

# Study plan

## Name of study plan: Biomedical Technician - full time study

Faculty/Institute/Others:

Department: Department of Biomedical Technology

Branch of study guaranteed by the department: Biomedical Technician

Garantor of the study branch: doc. Ing. Jiří Hozman, Ph.D.

Program of study: Biomedical and Clinical Technology

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: 17PBB POV 17

Name of the group: Biomedical Technician 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
17PBBALP	<b>Algorithmic and Programming Theory</b> Lenka Hanáková, Pavel Smrka <b>Pavel Smrka</b>	KZ	4	2P+2C	Z	z
17PBBAF1	<b>Anatomy and Physiology I</b> Radek Matlach <b>Yulia uprová</b> Radek Matlach (Gar.)	Z,ZK	5	2P+1S+1L	Z	z
17PBBAF2	<b>Anatomy and Physiology II</b>	Z,ZK	5	2P+1S+1L	L	z
17PBBAA3A	<b>English Language IIIA (part 1)</b> Eva Motyková <b>Eva Motyková</b> (Gar.)	KZ	2	2S	Z	z
17PBBAA3B	<b>English Language IIIB (part 2)</b> Eva Motyková	KZ	2	2S	L	z
17PBBBP	<b>Bachelor Thesis</b> Jiří Hozman	Z	8	8L	L	z
17BOZP	<b>Occupational Safety and Health, Fire Protection and First Aid</b> Petr Kudrna <b>Petr Kudrna</b> Petr Kudrna (Gar.)	Z	0	1P	Z	z
17PBBBCH	<b>Biochemistry</b> Kristýna Poncová <b>Iveta Horáková</b>	KZ	2	1P+1L	Z	z
17PBBBLS	<b>Biological Signals</b>	Z,ZK	4	2P+2C	L	z
17PBBBLG	<b>Biology</b> Veronika Vymtalová <b>Veronika Vymtalová</b> (Gar.)	Z,ZK	4	2P+2L	Z	z
17PBBBB	<b>Biomechanics and Biomaterials</b> Patrik Kutílek, Michaela Hrouzová <b>Patrik Kutílek</b> Patrik Kutílek (Gar.)	Z,ZK	4	2P+2L	Z	z
17PBBBOZP	<b>Safety Regulations and Standards in Electrical Engineering</b> Petr Kudrna, Miroslav Jelínek <b>Petr Kudrna</b> Petr Kudrna (Gar.)	Z	1	1P	Z	z
17PBBCHM	<b>Chemistry</b> Iveta Horáková	Z,ZK	4	2P+1C+1L	L	z
17PBBEM	<b>Electrical Measurements</b> Peter Kneppo, Jan Vrba <b>Petr Kudrna</b> Peter Kneppo (Gar.)	Z,ZK	4	2P+2L	Z	z
17PBBELFA	<b>Electrophysiology</b> Yulia uprová, Ksenia Sedova <b>Ksenia Sedova</b> Pavel Kuera (Gar.)	Z,ZK	2	1P+1L	Z	z
17PBBEO	<b>Electronic Circuits</b> Jan Uhlí, Martin Pokorný <b>Jan Uhlí</b> Jan Uhlí (Gar.)	Z,ZK	4	2P+2C	Z	z
17PBBESL	<b>Electronic Elements and Sensors in Medicine</b> David Vrba	Z,ZK	4	2P+2L	L	z
17PBBEBI	<b>Ethics in Biomedical Engineering</b>	KZ	2	2P	L	z

17PBFBFY1	<b>Physics I</b> <i>Jan Mikšovský, Eva Urbánková, Jana Urzová, Petr Písařík, Svitlana Strunina Petr Písařík Jan Mikšovský (Gar.)</i>	Z,ZK	5	2P+1S+1L	Z	z
17PBFBFY2	<b>Physics II</b> <i>Petr Písařík</i>	Z,ZK	5	2P+1S+1L	L	z
17PBFBFCH	<b>Physical Chemistry</b> <i>Iveta Horáková, Karel Roubík Iveta Horáková Karel Roubík (Gar.)</i>	Z,ZK	4	2P+1S+1L	Z	z
17PBFBISZ	<b>Information Systems in Health Care</b> <i>Dagmar Brechlerová, Dagmar Brechlerová, Zoltán Szabó, Radim Krupíka, Libor Seidl, Petr Šmíd Radim Krupíka Zoltán Szabó (Gar.)</i>	Z,ZK	4	2P+2C	Z	z
17PBFBITT	<b>Information Technologies and Telemedicine</b>	ZK	2	2P	Z	z
17PBFBITP	<b>Integral Calculus</b> <i>Eva Feuerstein</i>	Z,ZK	5	2P+2C	L	z
17PBFBKZS	<b>Conventional Imaging Systems</b> <i>Jiří Hozman</i>	Z,ZK	4	2P+2C	L	z
17PBFBLT	<b>Clinical Laboratory Instrumentation</b> <i>Iveta Horáková</i>	Z,ZK	4	2P+2L	L	z
17PBFBLAD	<b>Linear Algebra and Differential Calculus</b> <i>Jana Urzová, Eva Feuerstein Eva Feuerstein (Gar.)</i>	Z,ZK	4	2P+2S	Z	z
17PBFBLTR	<b>Medical Terminology</b>	Z	1	1P	Z	z
17PBFBLPZ1	<b>Medical Devices and Equipments I (Diagnostic Devices)</b> <i>Petr Kudrna, Karel Roubík, Martin Rožánek Petr Kudrna Karel Roubík (Gar.)</i>	Z,ZK	4	2P+2C	Z	z
17PBFBLPZ2	<b>Medical Devices and Equipments (Therapeutical Devices)</b> <i>Petr Kudrna</i>	Z,ZK	4	2P+2L	L	z
17PBFBMAZ	<b>Management and Administration in Healthcare</b>	KZ	1	1P	L	z
17PBFBMZT	<b>Management of Health Care Technology</b>	Z,ZK	2	1P+1C	L	z
17PBFBMEC	<b>Mechanics</b> <i>Patrik Kutílek</i>	Z,ZK	4	2P+2L	L	z
17PBFBMVP	<b>Research Methodology</b> <i>Karel Roubík, Jakub Ráfil, Marek Piorecký Karel Roubík (Gar.)</i>	KZ	2	1P+1S	Z	z
17PBFBMS	<b>Modelling and Simulation</b>	Z,ZK	4	2P+2C	L	z
17PBFBNMP	<b>Project Proposal and Management</b>	KZ	2	1P+1C	L	z
17PBFBIOIZ	<b>Protection Against Effects of Ionizing Radiation</b>	KZ	2	2P	L	z
17PBFBPPSA	<b>Patient and Device Simulators and Testers</b> <i>Petr Kudrna, Martin Rožánek, Jiří Hozman, Lenka Horáková Jiří Hozman Jiří Hozman (Gar.)</i>	Z,ZK	4	2P+2L	Z	z
17PBFBPNK	<b>Design and Construction of Medical Devices/Practical Exercises</b> <i>Roman Matějka Roman Matějka Roman Matějka (Gar.)</i>	KZ	2	2L	Z	z
17PBFBPMS	<b>Probability and Mathematical Statistics</b> <i>Hana Schaabová, Vladimír Rogalewicz, Jakub Šebek Hana Schaabová Vladimír Rogalewicz (Gar.)</i>	Z,ZK	4	2P+2C	Z	z
17PBFBPP	<b>First Aid</b>	KZ	2	1P+1C	L	z
17PBFBPPM	<b>Programming in Matlab</b> <i>Tereza Duspivová, David Jirsa, Michal Reimer</i>	KZ	2	2S	Z	z
17PBFBPSL	<b>Psychology</b>	KZ	2	1P+1S	Z	z
17PBFBSPR2	<b>Semestral Project II.</b> <i>Petr Kudrna Petr Kudrna Petr Kudrna (Gar.)</i>	KZ	4	4C	Z	z
17PBFBSEL	<b>Power Engineering</b>	Z,ZK	4	2P+2L	L	z
17PBFBSPPT	<b>Equipments for Anaesthesiology and Resuscitation</b> <i>Martin Rožánek</i>	Z,ZK	4	1P+1L	L	z
17PBFBTEL	<b>Theory of Electrical Engineering</b>	Z,ZK	4	2P+2L	L	z
17PBFBTZS	<b>Tomographical Imaging Systems</b> <i>Martin Rožánek, Jiří Hozman, Tomáš Dřímal Jiří Hozman Jiří Hozman (Gar.)</i>	Z,ZK	4	2P+2C	Z	z
17PBFBZLN	<b>Legislation in Health Care and Technical Standards</b> <i>Peter Kneppo, Ondřej Gajdoš, Vojtěch Kamenský, Anna Erfányuková Peter Kneppo (Gar.)</i>	KZ	2	1P+1S	Z	z
17PBFBZPD	<b>Fundamentals of Pathology, Hygiene and Epidemiology</b>	ZK	4	3P	L	z
17PBFBUSS	<b>Introduction to Signals and Systems</b> <i>Jan Kauler Jan Kauler Jan Kauler (Gar.)</i>	Z,ZK	4	2P+2C	Z	z
17PBFBROP	<b>Guided Practical Training</b> <i>Petr Kudrna</i>	Z	0	100XH	L	z

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

17PBFBALP	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.			
17PBFBAF1	Anatomy and Physiology I	Z,ZK	5
The combined subject of anatomy and physiology is the introductory course of medical subjects for non-medical specialties.			

17PBBAF2	Anatomy and Physiology II Anatomy and physiology II" links to Anatomy and Physiology I. The subject covers functional aspects of particular organs and their systems.	Z,ZK	5
17PBBA3A	English Language IIIA (part 1) Academic and professional English. This course focuses on expansion of professional vocabulary, grammar skills and listening and reading skills related to scientific topics.	KZ	2
17PBBA3B	English Language IIIB (part 2) Academic and professional English	KZ	2
17PBBDP	Bachelor Thesis 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.	Z	8
17BOZP	Occupational Safety and Health, Fire Protection and First Aid	Z	0
17PBBDCH	Biochemistry 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.	KZ	2
17PBBDLS	Biological Signals 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 processing.	Z,ZK	4
17PBBDLG	Biology Basic information about the cellular level of organisms - from acellular 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 (nucleic acids and proteins). The nucleus, plastids, mitochondria. Cytoplasm. Endomembrane system: endoplasmic reticulum, the Golgi apparatus, lysosomes, microbodies (glyoxisomes, peroxisomes), vacuoles. Semiautonomous 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. Plant anatomy and histology. Types of plant cells and tissues. Tissue systems: meristems, epidermal, water-conducting and ground tissues, their structure and functions. Animal tissue histology. Animal cells and tissues. Human genetics. Chromosomal aberrations, genetic disorders and diseases. Genetic engineering. GMO organisms. Gene therapy.	Z,ZK	4
17PBBDDB	Biomechanics and Biomaterials Introduce to biomechanics, Biomaterials, rheological models, Mechanic characteristic of bones, ligaments, tendons, muscles and cartilages, Endoprosthesis and exoprosthesis, Biomechanics of movement, gait mechanics, Kinematics and dynamics in biomechanics, Mechanical work and power of body, Stress and deformation, Finite element method. Intelligent prostheses.	Z,ZK	4
17PBBDZP	Safety Regulations and Standards in Electrical Engineering 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.	Z	1
17PBBDCHM	Chemistry 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	Z,ZK	4
17PBBDME	Electrical Measurements 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.	Z,ZK	4
17PBBDLFA	Electrophysiology 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.	Z,ZK	2
17PBBD EO	Electronic Circuits 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.	Z,ZK	4
17PBBD ESL	Electronic Elements and Sensors in Medicine 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.	Z,ZK	4
17PBBD EBI	Ethics in Biomedical Engineering 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.	KZ	2
17PBBD FY1	Physics I 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.	Z,ZK	5
17PBBD FY2	Physics II	Z,ZK	5

17PBBFCH	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, pO <sub>2</sub> , pCO <sub>2</sub> . Electrolysis and its application. Corrosion and protection of implants. Other analytical methods based on principles of physical chemistry.			
17PBBISZ	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.			
17PBBITT	Information Technologies and Telemedicine	ZK	2
Computer history, structure of computers, motherboard, processors, memory, 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, multiprocessing, set of instruction, assembler, programming languages, power test, network, LAN, WAN, internet, TCP/IP, HTTP, FTP etc., client-server, gate, router, using IT in medicine and telemedicine.			
17PBBITP	Integral Calculus	Z,ZK	5
The subject is an introduction to integral calculus and integral transforms. Integral calculus: primitive function, 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.			
17PBBKZS	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.			
17PBBLT	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), immunoassays 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.			
17PBBLAD	Linear Algebra and Differential Calculus	Z,ZK	4
Differential calculus consists of: sequences and their limits. Functions of one real variable, their limits, continuity, derivatives. Local and absolute extrema of a function of one variable, investigations of functions. Taylor-polynomial.			
17PBBLTR	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.			
17PBBLPZ1	Medical Devices and Equipments I (Diagnostic Devices)	Z,ZK	4
17PBBLPZ2	Medical Devices and Equipments (Therapeutical Devices)	Z,ZK	4
17PBBMAZ	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.			
17PBBMZT	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.			
17PBBMEC	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.			
17PBBMVP	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.			
17PBBMS	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.			
17PBBNMP	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.			
17PBBIOZ	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.)			

17PBBPPSA	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).			
17PBBPNK	Design and Construction of Medical Devices/Practical Exercises	KZ	2
Following situations will be addressed: properties and possibilities of instrumentation amplifier utilization, different ways to suppress common signal, different ways to perform galvanic separation, design and development of the ECG and EEG preamplifiers, connections of specialized sensors and transducers. Course is devoted especially to students who will have use medical electronic equipment in practice.			
17PBBPMS	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.			
17PBBPP	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.			
17PBBPPM	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.			
17PBBPSL	Psychology	KZ	2
Development, methodology and method of psychology. Mental activities and psychic processes, psychology of personality, object 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 technician and medical doctor, technician and patient, technician and nurse. Communication as a tool for good cooperation amongst people and helps in interactions with them. Basic expression and communication skills. Use of elocution and gestures in personal expression. Verbal and nonverbal communication. Dialogs, types of dialogs, questions during dialog. Model situations. Communication process as part of economics - components, tools and functions.			
17PBBSPR2	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.			
17PBBSEL	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.			
17PBBSP	Equipments for Anaesthesiology and Resuscitation	Z,ZK	4
Overview of the equipment, general requirements. Principles and adverse effects of artificial lung ventilation. Conventional and unconventional ventilatory regimens, ventilators. Principles and equipment in anesthesiology. Anaesthetics. Humidification and humidifiers. Bedside monitors. Other diagnostic and therapeutic equipment for CCM (ITU) departments.			
17PBBTEL	Theory of Electrical Engineering	Z,ZK	4
Electric current, DC and AC currents. Electrical circuits 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.			
17PBBTZS	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.			
17PBBZLN	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).			
17PBBZPD	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.			
17PBBUSS	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.			
17PBBROP	Guided Practical Training	Z	0

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: 17PBB PV 2S 17

Name of the group: Biomedical Technician 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) <i>Tutors, authors and guarantors (gar.)</i>	Completion	Credits	Scope	Semester	Role
17PBBBUJ	<b>Biological Effects of Ionizing Radiation</b>	KZ	2	2P	L	s
17PBBEZP	<b>Economics of Health Services</b>	KZ	2	1P+1S	L	s
17PBBMAT	<b>Marketing of Medical Technology</b>	KZ	2	2P	L	s
17PBBPPP	<b>Programming Tools</b> <i>Pavel Smr ka</i>	KZ	2	2C	L	s

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

17PBBBUJ	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.		
17PBBEZP	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.		
17PBBMAT	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.		
17PBBPPP	Programming Tools	KZ	2	Introduction to modern software resources in MS Windows and GNU/Linux environment - office applications, basic visualisation of experimental data, graphical presentation, Internet communication. Data formats, compatibility. Selected parts of the course are compatible with the ECDL (European Computer Driving Licence) knowledge syllabus .		

Code of the group: 17PBB PV 3S 17

Name of the group: Biomedical Technician 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) <i>Tutors, authors and guarantors (gar.)</i>	Completion	Credits	Scope	Semester	Role
17PBBBFT	<b>Biophotonics</b> <i>Jan Mikšovský, Petr Písa ik, Jan Remsa Petr Písa ik Petr Písa ik (Gar.)</i>	KZ	2	2P	Z	s
17PBBFVP	<b>Multivariable Calculus</b> <i>Jana Urzová Jana Urzová (Gar.)</i>	KZ	2	1P+1C	Z	s
17PBBMFJ	<b>Physical Phenomena Modeling in COMSOL Multiphysics</b> <i>Jan Vrba, David Vrba David Vrba David Vrba (Gar.)</i>	KZ	2	1P+1C	Z	s
17PBBPMP1A	<b>Devices, Methods and Procedures in Clinical Practice I</b>	KZ	2	1P+1L	Z	s

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

17PBBBFT	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.		
17PBBFVP	Multivariable Calculus	KZ	2	The course is focused at elements of calculus in two and more variables and at real, complex and functional series. 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. Complex sequences, series of numbers. Convergence of complex series. Functional series and their convergence, power series. Taylor series. .		

17PBMMFJ	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.			
17PBMP1A	Devices, Methods and Procedures in Clinical Practice I	KZ	2
Introducing the hospital, test, projects at the University Hospital Motol, DAICM for childrens, calibration gas analyzer PrinterNOx, laser marking of operational tools, hospital information systems - SW for administration of medical devices, radiotherapy, infusion technology, breathing apparatus - ventilation, ventilators, DAICM - department of anaesthesiology and critical care medicine, department of medical imaging - MRI, X-ray, internal safety check, pediatrics, endoscopy, immunology, blood bank, vacuum therapy, operating theaters-anesthesia, department of nuclear medicine, central sterilization, tube post, summary of practice.			

Code of the group: 17PBB PV 4S 17

Name of the group: Biomedical Technician 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
17PBBDIZ	Detectors of Ionizing Radiation	KZ	2	2P	L	s
17PBIFY3	Physics III Petr Písa ík	KZ	2	1P+1L	L	s
17PBMDT	Microwave Diagnostics and Therapy David Vrba	KZ	2	1P+1C	L	s
17PBMP2A	Devices, Methods and Procedures in Clinical Practise II	KZ	2	1P+1L	L	s
17PBSPR1	Semestral project I. Petr Kudrna	KZ	2	2C	L	s

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

17PBBDIZ	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.			
17PBIFY3	Physics III	KZ	2
The course extends the previous courses Physics I. and Physics II. It focuses on phenomena related to waves (mechanic or electromagnetic waves) and their applications in science, technics and medicine. In the first part, acoustics and applications of ultrasound will be presented. The second part describes wave and geometric optics. We will also touch basics of quantum mechanics.			
17PBMDT	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.			
17PBMP2A	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).			
17PBSPR1	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: 17PBB PV 5S 17

Name of the group: Biomedical Technician 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
17PBBAZD	<b>Biomedical Data Analysis and Processing</b> Tereza Duspivová, Jan Kauler Jan Kauler (Gar.)	KZ	2	1P+1C	Z	s
17PBMBTB	<b>Microprocessors in Biomedicine</b> Pavel Smr ka Pavel Smr ka Pavel Smr ka (Gar.)	KZ	2	1P+1L	Z	s
17PBVBVI	<b>Virtual Bioinstrumentation</b> Roman Mat jka Roman Mat jka Roman Mat jka (Gar.)	KZ	2	1P+1L	Z	s
17PBZOD	<b>Image Data Processing</b> Zoltán Szabó, Jan Tesa Radim Krupi ka Zoltán Szabó (Gar.)	KZ	2	1P+1L	Z	s

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

17PBBAZD	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 spectral 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.		
17PBMBTB	Microprocessors in Biomedicine	KZ	2	Introduction to embedded microprocessor systems in medicine, principles and structure of microcontrollers, logical circuits. Interconnection with common peripheral devices: AD and DA converters, serial communication, RS232, Ethernet, WIFI, Bluetooth and mobile 3G/4G communication, GPS localization. Examples of embedded systems on architectures ATmega and ARM Coretx M. Introduction to multiplatform software development fo embedded systems.		
17PBVBVI	Virtual Bioinstrumentation	KZ	2			
17PBZOD	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: 17PBB PV 6S 17

Name of the group: Biomedical Technician 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
17PBBAZC	<b>Algorithms for Biosignal Processing in the C Language</b>	KZ	2	1P+1C	L	s
17PBEBMP	<b>Electromagnetic Fields of Living Organisms</b> Jan Vrba	KZ	2	1P+1S	L	s
17PBEBRI	<b>Rehabilitation Engineering</b>	KZ	2	1P+1L	L	s
17PBEBRBL	<b>Robotics in Medicine</b> Jan Kauler	KZ	2	1P+1L	L	s

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

17PBBAZC	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.		
17PBEBMP	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.		
17PBEBRI	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.		
17PBEBRBL	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
17BOZP	Occupational Safety and Health, Fire Protection and First Aid	Z	0
17PBBA3A	English Language IIIA (part 1) Academic and professional English. This course focuses on expansion of professional vocabulary, grammar skills and listening and reading skills related to scientific topics.	KZ	2
17PBBA3B	English Language IIIB (part 2) Academic and professional English	KZ	2
17PBBAF1	Anatomy and Physiology I The combined subject of anatomy and physiology is the introductory course of medical subjects for non-medical specialties.	Z,ZK	5
17PBBAF2	Anatomy and Physiology II Anatomy and physiology II" links to Anatomy and Physiology I. The subject covers functional aspects of particular organs and their systems.	Z,ZK	5
17PBBALP	Algorithmic and Programming Theory 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.	KZ	4
17PBBAZC	Algorithms for Biosignal Processing in the C Language 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 and IIR filters. Methods of biosignal visualisation.	KZ	2
17PBBAZD	Biomedical Data Analysis and Processing 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 correlogram 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 spectral analysis. Repeated measurements and analysis of their properties. AR and ARMA model parameter identification. Prediction. Bivariate analysis of time series - cross-correlation and cross-covariance and their estimation. Bispectrum.	KZ	2
17PBBBBB	Biomechanics and Biomaterials Introduce to biomechanics, Biomaterials, rheological models, Mechanic characteristic of bones, ligaments, tendons, muscles and cartilages, Endoprothesis and exoprothesis, Biomechanics of movement, gait mechanics, Kinematics and dynamics in biomechanics, Mechanical work and power of body, Stress and deformation, Finite element method. Intelligent prostheses.	Z,ZK	4
17PBBBCH	Biochemistry 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.	KZ	2
17PBBBFT	Biophotonics 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.	KZ	2
17PBBBLG	Biology Basic information about the cellular level of organisms - from acellular 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 (nucleic acids and proteins). The nucleus, plastids, mitochondria. Cytoplasm. Endomembrane system: endoplasmic reticulum, the Golgi apparatus, lysosomes, microbodies (glyoxisomes, peroxisomes), vacuoles. Semiautonomous 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. Plant anatomy and histology. Types of plant cells and tissues. Tissue systems: meristems, epidermal, water-conducting and ground tissues, their structure and functions. Animal tissue histology. Animal cells and tissues. Human genetics. Chromosomal aberrations, genetic disorders and diseases. Genetic engineering. GMO organisms. Gene therapy.	Z,ZK	4
17PBBBLS	Biological Signals 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 processing.	Z,ZK	4
17PBBBOZP	Safety Regulations and Standards in Electrical Engineering 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.	Z	1
17PBBBBP	Bachelor Thesis 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.	Z	8

17PBBBUI	<b>Biological Effects of Ionizing Radiation</b>	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.			
17PBBCHM	<b>Chemistry</b>	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			
17PBBDIZ	<b>Detectors of Ionizing Radiation</b>	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.			
17PBBEBI	<b>Ethics in Biomedical Engineering</b>	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.			
17PBBELFA	<b>Electrophysiology</b>	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.			
17PBBEM	<b>Electrical Measurements</b>	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.			
17PBBEMP	<b>Electromagnetic Fields of Living Organisms</b>	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.			
17PBBEO	<b>Electronic Circuits</b>	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.			
17PBBESL	<b>Electronic Elements and Sensors in Medicine</b>	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.			
17PBBEZP	<b>Economics of Health Services</b>	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.			
17PBBFCH	<b>Physical Chemistry</b>	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, pO <sub>2</sub> , pCO <sub>2</sub> . Electrolysis and its application. Corrosion and protection of implants. Other analytical methods based on principles of physical chemistry.			
17PBBFVP	<b>Multivariable Calculus</b>	KZ	2
The course is focused at elements of calculus in two and more variables and at real, complex and functional series. 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. Complex sequences, series of numbers. Convergence of complex series. Functional series and their convergence, power series. Taylor series. .			
17PBBFY1	<b>Physics I</b>	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.			
17PBBFY2	<b>Physics II</b>	Z,ZK	5
17PBBFY3	<b>Physics III</b>	KZ	2
The course extends the previous courses Physics I. and Physics II. It focuses on phenomena related to waves (mechanic or electromagnetic waves) and their applications in science, technics and medicine. In the first part, acoustics and applications of ultrasound will be presented. The second part describes wave and geometric optics. We will also touch basics of quantum mechanics.			
17PBBISZ	<b>Information Systems in Health Care</b>	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.			
17PBBITP	<b>Integral Calculus</b>	Z,ZK	5
The subject is an introduction to integral calculus and integral transforms. Integral calculus: primitive function, 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.			
17PBBITT	Information Technologies and Telemedicine	ZK	2
Computer history, structure of computers, motherboard, processors, memory, 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, multimedia devices, mass data storage, multitasking, multiprocessing, set of instruction, assembler, programming languages, power test, network, LAN, WAN, internet, TCP/IP, HTTP, FTP etc., client-server, gate, router, using IT in medicine and telemedicine.			
17PBBKZS	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.			
17PBBLAD	Linear Algebra and Differential Calculus	Z,ZK	4
Differential calculus consists of: sequences and their limits. Functions of one real variable, their limits, continuity, derivatives. Local and absolute extrema of a function of one variable, investigations of functions. Taylor-polynomial.			
17PBBLPZ1	Medical Devices and Equipments I (Diagnostic Devices)	Z,ZK	4
17PBBLPZ2	Medical Devices and Equipments (Therapeutical Devices)	Z,ZK	4
17PBBLT	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), immunoassays 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.			
17PBBLTR	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 knowledge check up through the use of tests.			
17PBBMAT	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.			
17PBBMAZ	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.			
17PBBMDT	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.			
17PBBMEC	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.			
17PBBMFJ	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.			
17PBBMS	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.			
17PBBMTB	Microprocessors in Biomedicine	KZ	2
Introduction to embedded microprocessor systems in medicine, principles and structure of microcontrollers, logical circuits. Interconnection with common peripheral devices: AD and DA converters, serial communication, RS232, Ethernet, WIFI, Bluetooth and mobile 3G/4G communication, GPS localization. Examples of embedded systems on architectures ATmega and ARM Coretx M. Introduction to multiplatform software development for embedded systems.			
17PBBMVP	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 tool 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.			
17PBBMZT	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.			
17PBBNMP	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.			
17PBBOIZ	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.)			
17PBPPMP1A	Devices, Methods and Procedures in Clinical Practice I	KZ	2
Introducing the hospital, test, projects at the University Hospital Motol, DAICM for childrens, calibration gas analyzer PrinterNOx, laser marking of operational tools, hospital information systems - SW for administration of medical devices, radiotherapy, infusion technology, breathing apparatus - ventilation, ventilators, DAICM - department of anaesthesiology and critical care medicine, department of medical imaging - MRI, X-ray, internal safety check, pediatrics, endoscopy, immunology, blood bank, vacuum therapy, operating theaters-anesthesia, department of nuclear medicine, central sterilization, tube post, summary of practice.			
17PBPPMP2A	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).			
17PBPPMS	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.			
17PBPPNK	Design and Construction of Medical Devices/Practical Exercises	KZ	2
Following situations will be addressed: properties and possibilities of instrumentation amplifier utilization, different ways to suppress common signal, different ways to perform galvanic separation, design and development of the ECG and EEG preamplifiers, connections of specialized sensors and transducers. Course is devoted especially to students who will have use medical electronic equipment in practice.			
17PBPP	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.			
17PBPPPM	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.			
17PBPPPP	Programming Tools	KZ	2
Introduction to modern software resources in MS Windows and GNU/Linux environment - office applications, basic visualisation of experimental data, graphical presentation, Internet communication. Data formats, compatibility. Selected parts of the course are compatible with the ECDL (European Computer Driving Licence) knowledge syllabus .			
17PBPPPSA	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).			
17PBPPSL	Psychology	KZ	2
Development, methodology and method of psychology. Mental activities and psychic processes, psychology of personality, object 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 technician and medical doctor, technician and patient, technician and nurse. Communication as a tool for good cooperation amongst people and helps in interactions with them. Basic expression and communication skills. Use of elocution and gestures in personal expression. Verbal and nonverbal communication. Dialogs, types of dialogs, questions during dialog. Model situations. Communication process as part of economics - components, tools and functions.			
17PBPPBRL	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.			
17PBPPRI	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.			
17PBPPROP	Guided Practical Training	Z	0
17PBPPSEL	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.			
17PBPPSPR1	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.			
17PBPPSPR2	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.			
17PBPPSPT	Equipments for Anaesthesiology and Resuscitation	Z,ZK	4
Overview of the equipment, general requirements. Principles and adverse effects of artificial lung ventilation. Conventional and unconventional ventilatory regimens, ventilators. Principles and equipment in anaesthesiology. Anaesthetics. Humidification and humidifiers. Bedside monitors. Other diagnostic and therapeutic equipment for CCM (ITU) departments.			
17PBPPTEL	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.

17PBBTZS	<b>Tomographical Imaging Systems</b>	Z,ZK	4
<p>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.</p>			
17PBBUSS	<b>Introduction to Signals and Systems</b>	Z,ZK	4
<p>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.</p>			
17PBBVBI	<b>Virtual Bioinstrumentation</b>	KZ	2
17PBBZLN	<b>Legislation in Health Care and Technical Standards</b>	KZ	2
<p>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).</p>			
17PBBZOD	<b>Image Data Processing</b>	KZ	2
<p>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.</p>			
17PBBZPD	<b>Fundamentals of Pathology, Hygiene and Epidemiology</b>	ZK	4
<p>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.</p>			

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

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