, histogram, Discrete Fourier transform, discrete cosine transform, image enhancement, geometric operations, image filtering, morphological operations, image restoration, image segmentation, basic principles of image compression.

17ABBZPD	Fundamentals of Pathology, Hygiene and Epidemiology	ZK	4

The subject provides a brief, clear and integral concept of medical branches, particularly internal medicine. The purpose of the subject is to acquaint the students with basic diseases, primary and secondary prevention of internal diseases and to define terms associated with the consideration of the patient health condition. The student should be able to compare

and differentiate from each other methods of health examination, described procedures for the basic clinical examination and understand its principle and importance. He/she is supposed to know methods of monitoring the patient health condition.			
17ABOZP	Occupational Safety and Health, Fire Protection and First Aid	Z	0

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