Study plan

Name of study plan: Biomedical Technology

Faculty/Institute/Others:
Department:
Branch of study guaranteed by the department: Welcome page
Garantor of the study branch:
Program of study: Biomedical 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: F7PBB POV 20
Name of the group: Biomedical Technology compulsory course
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 56 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
F7PBBALP	**Algorithmic and Programming Theory** *Pavel Smrčka, Tomáš Veselý, Lenka Hanáková, Christiane Malá* ***Pavel Smrčka*** *Pavel Smrčka (Gar.)*	KZ	4	2P+2C	Z	z
F7PBBAF1	**Anatomy and Physiology I.** *Roman Máčalík, Jakub Tlapák* ***Jakub Tlapák*** *Jakub Tlapák (Gar.)*	Z,ZK	4	2P+1C+1L	Z	z
F7PBBAF2	**Anatomy and Physiology II.** *Jakub Tlapák* ***Jakub Tlapák*** *Jakub Tlapák (Gar.)*	Z,ZK	4	2P+1C+1L	L	z
F7PBBA3A	**English Language IIIA (part 1)** *Eva Motyčková* ***Eva Motyčková*** *Eva Motyčková (Gar.)*	KZ	2	2C	Z	z
F7PBBA3B	**English Language IIIB (part 2)** *Eva Motyčková* ***Eva Motyčková*** *Eva Motyčková (Gar.)*	KZ	2	2C	L	z
F7PBBBP	**Bachelor Thesis** *Jiří Hozman* ***Jiří Hozman*** *Jiří Hozman (Gar.)*	Z	6	8C	L	z
17BOZP	**Occupational Safety and Health, Fire Protection and First Aid** *Petr Kudrna* ***Petr Kudrna*** *Petr Kudrna (Gar.)*	Z	0	1P	Z	z
F7PBBBCH	**Biochemistry** *Martina Turchichová, Anna Ludvíková, Kateřina Dunovská* ***Anna Ludvíková*** *Martina Turchichová (Gar.)*	Z,ZK	2	1P+1L	Z	z
F7PBBBLS	**Biological Signals** *Marek Piorecký, Václava Piorecká* ***Václava Piorecká*** *Václava Piorecká (Gar.)*	Z,ZK	4	2P+2L	L	z
F7PBBBLG	**Biology** *Veronika Vymětalová, Aneta Buchtelová* ***Veronika Vymětalová*** *Veronika Vymětalová (Gar.)*	Z,ZK	4	2P+2L	Z	z
F7PBBBB	**Biomechanics and Biomaterials** *Matej Daniel* ***Petr Volf*** *Matej Daniel (Gar.)*	Z,ZK	4	2P+2L	Z	z
F7PBBBOZP	**Safety Regulations and Standards in Electrical Engineering** *Petr Kudrna, Jan Remsa* ***Petr Kudrna*** *Petr Kudrna (Gar.)*	Z	1	1P	Z	z
F7PBBCHM	**Chemistry** *Iveta Horáčková, Miriam Hošková* ***Iveta Horáčková*** *Miriam Hošková (Gar.)*	Z,ZK	4	2P+1C+1L	L	z
F7PBBEM	**Electrical Measurements** *Roman Matějka, Jan Vrba* ***Jan Vrba*** *Jan Vrba (Gar.)*	Z,ZK	4	2P+2C	Z	z
F7PBBELF	**Electrophysiology** *Anastasia Sedova, Ksenia Sedova, Pavel Kučera* ***Anastasia Sedova*** *Ksenia Sedova (Gar.)*	Z,ZK	2	1P+1L	Z	z
F7PBBEO	**Electronic Circuits** *Jan Uhlíř* ***Tomáš Dřížďal*** *Jan Uhlíř (Gar.)*	Z,ZK	4	2P+2C	Z	z

F7PBBEBI	**Ethics in Biomedical Engineering** *Martina Dingová Šliková **Martina Dingová Šliková** Martina Dingová Šliková (Gar.)*	ZK	2	2P	L	z
F7PBBESP	**Management of Health Care Technology** *Jiří Petráček **Jiří Petráček** Jiří Petráček (Gar.)*	Z,ZK	2	1P+1C	L	z
F7PBBFY1	**Physics I.** *Jan Mikšovský, Eva Urbánková, Petr Písařík **Petr Písařík** Jan Mikšovský (Gar.)*	Z,ZK	4	2P+1C+1L	Z	z
F7PBBFY2	**Physics II.** *Jan Mikšovský, Eva Urbánková, Petr Písařík, Jana Urzová **Petr Písařík** Jan Mikšovský (Gar.)*	Z,ZK	6	2P+2C+2L	L	z
F7PBBFCH	**Physical Chemistry** *Karel Roubík, Martina Turchichová, Iveta Horáčková **Iveta Horáčková** Karel Roubík (Gar.)*	Z,ZK	4	2P+1C+1L	Z	z
F7PBBHE	**Hygiene and Epidemiology** *Lucie Lidická, Emil Pavlík **Lucie Lidická** Emil Pavlík (Gar.)*	ZK	1	1P	L	z
F7PBBISZ	**Information Systems in Health Care** *Zoltán Szabó, Dagmar Brechlerová, David Jirsa, Anna Horňáková, Petr Šmíd, Tomáš Krajča **Anna Horňáková** Zoltán Szabó (Gar.)*	Z,ZK	4	2P+2C	Z	z
F7PBBITP	**Integral Calculus** *Jiří Neustupa, Tomáš Parkman **Tomáš Parkman** Tomáš Parkman (Gar.)*	Z,ZK	4	2P+2C	L	z
F7PBBKT	**Communication Technology** *Tomáš Veselý, Aneta Buchtelová, Karel Hána, Tomáš Funda, Martin Vítězník, Markéta Janatová, Kateřina Pilátová **Tomáš Funda** Karel Hána (Gar.)*	Z,ZK	2	1P+1C	Z	z
F7PBBKZS	**Conventional Imaging Systems** *Jiří Hozman, Tomáš Dřížďal, Martin Rožánek, Martin Čapek **Tomáš Dřížďal** Jiří Hozman (Gar.)*	Z,ZK	4	2P+1C+1L	L	z
F7PBBLT	**Clinical Laboratory Instrumentation** *Martina Turchichová **Martina Turchichová** Martina Turchichová (Gar.)*	Z,ZK	4	2P+2L	L	z
F7PBBLPZ1	**Management of Health Care Technology** *Petr Kudrna, Martin Rožánek **Petr Kudrna** Martin Rožánek (Gar.)*	Z,ZK	4	2P+2L	Z	z
F7PBBLPZ2	**Medical Devices and Equipment II. (Therapeutical Devices)** *Petr Kudrna, Václav Ort, Karel Roubík **Petr Kudrna** Petr Kudrna (Gar.)*	Z,ZK	2	1P+1L	L	z
F7PBBLAD	**Linear Algebra and Differential Calculus** *Jana Urzová, Jiří Neustupa, Tomáš Parkman, Lukáš Liebzeit **Tomáš Parkman** Tomáš Parkman (Gar.)*	Z,ZK	6	2P+4C	Z	z
F7PBBMAZ	**Management and Admininistration in Health Care** *Jiří Černý **Jiří Černý** Jiří Černý (Gar.)*	KZ	1	1P	Z	z
F7PBBMEC	**Mechanics** *Matej Daniel **Matej Daniel** Matej Daniel (Gar.)*	Z,ZK	4	2P+2L	L	z
F7PBBMT	**Medical Terminology** *Dana Rebeka Ralbovská **Dana Rebeka Ralbovská** Dana Rebeka Ralbovská (Gar.)*	Z	1	1C	Z	z
F7PBBMVP	**Research Methodology** *Jakub Ráfl, Marek Novák **Jakub Ráfl** Jakub Ráfl (Gar.)*	KZ	2	1P+1C	Z	z
F7PBBMS	**Modelling and Simulation** *Jan Kauler **Jan Kauler** Jan Kauler (Gar.)*	Z,ZK	4	2P+2C	L	z
F7PBBNMP	**Project Proposal and Management** *Jiří Petráček, Pavlína Pokošová **Jiří Petráček** Jiří Petráček (Gar.)*	KZ	2	1P+1C	L	z
F7PBBOIZ	**Protection Against Ionizing Radiation** *František Podzimek **František Podzimek** František Podzimek (Gar.)*	ZK	2	2P	L	z
F7PBBPPS	**Pacient and Device Simulators and Testers** *Petr Kudrna, Martin Rožánek, Lenka Horáková **Petr Kudrna** Petr Kudrna (Gar.)*	Z,ZK	2	1P+1L	Z	z
F7PBBPPM1	**Programming in Matlab I.** *Christiane Malá, Radim Krupička, Lucie Horáková **Radim Krupička** Radim Krupička (Gar.)*	KZ	1	1C	Z	z
F7PBBPPM2	**Programming in Matlab II.** *Christiane Malá, Adéla Mádlová **Radim Krupička** Radim Krupička (Gar.)*	KZ	2	2C	L	z
F7PBBPNK	**Design and Construction of Medical Devices/Practical Exercises** *Roman Matějka, Jana Matějková **Roman Matějka** Roman Matějka (Gar.)*	KZ	4	4L	Z	z
F7PBBPMS	**Probability and Mathematical Statistics** *Marek Piorecký, Jan Štrobl, Michaela Mrázková, Tomáš Nagy **Michaela Mrázková** Marek Piorecký (Gar.)*	Z,ZK	4	2P+2C	Z	z
F7PBBPP	**First Aid** *Pavel Böhm **Pavel Böhm***	KZ	2	1P+1C	L	z
F7PBBPSL	**Psychology** *Jaroslava Jirásková, Martina Kusáková **Martina Kusáková** Martina Kusáková (Gar.)*	KZ	2	1P+1C	Z	z
F7PBBROP	**Guided Practical Training** *Petr Kudrna **Petr Kudrna** Petr Kudrna (Gar.)*	Z	2	80XH	L	z
F7PBBSPR1	**Semestral Project I.** *Petr Kudrna, Marek Piorecký **Petr Kudrna** Petr Kudrna (Gar.)*	KZ	1	1C	L	z
F7PBBSPR2	**Semestral Project II.** *Petr Kudrna **Petr Kudrna** Petr Kudrna (Gar.)*	KZ	4	4C	Z	z
F7PBBSBP	**Bachelor Thesis Seminar** *Jiří Hozman **Jiří Hozman** Jiří Hozman (Gar.)*	Z	1	1C	L	z

F7PBBSM	**Sensors in Medicine** *David Vrba, Miroslav Husák* ***David Vrba*** *Miroslav Husák (Gar.)*	Z,ZK	4	2P+2L	L	z
F7PBBSEL	**Power Engineering** *Jiří Hozman, David Vrba, Jiří Petráček* ***David Vrba*** *David Vrba (Gar.)*	Z,ZK	5	2P+3L	L	z
F7PBBSPT	**Research Methodology** *Václav Ort, Karel Roubík, Jakub Ráfl, Šimon Walzel* ***Jakub Ráfl*** *Václav Ort (Gar.)*	Z,ZK	4	2P+2L	L	z
F7PBBTEL	**Theory of Electrical Engineering** *Tomáš Dřížďal, Jan Uhlíř, Marek Novák, Pavel Máša* ***Tomáš Dřížďal*** *Jan Uhlíř (Gar.)*	Z,ZK	4	2P+2C	L	z
F7PBBTZS	**Tomographical Imaging Systems** *Jiří Hozman, Tomáš Dřížďal, Martin Rožánek, Evgeniia Karnoub* ***Martin Rožánek*** *Jiří Hozman (Gar.)*	Z,ZK	4	2P+1C+1L	Z	z
F7PBBUSS	**Introduction to Signals and Systems** *Jan Kauler* ***Jan Kauler*** *Jan Kauler (Gar.)*	Z,ZK	4	2P+2C	Z	z
F7PBBZP	**Basics of Pathology** *Miloš Sokol* ***Miloš Sokol*** *Miloš Sokol (Gar.)*	ZK	2	2P	L	z
F7PBBZLN	**Legislation in Health Care and Technical Standards** *Peter Kneppo, Vojtěch Kamenský, Ondřej Gajdoš* ***Vojtěch Kamenský*** *Peter Kneppo (Gar.)*	KZ	2	1P+1C	Z	z

Characteristics of the courses of this group of Study Plan: Code=F7PBB POV 20 Name=Biomedical Technology compulsory course

F7PBBALP	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.

F7PBBAF1	Anatomy and Physiology I.	Z,ZK	4

Entry requirements of the course: - - Output knowledge, skills, abilities and competences: The course serves to understand the relationships between the structure and functions of the human body. The teaching follows modern pedagogical trends consisting in a direct connection between the morphology and the functions of organ systems. Seminar teaching is closely linked to the topics of lectures and connected with practical exercises. It focuses significantly on problems of program and uses activation methodologies to increase student motivation. The use of modern multimedia programs (eg ADAM and others) is a matter of course. From a theoretical and practical point of view, the main emphasis will be on the morphology and function of vital organs and systems.

F7PBBAF2	Anatomy and Physiology II.	Z,ZK	4
F7PBBA3A	English Language IIIA (part 1)	KZ	2

The aim of the course is to increase students' language competence in academic English and professional vocabulary, along with common communication skills. Students should be able to work actively with academic text, understand and be able to use basic terminology, and be aware of the different stylistic levels of English and the associated syntactic and lexical devices.

F7PBBA3B	English Language IIIB (part 2)	KZ	2

Teaching in the summer semester is based on a modern, non-frontal, project-based, and interdisciplinary way of teaching that is gaining prominence in the world. The system is based on the independent creative work of students who are asked to develop an interesting topic in their field of study, i.e. biomedical engineering, and make it available to their colleagues in the form of a project. Another activity of the students in the summer semester is a discussion with the tutor over an article from the New Scientist magazine available from the faculty library.

F7PBBBP	Bachelor Thesis	Z	6

Aim: Student work under the guidance of a supervisor and possible consultant on a given BP topic, especially in the laboratory, using knowledge and skills from previous courses and in the time allotted. Course entry requirements: Prerequisite F7ABBMVP Research Methodology - This course is essential because it prepares students to write a bachelor thesis and how to prepare it methodically. Outcome knowledge, skills, abilities and competencies: The student is able to work on a given topic in a defined form, in a defined time and is able to work under the guidance of a BP supervisor and also in a team. The student is able to use knowledge, skills and knowledge from previous courses to solve the assigned problem. This is a Bachelor's thesis, which is defended in front of the HSS committee. This thesis is assessed by the supervisor and the opponent according to the ECTS grading scale. Subsequently, these evaluations and the result of the state final examination in the subject areas are included in one final evaluation.

17BOZP	Occupational Safety and Health, Fire Protection and First Aid	Z	0
F7PBBBCH	Biochemistry	Z,ZK	2

The student will become familiar with the basic areas of Biochemistry and understand the interrelationships between these areas. The learner will be able to navigate biochemical concepts especially in the context of clinical biochemistry. The student will learn to work in the laboratory according to good laboratory practice, learn the specifics of working with biological material and acquire good work habits. He/she will be able to process, interpret and discuss the results correctly.

F7PBBBLS	Biological Signals	Z,ZK	4

The subject deals with origins and description of the most important electric and non-electric biological signals. The principles of generation, recording and basic properties are studied in all the signals. The studied signals involve native and evoked biosignals, including biological signals of the heart, brain, muscles, nervous system, auditory signals, visual system, signals from the gastro-intestinal system etc. Advanced methods of digital biosignal processing,spectrum analysis, modern methods of artificial intelligence, features extraction, automatic classification, graphic presentation of results. Adaptive segmentation, artificial neural networks for signal procesing.

F7PBBBLG	Biology	Z,ZK	4

The student will gain clear knowledge of general and cell biology, through the formation of cells and organelles (endosymbiotic theory) and basic chemical composition of cells (simple inorganic and organic substances, carbohydrates, fats, amino acids, biopolymers - NK and proteins), construction of non-cellular forms (especially viruses) and cells, both prokaryotic (bacteria) and eukaryotic (plant, animal and fungal cells), they will get acquainted with cell metabolism (anabolism and catabolism), growth and cell differentiation, division (cell cycle and its regulatory mechanisms) until apoptosis and necrosis. They will get acquainted with the basics of microbiology (viral and bacterial diseases of man) and applications in technical and medical fields. He will gain detailed knowledge about the internal structure of a eukaryotic cell, its endomembrane system and semiautonomous organelles and the processes that take place in them. Following in the field of molecular biology, they will get acquainted with the basic processes that are necessary for the implementation of genetic information, the processes of replication, transcription, translation (ie proteosynthesis) and gene expression, the genetic code. In general genetics, with basic genetic terminology and processes of passing genetic information from parents to offspring according to Mendel's and Morgan's laws, changing genetic information in the form of mutations and possibilities of repair in the cell. Human genetics (clinical genetics) includes basic examination methods and human genetic diseases (autosomal dominant, recessive, gonosomal dominant, recessive, mitochondrial and others). Following the great development of molecular biology and biochemistry techniques, the student is acquainted with genetic engineering and its methods of genetically modified organisms and their preparation, tissue cultures and biotechnologies. Applied biology in technical and medical fields describes the use of biological structures and mechanisms in modern technology and medicine. The conclusion consists of issues related to the field of animal cells and tissues, their histology and issues of biocompatibility.

F7PBBBB	Biomechanics and Biomaterials	Z,ZK	4
The course is intended for all students who need to supplement their knowledge and have a general knowledge about biomechanics and its application in specific practical problems. The content is chosen to be sufficient to understand athe issues in related subjects, especially the subject of Mechanics and Robotics in Medicine. If the student does not choose the subject and has never had the opportunity to complete these basic knowledge, they will be exposed to the risk of misunderstanding the subsequent issues in related subjects, in which this is not taken into account the basic knowledge.			
F7PBBBOZP	Safety Regulations and Standards in Electrical Engineering	Z	1
Safety and Health protection during work; the role of the biomedical technician in clinical practice; risk-determining effects; patient environment; medical isolated system; electric shock; types of distribution systems; protection classes; electrical inspections; regulations and standards; work with lasers			
F7PBBCHM	Chemistry	Z,ZK	4
F7PBBEM	Electrical Measurements	Z,ZK	4
Measuring of electric values, principles, using, and parameters. Analogue measuring converters. Electromechanical measuring devices. Current and potential measuring. Frequency and shift phase measuring. Electric work and electric power measuring: direct current, single-phase and three-phase current. Electrical resistance and impedance measuring. Magnetic measuring. Analogue scope. Digitalization, digital signal processing, signal reconstruction. Electronic measuring devices: multimeter, digital scope. Optoelectronic measuring device.			
F7PBBELF	Electrophysiology	Z,ZK	2
Aim/objectives: to introduce students to the theory of electrical phenomena at the cell, organ and organism level, to the possibilities of measuring and using these manifestations. A sub-objective is to enable students to experimentally verify the knowledge. This course builds on Anatomy and Physiology I and II and requires a basic knowledge of the structure (anatomy) and function (physiology) of the following systems (excitable tissues): nervous, musculoskeletal, circulatory (especially the heart). The course deals with the problems of excitable tissues (nervous, The course deals with the physiology of nervous tissue, muscle and glandular tissue and provides knowledge of the physiology of electrical processes at different levels: cell, tissue, organ, organism.			
F7PBBEO	Electronic Circuits	Z,ZK	4
The course provides a basic orientation in the principles of electronic circuits used in electronic laboratory and medical devices. It provides a prerequisite for the skilled operation of analogue and digital instrumentation. technology. Course entry requirements: Successful completion of Theoretical Electrical Engineering. Exit Knowledge, Skills, Abilities and Competencies: Students will become familiar with functional electronic blocks that are used in the design of laboratory and medical instruments. The course will prepare them to competently assess the basic properties and parameters of electronic devices.			
F7PBBEBI	Ethics in Biomedical Engineering	ZK	2
Prerequisites: Knowledge of school humanities objects (philosophy, history, psychology) Target knowledge and skills: basic concepts and controversial topics in biomedical theoretical and applied ethics; be able to think critically in ethical contexts; argue and defend opinions in ethical dilemma situations; ability development of professional literature and development of empathy.			
F7PBBESP	Management of Health Care Technology	Z,ZK	2
F7PBBFY1	Physics I.	Z,ZK	4
Course Physics 1 is used to repeat and expand the basic knowledge of physics in the field of classical mechanics, thermals and optics, which is needed for further study at FBME CTU. Students will gain theoretical knowledge, the ability to solve numerical problems and practical skills associated with working in laboratories.			
F7PBBFY2	Physics II.	Z,ZK	6
The course Physics 2 follows the course Physics 1 and expands the acquired knowledge in the field of electromagnetism and the basics of atomic and nuclear physics and condensed matter physics.			
F7PBBFCH	Physical Chemistry	Z,ZK	4
The course is aimed at clarifying the physicochemical principles of topics related to the profession of biomedical engineer and technician in clinical practice or research. The goal of the course is to provide students with the fundamentals of physical chemistry as they occur and are applied in the design of medical devices, in clinical research, or directly in clinical practice. The course demonstrates the direct application of theoretical principles in practice.			
F7PBBHE	Hygiene and Epidemiology	ZK	1
F7PBBISZ	Information Systems in Health Care	Z,ZK	4
Lectures are focused on the definition and clarification of individual subfields of medical informatics, the links of information systems to the organization of health care, payments and controlling, the definition of IS users and their roles. The course includes the necessary overview of information technology and technical and SW resources for building IS. Attention is also paid to the principles of coding and interpretation of medical data, data standards and communications. The individual types and properties of clinical, complementary, hospital, regional and managerial medical and medical IS are analyzed. The course also provides detailed information on the methodology of development, implementation and support of large-scale information systems in health care.			
F7PBBITP	Integral Calculus	Z,ZK	4
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.			
F7PBBKT	Communication Technology	Z,ZK	2
Význam a praktické příklady nasazení informačních a komunikačních technologií ve zdravotnictví. Historie, základní struktura a rozdělení počítačů, motherboard, sběrnice, BIOS, autotest, procesor, operační paměť, klasické a SSD pevné disky, paměťové karty, zvukové karty, grafické karty, monitory, klávesnice, myši, tiskárny a skenery, univerzální vstupně výstupní porty (USB, USB-C, HDMI, DisplayPort, Thunderbolt, HDMI, S/PDIF), RS232 jako virtuální COM port a jeho použití v praxi, modemy, nejčastější sběrnice pro připojování periferií v mikroprocesorových systémech (IIC, SPI), nejčastější sběrnice pro komunikaci přístrojů a systémů ve zdravotnictví, standardizace, operační systémy, mobilní platforma pro snímání, vyhodnocování a přenos dat, rozhraní Bluetooth, NFC, počítačové sítě, LAN, WAN, vrstvový referenční model OSI, základní technické prostředky LAN (Ethernet, WiFi a jejich praktická realizace), Internet - prohlížeče, používané standardy a jazyky, úvod do architektury TCP/IP, protokoly a adresování, propojování lokálních sítí, brány a směrovače, pojem server, architektura klient-server, nejčastěji používané protokoly síťové architektury TCP/IP: HTTP, FTP, DNS, DHCP, VPN.			
F7PBBKZS	Conventional Imaging Systems	Z,ZK	4
F7PBBLT	Clinical Laboratory Instrumentation	Z,ZK	4
F7PBBLPZ1	Management of Health Care Technology	Z,ZK	4
Overview and categorization of medical (diagnostic devices) according to international directives (EU directives), including correct terminology. The electrical safety of medical equipment operation. Medical technology in clinical practice; Construction of diagnostic apparatus; Biosignal amplifiers, sensing electrodes, recording systems; Measurement of cardiac electrical activity (ECG) - electrocardiographs, vector cardiographs; Blood pressure monitors - NIBP; Blood pressure measuring instruments - IBP, PCWP; Dilution measurement of cardiac output, Swan-Ganz catheter; SpO2 pulse oximetry; Vital signs monitors, central monitoring systems. Special monitors for clinical practice - cardiotocographs, NIRS, BIS; Electroimpedance methods in clinical practice - a measurement of respiration by impedance method, EIT; Measurement of brain bioelectrical activity (EEG); Measurement of muscle bioelectric activity (EMG); Spirometry; Examination of the auditory system; Simulators and testers of diagnostic equipment.			
F7PBBLPZ2	Medical Devices and Equipment II. (Therapeutical Devices)	Z,ZK	2
F7PBBLAD	Linear Algebra and Differential Calculus	Z,ZK	6
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.			

F7PBBMAZ	Management and Admininistration in Health Care	KZ	1
F7PBBMEC	Mechanics	Z,ZK	4

Students will get acquainted with the following areas of mechanics: General physical equations, Newton's laws, statics and dynamics. Force and moment effect - decomposition, replacement. Equilibrium of a force system in a plane and space - equation of equilibrium, systems into equilibrium. Reactions on statically determined systems - motion restrictions, spatial and planar constraints, solution of reactions. Static moment, center of gravity and center of area. Spatial moment of inertia - kinetic energy of rotational motion, product moment, momentum, law of conservation of momentum. Second moment of area - product moment, polar moment, Mohr circle, main moments of inertia, ellipse of inertia. Internal static effects - beam, system of plates, course of internal static effects, kinematic method, statically indeterminate problems. Mechanical properties of materials - tests of mechanical properties, stresses and deformations, Hooke's law. Stress and strain - uniaxial and biaxial stress state, simple bending, bending curve, torsional stress, cross-section design, thin-walled cross-sections, combined stress, nonlinear models. Buckling strength - critical load, stability of members, calculation of cross section. Tests of hardness, adhesion, toughness, tribological.

F7PBBMT	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.

F7PBBMVP	Research Methodology	KZ	2

The course introduces students to the basic methods of research work and the requirements for scientific communication. The course also introduces students to the principles of writing and presenting of bachelor's thesis.

F7PBBMS	Modelling and Simulation	Z,ZK	4

Basic concepts and consequences of modeling and simulation. Be able to use modeling and simulation methodologies. Emphasis is placed on a thorough understanding of compartmental models, physiological models, pharmacokinetics. Furthermore, continuous and discrete models of population dynamics, epidemiological models, models of venereal diseases.

F7PBBNMP	Project Proposal and Management	KZ	2

As part of the lectures, students will become familiar with topics such as project management (PM) according to IPMA, the certification process, project, program, portfolio, phases, and the project life cycle, as well as project initiation. They will learn about the feasibility study, project initiation, project identification document, and logical framework. Other topics include an introduction to project planning, scheduling, risk and risk analysis, project implementation, behavioral competencies in PM, project closure, and evaluation. Students will also gain practical insights from a hospital environment. During the exercises, students will master the following concepts and topics and develop relevant outputs: teamwork, feasibility study, identification document, logical framework, WBS (Work Breakdown Structure a hierarchical structure of tasks or activities), scheduling, risk analysis, project implementation, and a final test. As part of this course, students have the opportunity to obtain the IPMA Level D certification, which is intended for aspiring project managers, project coordinators, and team members. The certification is valid for five years.

F7PBBOIZ	Protection Against Ionizing Radiation	ZK	2
F7PBBPPS	Pacient and Device Simulators and Testers	Z,ZK	2

Patient and instrument simulators and testers. Basic principles of implementation, connections with other disciplines. Detailed description and implementation of a selected model of a subsystem. Design and implementation of patient and instrument simulator sub-blocks. Examples of circuit implementations of simulators and testers. Environment, scenario creation and other related procedures in manikin control, basic concepts and principles of anesthesiology. Other types of simulators and phantoms. Possibilities of use in clinical practice. Practical demonstration. Connection of the simulator with other medical equipment. Simulators and testers. Implementation of an established simulation scenario, scenario testing, creation of new scenarios. Collaboration between HPS and anaesthesia machine.

F7PBBPPM1	Programming in Matlab I.	KZ	1

Students will learn how to use Matlab, get knowledge of data structures and with data and working with data and their display. During the semester, they will gain knowledge of creating scripts in Matlab and the basics for their use in the processing of biomedical data.

F7PBBPPM2	Programming in Matlab II.	KZ	2

The aim of the course is to understand the topic of scripting languages and their applications, to understand their advantages and disadvantages and their complementarity with system languages. Students will become familiar with regular expressions and tools for word processing. The course focuses on the scripting languages within the Unix operating system and the scripting languages Python.

F7PBBPNK	Design and Construction of Medical Devices/Practical Exercises	KZ	4

The aim of the practically oriented course is to acquaint students with the design process of the measuring part of the device, ie basic problem analysis, determination of functional blocks and their design, selection of suitable components and their values with emphasis on working with catalog sheets and application recommendations, preparation of electrical documentation and board design. printed circuit board, its mounting, soldering and revitalization. During the course, students will implement a functional device (mounting, soldering, recovery) electronic thermometer, which will consist of two functional units - analog part for temperature measurement and signal conditioning (equipped with THT components) and display element with diode bargraph (equipped with SMT components). For both products, students will implement the design of the diagram and PCB in the CAD environment EAGLE. In addition to the analog part of the device, an application for digitizing data from the analog device using NI-DAQ cards and a cheap solution with the help of Arduino will be implemented. The last part will be a service intervention in the device (monitor of vital functions) with emphasis on safe handling and measurement of test points.

F7PBBPMS	Probability and Mathematical Statistics	Z,ZK	4

Objectives: to familiarize students with the basic principles of the theory of probability and mathematical statistics. Pre-requisites and entry requirements of the course: Knowledge of mathematics (linear algebra, differential and integral calculus) in the range of F7PBBLAD and F7PBBITP courses taught in the first year of study. Knowledge, skills, abilities and competencies: The student is acquainted with the probabilistic model, basic definitions of Kolmogorov theory of probability and inductive statistics. The student can apply these definitions to practical problems that arise in other areas of professional work and can explain them sufficiently (e.g. doctors). The student is familiar with the basic methods of inductive statistics and can choose a suitable method for standard statistical problems.

F7PBBPP	First Aid	KZ	2
F7PBBPSL	Psychology	KZ	2

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

F7PBBROP	Guided Practical Training	Z	2

Familiarization of students with the organization and provision of professional internships at the clinical workplace. Provision of contractual documents for the implementation of the ROP (supervised professional practice). The ROP will then enable the acquired practical skills and habits to be applied in the key subjects of the 3rd year. The student thus has an overview of the current technical level of hospital equipment; an overview of the organization of the work of biomedical technicians and engineers; can apply legal requirements to ensure the safe operation of medical equipment. He can communicate with technicians, but also medical staff. He is able to work in a team.

F7PBBSPR1	Semestral Project I.	KZ	1

The topic of the semester project (SPR1) must be in the field of biomedical engineering and must be related to the study field of the same name Biomedical Technician. The topics are available for the relevant academic year in the database projects.fbmi.cvut.cz Note: It is not possible to implement economic-managerial topics, topics based mainly on the creation of research, clean programming, topics purely in the field of biology, etc. The application must always be part of the work in accordance with the focus of the field. The topic must always be related to technology (medical devices, or the scope of work of a Biomedical Technician in clinical practice)! Entries that do not fall into the above areas will not be approved.

F7PBBSPR2	Semestral Project II.	KZ	4
The main idea is to start work on a project which can be improved in time and finish as a Bachelor thesis. In the course will be discussed topic as basic communication and presentation skills, including teamwork 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. The student solves topic (project) from the selection of the PROJECTS database - http://projects.fbmi.cvut.cz During the term, there are dedicated 2 hours every week for work under teacher supervising.			
F7PBBSBP	Bachelor Thesis Seminar	Z	1
Objective(s): The aim of the course is to accentuate the realized outcomes of the projects solved in the 4th, 5th and 6th semesters of the Biomedical Technology Bachelor's degree study program. The aim of the course is also to prepare students for the defense of their bachelor thesis infront of the final state examination committee. Course entrance requirements: Prerequisite F7PBBMVP Exit Knowledge, Skills, Abilities and Competencies: Students are fully aware of the requirements for the requirements of professional reports and communications, they are proficient in the orientation in the professional literature. The students are able to understand the literature and literature on a given topic, apply scientific research methods to specific assignments. They present their proposed solutions and results, are able to interpret the results.			
F7PBBSM	Sensors in Medicine	Z,ZK	4
This subject provides information about basic electronic devices - sensors, describes their operation principle, basic circuit configuration and application. The stress is aid mainly on clarifying of basic principles and practical utilization. Integral part of this course is basic information about sensors of non-electric quantities and their read-out circuits eg. strain related sensors (force, pressure, torque, vibration, displacement, acceleration etc.) magnetic field sensors, temperature sensors, chemical sensors, optical sensors and biosensors. The stress is aid on miniaturization, integration			
F7PBBSEL	Power Engineering	Z,ZK	5
Basics of power electronics, power supplies, including electrochemical sources, rectifiers, stabilizers, the most commonly used types of motors, basics of power distribution, types of electrical systems and connecting appliances with a focus on medical use. Emphasis is placed primarily on the physical nature of the problem and its understanding. knowledge will be verified on practical examples and in the laboratory.			
F7PBBSPT	Research Methodology	Z,ZK	4
The main objective of the course is to introduce students to the basic equipment of intensive care units (ICU) and anesthesiology and resuscitation departments of hospitals. These are devices to support vital functions, especially lung ventilation, as well as patient monitors, anesthesia machines and their parts and other equipment. Another objective of the course is to integrate knowledge and skills of students from the fields of science (especially physics, chemistry and physiology) and engineering (modeling, circuit theory, pneumatic elements, etc.) in the analysis of clinical technology and in the design and implementation of functional technical systems.			
F7PBBTEL	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.			
F7PBBTZS	Tomographical Imaging Systems	Z,ZK	4
CT systems (basic principle, schematic arrangement system, basic physical principle, developmental generations, basic principles of reconstruction). Imaging systems magnetic resonance. PET and SPECT principle. Specialized imaging systems (hybride). Ultrasound imaging systems. Doppler systems. Subject and especially laboratory exercises provide students with an insight into the principles of creating image data used in medicine, the principle of methods their scanning, digitization and subsequent processing, on the principle of function and properties of scanning image means in context, which is important especially in terms of interdisciplinarity of the subject and the field as a whole.			
F7PBBUSS	Introduction to Signals and Systems	Z,ZK	4
The aim of the course is to acquaint students with the basics of signal processing, especially with time and frequency domain operations. Emphasis is placed on a thorough understanding of Fourier analysis. The second part of the course is focused on acquainting students with systems, their properties and description. Emphasis is placed on the external and internal description of linear dynamical systems.			
F7PBBZP	Basics of Pathology	ZK	2
F7PBBZLN	Legislation in Health Care and Technical Standards	KZ	2
Aims / aims: The aim of the course Legislation in Health Care and Technical Standards is to teach students the basic requirements and regulatory obligations in healthcare, especially in the field of medical devices. During the course, students will learn the basics of legislation process, as well as regulation related to the medical devices, lso with legislative regulations in the field of clinical trials and the operation of medical devices. Furthermore, students will learn the legal context of providing health care. The aim is to acquaint students with the rights and obligations arising from current legislation relating to health care issues.The emphasis is not on memorizing of the text of legal regulations, but on acquainting students with the main points and ideas contained in the laws, regulations and standards of the Czech Republic and EU directives in the field of healthcare. Prerequisites and co-requisites: To successfully complete the course, students should know the basics of the principles of medical devices due to the practical application of legislation in this area. Output knowledge, skills, abilities and competences: After completing the course, the student should have a comprehensive overview of health legislation. He should be able to orientate himself in a given problem related to legislation without any problems and he should know where he can find individual details related to legal issues in health care.			

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: F7PBB PV 2S 20
Name of the group: Biomedical Technology compulsory optional course
Requirement credits in the group: In this group you have to gain at least 2 credits (at most 6)
Requirement courses in the group: In this group you have to complete at least 1 course (at most 3)
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**
F7PBBEZP	**Economics of Health Services**	KZ	2	1P+1C	L	S
F7PBBMAT	**Marketing of Medical Technology** *Tomáš Kolář* ***Tomáš Kolář*** *Tomáš Kolář (Gar.)*	KZ	2	2P	L	S

F7PBBPPP	**Programming Tools** *Pavel Smrčka, Tomáš Funda, Radim Kliment* ***Pavel Smrčka*** *Pavel Smrčka (Gar.)*	KZ	2	2C	L	S

Characteristics of the courses of this group of Study Plan: Code=F7PBB PV 2S 20 Name=Biomedical Technology compulsory optional course

F7PBBEZP	Economics of Health Services	KZ	2

Methodology of managing the economics of healthcare operations. The role of management and administration. Healthcare legislation and law, application of laws in a real hospital. The role of management control and its role in the medical technology market, Planning strategies, analysis and research of consumer and organisational markets, market development and positioning. Aim: economics of healthcare operations, which is the goal and guarantee of success and level of healthcare delivery.The course The course provides a knowledge base for the PBB2ESP course. Course entry requirements: Exit knowledge, skills, abilities and competencies: the student will be able to calculate interest, inflation, annuity. The student will therefore be able to be able to produce the economic part of a feasibility study.

F7PBBMAT	Marketing of Medical Technology	KZ	2
F7PBBPPP	Programming Tools	KZ	2

The aim of the course is to provide an overview of basic application software for GNU / Linux and MS Windows with examples and examples of use, including a comparison of parameters of individual programs. The areas of focus of individual program resources are selected with regard to the usability of FBMI students in other subjects and also in the preparation of qualification works and in subsequent professional employment in the field. The entry requirements of the course are knowledge of computer control at the secondary school level. After completing the course, students will gain the following output knowledge, skills, abilities and competencies: Routine control of common user programs in MS Windows and GNU / Linux, measured in the following areas: creation of technical documentation, processing of 2D graphics, audio, video, secure information sharing and network communication, creation and publication of personal web pages, processing and visualization of biomedical data, basics of scripting.

Code of the group: F7PBB PV 3S 20
Name of the group: Biomedical Technology compulsory optional course
Requirement credits in the group: In this group you have to gain at least 2 credits (at most 6)
Requirement courses in the group: In this group you have to complete at least 1 course (at most 3)
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
F7PBBBFT	**Biophotonics** *Jan Remsa, Jan Mikšovský, Petr Písařík* ***Petr Písařík*** *Petr Písařík (Gar.)*	KZ	2	2P	Z	S
F7PBBFVP	**Multivariable Calculus** *Jana Urzová* ***Jana Urzová*** *Jana Urzová (Gar.)*	KZ	2	1P+1C	Z	S
F7PBBMFJ	**Physical Phenomena Modeling in COMSOL MULTIPHYSICS** *David Vrba* ***David Vrba*** *David Vrba (Gar.)*	KZ	2	1P+1C	Z	S

Characteristics of the courses of this group of Study Plan: Code=F7PBB PV 3S 20 Name=Biomedical Technology compulsory optional course

F7PBBBFT	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.

F7PBBFVP	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. .

F7PBBMFJ	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.

Code of the group: F7PBB PV 4S 20
Name of the group: Biomedical Technology compulsory optional course
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
F7PBBDIZ	**Detectors of Ionizing Radiation** *Ladislav Pína* ***Ladislav Pína*** *Ladislav Pína (Gar.)*	KZ	2	2P	L	S
F7PBBMDT	**Microwave Diagnostics and Therapy** *Ondřej Fišer, Jan Vrba, David Vrba, Tomáš Pokorný* ***Ondřej Fišer*** *Jan Vrba (Gar.)*	KZ	2	1P+1L	L	S
F7PBBPTI	**Principles and Practice in Tissue Engineering** *Roman Matějka, Jana Matějková* ***Roman Matějka*** *Roman Matějka (Gar.)*	KZ	2	0P+2C	L	S
F7PBBSJ	**Scripting Languages** *Tomáš Krajča* ***Radim Krupička*** *Radim Krupička (Gar.)*	KZ	2	2C	L	S
F7PBBVBI	**Virtual Bioinstrumentation** ***Roman Matějka***	KZ	2	1P+1L	L	S

Characteristics of the courses of this group of Study Plan: Code=F7PBB PV 4S 20 Name=Biomedical Technology compulsory optional course

F7PBBDIZ	Detectors of Ionizing Radiation	KZ	2
F7PBBMDT	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.

F7PBBPTI	Principles and Practice in Tissue Engineering	KZ	2
F7PBBSJ	Scripting Languages	KZ	2

The aim of the course is to understand the topic of scripting languages and their applications, to understand their advantages and disadvantages and their complementarity to system languages. The course focuses on scripting languages in the Unix operating system and Python scripting languages.

F7PBBVBI	Virtual Bioinstrumentation	KZ	2

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

Code of the group: F7PBB PV 5S 20
Name of the group: Biomedical Technology compulsory optional course
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
F7PBBAZD	**Biomedical Data Analysis and Processing** *Jan Kauler, Lucie Horáková* ***Jan Kauler*** *Jan Kauler (Gar.)*	KZ	2	1P+1C	Z	S
F7PBBMTB	**Microprocessors in Biomedicine** *Pavel Smrčka, Karel Hána* ***Pavel Smrčka*** *Pavel Smrčka (Gar.)*	KZ	2	1P+1L	Z	S
F7PBBTA	**Technical Audiology** *Oliver Profant, Zbyněk Bureš* ***Oliver Profant*** *Oliver Profant (Gar.)*	KZ	2	1P+1L	Z	S
F7PBBZOD	**Image Data Processing** *Zoltán Szabó, Pavla Suchánková* ***Zoltán Szabó*** *Zoltán Szabó (Gar.)*	KZ	2	1P+1C	Z	S

Characteristics of the courses of this group of Study Plan: Code=F7PBB PV 5S 20 Name=Biomedical Technology compulsory optional course

F7PBBAZD	Biomedical Data Analysis and Processing	KZ	2
F7PBBMTB	Microprocessors in Biomedicine	KZ	2

We will explain the principle and building elements of a microprocessor system, the structure of a microprocessor, the connection of basic peripherals, the programming model of a microcomputer system in the form of a practically oriented explanation and demonstration tasks. Provide a basic overview of ATMega and ARM Cortex M architectures with practical examples of their programming with examples of use in biomedicine. Prerequisites and co-requisites: basic knowledge of digital technology and signal processing, basics of ISO C. Output knowledge, skills, abilities and competencies: The student is familiar with the selection and design of microprocessor system solutions for use in biomedicine. It manages the configuration and program control of these building blocks of the microprocessor system: digital inputs and outputs, A / D and D / A converters, serial and parallel communication, counters and timers, interrupt controller. Understands the basics of communication of microcomputers with the environment: interfaces for LCD displays, keyboards, RS232, Ethernet, WIFI, Bluetooth, XBee and mobile 3G / 4G communication, GPS / GLONAS localization.

F7PBBTA	Technical Audiology	KZ	2

The aim of the course is to give students a basic overview of audiology, i.e. basic knowledge of biology, medicine and technology in relation to normal and impaired hearing, and all this in an interrelated context with emphasis on technical aspects. Motivation to work in clinical practice in audiology is also an integral part of this goal. workplace. Course entry requirements: These requirements are expressed as prerequisites and a detailed breakdown of the requirements is as follows: - nervous system - organisation and function of the CNS, internal environment of the CNS (blood-brain barrier, cerebrospinal formation, transport and function), neuroglia, motor nervous system, spinal cord (structure, reflexes), - nervous system - motor system, brainstem (structure, reflexes), cerebellum (structure, reflexes), basal ganglia (structure, reflexes), cerebral cortex (structure, rexlexes), physiology of movement control, - sensory nervous system - receptors, skin sensation, movement and position perception, vision, hearing, taste, smell, pain, autonomic nervous system, brain stem, hypothalamus, peripheral compartments: sympathetic and parasympathetic, - waves, types of waves, successive waves, interference, standing waves, sound, - types of signals, basic signal operations, signal decomposition, - harmonic analysis, Fourier transform for continuous and discrete signals, DFT, FFT, - convolution, - technical and biological systems, systems and their description, linear and non-linear system, - external description of continuous and discrete linear system - differential/differential equations, transfer functions, frequency characteristics, distribution of zeros and poles, time characteristics, - coupling of systems, feedback loops, - Characteristics of basic biosignals EEG, ECG, EOG, EP, EMG, artefacts, origin, sources, diagnostic applications, frequency range and bands, - Biological data acquisition and preprocessing, basic computer conversion chain, A/D converters, problems signal sampling and quantization, Nyquist theorem, conversion errors, signal conditioning, aliasing, filtering, trends, sensing options. Output knowledge, skills, abilities and competences: Students will acquire a basic understanding of acoustics, measurement and diagnosis of auditory functions, including technical principles. instrumentation and software, and hearing aids and replacements. The students will be able to orient themselves. They will be able to learn about these issues, learn about other areas of medical instrumentation and methods used in clinical practice, as well as motivated and ready to enter the field of audiology upon graduation and to add to this knowledge and advanced skills within the framework of the so-called certified course, which, according to Act 96/2004 Coll., allows for the acquisition of the so-called "certificate of audiology". Special professional competence Technical audiologist after graduation, i.e. after obtaining the so-called professional competence Biomedical technician under the Act.

F7PBBZOD	Image Data Processing	KZ	2

The aim of the course is to provide basic knowledge about the principles of the digital image processing process (algorithms - implementation and realization). This goal also includes the issue of digitization and basic methods of image data analysis.

Code of the group: F7PBB PV 6S 20
Name of the group: Biomedical Technology compulsory optional course
Requirement credits in the group: In this group you have to gain at least 2 credits (at most 6)
Requirement courses in the group: In this group you have to complete at least 1 course (at most 3)
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
F7PBBAZC	**Algorithms for Biosignals in the C Language** *Pavel Smrčka* ***Pavel Smrčka*** *Pavel Smrčka (Gar.)*	KZ	2	1P+1C	L	S
F7PBBEMP	**Electromagnetic Fields of Living Organisms** *Ondřej Fišer, Jan Vrba* ***Ondřej Fišer*** *Jan Vrba (Gar.)*	KZ	2	1P+1L	L	S
F7PBBRBL	**Robotics in Medicine** *Jan Kauler* ***Jan Kauler*** *Jan Kauler (Gar.)*	KZ	2	1P+1C	L	S

Characteristics of the courses of this group of Study Plan: Code=F7PBB PV 6S 20 Name=Biomedical Technology compulsory optional course

F7PBBAZC	Algorithms for Biosignals in the C Language	KZ	2

Explain the principle and implementation of the most used algorithms for biosignal processing and their specific functional (and time and memory efficient) implementation in C and C ++ in the form of practically oriented interpretation and demonstration tasks. Graduates will be acquainted with specific solutions to basic algorithmic problems in biosignal processing: with segmentation, analysis in the time and frequency domain, with the design of linear digital filters (FIR and IIR) and with the visualization of results. Prerequisites and co-requisites: basic knowledge of systems and signal processing, basics of ISO C. Output knowledge, skills, abilities and competences: The student is familiar with algorithms for preprocessing and intelligent segmentation of biological time series in C and C ++, eg: FFT algorithm, SFFT and wavelet transforms, algorithm for calculating autocorrelation and cross-correlation functions, convolution, etc. Can implement in C language the floating time window method for feature extraction and basic algorithms for the design and implementation of digital FIR and IIR filters. Understands and can implement in C language the basic ways of visualization of biological data and the results of their processing.

F7PBBEMP	Electromagnetic Fields of Living Organisms	KZ	2

Static and quasi-static electric and magnetic fields, electromagnetic fields. Electrical and magnetic properties of biological tissues. Electrical, magnetic and electromagnetic stimulation in medicine. Anatomical and physiological bases of bioelectromagnetism. Bioelectric sources and conductive environment. Integral relations of electrodynamics of bioelectric fields, electrodynamic aspects of mathematical modeling of electrocardiography and electroencephalography. Topographic concept of bioelectrical and biomagnetic measurements. Methods and techniques of measurement. Human-robotic limb replacement interface.

F7PBBRBL	Robotics in Medicine	KZ	2

Application of robotic principles of medicine, ie medicine and laboratory technology. Description of the kinematic chain of robots with regard to their use. Explains their kinematic analysis and synthesis. Thus, the investigation of the relationships between the position, speed and acceleration of individual kinematic pairs relative to the frame of the chain. And also the action of the prescribed movement (trajectory) of the end point of the chain. It introduces the methods of investigating the dynamics of kinematic chains of surgical and manipulative arms. Above all, it is a matter of finding such force effects in the drives of the kinematic pairs so that the end point of the chain performs the desired movement. Furthermore, the course explains the most commonly used paradigms of control of these arms. Especially in connection with the role of inverse kinematics and inverse dynamics. Due to the installation, the most frequently used sensors and actuators are listed, ie design and function. Finally, specific examples of the application of robotic principles of medicine will be given

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
F7PBBA3A	English Language IIIA (part 1)	KZ	2
The aim of the course is to increase students' language competence in academic English and professional vocabulary, along with common communication skills. Students should be able to work actively with academic text, understand and be able to use basic terminology, and be aware of the different stylistic levels of English and the associated syntactic and lexical devices.			
F7PBBA3B	English Language IIIB (part 2)	KZ	2
Teaching in the summer semester is based on a modern, non-frontal, project-based, and interdisciplinary way of teaching that is gaining prominence in the world. The system is based on the independent creative work of students who are asked to develop an interesting topic in their field of study, i.e. biomedical engineering, and make it available to their colleagues in the form of a project. Another activity of the students in the summer semester is a discussion with the tutor over an article from the New Scientist magazine available from the faculty library.			
F7PBBAF1	Anatomy and Physiology I.	Z,ZK	4
Entry requirements of the course: - - Output knowledge, skills, abilities and competences: The course serves to understand the relationships between the structure and functions of the human body. The teaching follows modern pedagogical trends consisting in a direct connection between the morphology and the functions of organ systems. Seminar teaching is closely linked to the topics of lectures and connected with practical exercises. It focuses significantly on problems of program and uses activation methodologies to increase student motivation. The use of modern multimedia programs (eg ADAM and others) is a matter of course. From a theoretical and practical point of view, the main emphasis will be on the morphology and function of vital organs and systems.			
F7PBBAF2	Anatomy and Physiology II.	Z,ZK	4
F7PBBALP	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.			
F7PBBAZC	Algorithms for Biosignals in the C Language	KZ	2
Explain the principle and implementation of the most used algorithms for biosignal processing and their specific functional (and time and memory efficient) implementation in C and C ++ in the form of practically oriented interpretation and demonstration tasks. Graduates will be acquainted with specific solutions to basic algorithmic problems in biosignal processing: with segmentation, analysis in the time and frequency domain, with the design of linear digital filters (FIR and IIR) and with the visualization of results. Prerequisites and co-requisites: basic knowledge of systems and signal processing, basics of ISO C. Output knowledge, skills, abilities and competences: The student is familiar with algorithms for preprocessing and intelligent segmentation of biological time series in C and C ++, eg: FFT algorithm, SFFT and wavelet transforms, algorithm for calculating autocorrelation and cross-correlation functions, convolution, etc. Can implement in C language the floating time window method for feature extraction and basic algorithms for the design and implementation of digital FIR and IIR filters. Understands and can implement in C language the basic ways of visualization of biological data and the results of their processing.			
F7PBBAZD	Biomedical Data Analysis and Processing	KZ	2
F7PBBBB	Biomechanics and Biomaterials	Z,ZK	4
The course is intended for all students who need to supplement their knowledge and have a general knowledge about biomechanics and its application in specific practical problems. The content is chosen to be sufficient to understand athe issues in related subjects, especially the subject of Mechanics and Robotics in Medicine. If the student does not choose the subject and has never had the opportunity to complete these basic knowledge, they will be exposed to the risk of misunderstanding the subsequent issues in related subjects, in which this is not taken into account the basic knowledge.			
F7PBBBCH	Biochemistry	Z,ZK	2
The student will become familiar with the basic areas of Biochemistry and understand the interrelationships between these areas. The learner will be able to navigate biochemical concepts especially in the context of clinical biochemistry. The student will learn to work in the laboratory according to good laboratory practice, learn the specifics of working with biological material and acquire good work habits. He/she will be able to process, interpret and discuss the results correctly.			
F7PBBBFT	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.			
F7PBBBLG	Biology	Z,ZK	4
The student will gain clear knowledge of general and cell biology, through the formation of cells and organelles (endosymbiotic theory) and basic chemical composition of cells (simple inorganic and organic substances, carbohydrates, fats, amino acids, biopolymers - NK and proteins), construction of non-cellular forms (especially viruses) and cells, both prokaryotic (bacteria) and eukaryotic (plant, animal and fungal cells), they will get acquainted with cell metabolism (anabolism and catabolism), growth and cell differentiation, division (cell cycle and its regulatory mechanisms) until apoptosis and necrosis. They will get acquainted with the basics of microbiology (viral and bacterial diseases of man) and applications in technical and medical fields. He will gain detailed knowledge about the internal structure of a eukaryotic cell, its endomembrane system and semiautonomous organelles and the processes that take place in them. Following in the field of molecular biology, they will get acquainted with the basic processes that are necessary for the implementation of genetic information, the processes of replication, transcription, translation (ie proteosynthesis) and gene expression, the genetic code. In general genetics, with basic genetic terminology and processes of passing genetic information from parents to offspring according to Mendel's and Morgan's laws, changing genetic information in the form of mutations and possibilities of repair in the cell. Human genetics (clinical genetics) includes basic examination methods and human genetic diseases (autosomal dominant, recessive, gonosomal dominant, recessive, mitochondrial and others). Following the great development of molecular biology and biochemistry techniques, the student is acquainted with genetic engineering and its methods of genetically modified organisms and their preparation, tissue cultures and biotechnologies. Applied biology in technical and medical fields describes the use of biological structures and mechanisms in modern technology and medicine. The conclusion consists of issues related to the field of animal cells and tissues, their histology and issues of biocompatibility.			
F7PBBBLS	Biological Signals	Z,ZK	4
The subject deals with origins and description of the most important electric and non-electric biological signals. The principles of generation, recording and basic properties are studied in all the signals. The studied signals involve native and evoked biosignals, including biological signals of the heart, brain, muscles, nervous system, auditory signals, visual system, signals from the gastro-intestinal system etc. Advanced methods of digital biosignal processing,spectrum analysis, modern methods of artificial intelligence, features extraction, automatic classification, graphic presentation of results. Adaptive segmentation, artificial neural networks for signal procesing.			
F7PBBBOZP	Safety Regulations and Standards in Electrical Engineering	Z	1
Safety and Health protection during work; the role of the biomedical technician in clinical practice; risk-determining effects; patient environment; medical isolated system; electric shock; types of distribution systems; protection classes; electrical inspections; regulations and standards; work with lasers			

F7PBBBP	Bachelor Thesis	Z	6
Aim: Student work under the guidance of a supervisor and possible consultant on a given BP topic, especially in the laboratory, using knowledge and skills from previous courses and in the time allotted. Course entry requirements: Prerequisite F7ABBMVP Research Methodology - This course is essential because it prepares students to write a bachelor thesis and how to prepare it methodically. Outcome knowledge, skills, abilities and competencies: The student is able to work on a given topic in a defined form, in a defined time and is able to work under the guidance of a BP supervisor and also in a team. The student is able to use knowledge, skills and knowledge from previous courses to solve the assigned problem. This is a Bachelor's thesis, which is defended in front of the HSS committee. This thesis is assessed by the supervisor and the opponent according to the ECTS grading scale. Subsequently, these evaluations and the result of the state final examination in the subject areas are included in one final evaluation.			
F7PBBCHM	Chemistry	Z,ZK	4
F7PBBDIZ	Detectors of Ionizing Radiation	KZ	2
F7PBBEBI	Ethics in Biomedical Engineering	ZK	2
Prerequisites: Knowledge of school humanities objects (philosophy, history, psychology) Target knowledge and skills: basic concepts and controversial topics in biomedical theoretical and applied ethics; be able to think critically in ethical contexts; argue and defend opinions in ethical dilemma situations; ability development of professional literature and development of empathy.			
F7PBBELF	Electrophysiology	Z,ZK	2
Aim/objectives: to introduce students to the theory of electrical phenomena at the cell, organ and organism level, to the possibilities of measuring and using these manifestations. A sub-objective is to enable students to experimentally verify the knowledge. This course builds on Anatomy and Physiology I and II and requires a basic knowledge of the structure (anatomy) and function (physiology) of the following systems (excitable tissues): nervous, musculoskeletal, circulatory (especially the heart). The course deals with the problems of excitable tissues (nervous, The course deals with the physiology of nervous tissue, muscle and glandular tissue and provides knowledge of the physiology of electrical processes at different levels: cell, tissue, organ, organism.			
F7PBBEM	Electrical Measurements	Z,ZK	4
Measuring of electric values, principles, using, and parameters. Analogue measuring converters. Electromechanical measuring devices. Current and potential measuring. Frequency and shift phase measuring. Electric work and electric power measuring: direct current, single-phase and three-phase current. Electrical resistance and impedance measuring. Magnetic measuring. Analogue scope. Digitalization, digital signal processing, signal reconstruction. Electronic measuring devices: multimeter, digital scope. Optoelectronic measuring device.			
F7PBBEMP	Electromagnetic Fields of Living Organisms	KZ	2
Static and quasi-static electric and magnetic fields, electromagnetic fields. Electrical and magnetic properties of biological tissues. Electrical, magnetic and electromagnetic stimulation in medicine. Anatomical and physiological bases of bioelectromagnetism. Bioelectric sources and conductive environment. Integral relations of electrodynamics of bioelectric fields, electrodynamic aspects of mathematical modeling of electrocardiography and electroencephalography. Topographic concept of bioelectrical and biomagnetic measurements. Methods and techniques of measurement. Human-robotic limb replacement interface.			
F7PBBEO	Electronic Circuits	Z,ZK	4
The course provides a basic orientation in the principles of electronic circuits used in electronic laboratory and medical devices. It provides a prerequisite for the skilled operation of analogue and digital instrumentation. technology. Course entry requirements: Successful completion of Theoretical Electrical Engineering. Exit Knowledge, Skills, Abilities and Competencies: Students will become familiar with functional electronic blocks that are used in the design of laboratory and medical instruments. The course will prepare them to competently assess the basic properties and parameters of electronic devices.			
F7PBBESP	Management of Health Care Technology	Z,ZK	2
F7PBBEZP	Economics of Health Services	KZ	2
Methodology of managing the economics of healthcare operations. The role of management and administration. Healthcare legislation and law, application of laws in a real hospital. The role of management control and its role in the medical technology market, Planning strategies, analysis and research of consumer and organisational markets, market development and positioning. Aim: economics of healthcare operations, which is the goal and guarantee of success and level of healthcare delivery.The course The course provides a knowledge base for the PBB2ESP course. Course entry requirements: Exit knowledge, skills, abilities and competencies: the student will be able to calculate interest, inflation, annuity. The student will therefore be able to be able to produce the economic part of a feasibility study.			
F7PBBFCH	Physical Chemistry	Z,ZK	4
The course is aimed at clarifying the physicochemical principles of topics related to the profession of biomedical engineer and technician in clinical practice or research. The goal of the course is to provide students with the fundamentals of physical chemistry as they occur and are applied in the design of medical devices, in clinical research, or directly in clinical practice. The course demonstrates the direct application of theoretical principles in practice.			
F7PBBFVP	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. .			
F7PBBFY1	Physics I.	Z,ZK	4
Course Physics 1 is used to repeat and expand the basic knowledge of physics in the field of classical mechanics, thermals and optics, which is needed for further study at FBME CTU. Students will gain theoretical knowledge, the ability to solve numerical problems and practical skills associated with working in laboratories.			
F7PBBFY2	Physics II.	Z,ZK	6
The course Physics 2 follows the course Physics 1 and expands the acquired knowledge in the field of electromagnetism and the basics of atomic and nuclear physics and condensed matter physics.			
F7PBBHE	Hygiene and Epidemiology	ZK	1
F7PBBISZ	Information Systems in Health Care	Z,ZK	4
Lectures are focused on the definition and clarification of individual subfields of medical informatics, the links of information systems to the organization of health care, payments and controlling, the definition of IS users and their roles. The course includes the necessary overview of information technology and technical and SW resources for building IS. Attention is also paid to the principles of coding and interpretation of medical data, data standards and communications. The individual types and properties of clinical, complementary, hospital, regional and managerial medical and medical IS are analyzed. The course also provides detailed information on the methodology of development, implementation and support of large-scale information systems in health care.			
F7PBBITP	Integral Calculus	Z,ZK	4
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.			
F7PBBKT	Communication Technology	Z,ZK	2
Význam a praktické příklady nasazení informačních a komunikačních technologií ve zdravotnictví. Historie, základní struktura a rozdělení počítačů, motherboard, sběrnice, BIOS, autotest, procesor, operační paměť, klasické a SSD pevné disky, paměťové karty, zvukové karty, grafické karty, monitory, klávesnice, myši, tiskárny a skenery, univerzální vstupně výstupní porty (USB, USB-C, HDMI, DisplayPort, Thunderbolt, HDMI, S/PDIF), RS232 jako virtuální COM port a jeho použití v praxi, modemy, nejčastější sběrnice pro připojování			

periferií v mikroprocesorových systémech (IIC, SPI), nejčastější sběrnice pro komunikaci přístrojů a systémů ve zdravotnictví, standardizace, operační systémy, mobilní platforma pro snímání, vyhodnocování a přenos dat, rozhraní Bluetooth, NFC, počítačové sítě, LAN, WAN, vrstvový referenční model OSI, základní technické prostředky LAN (Ethernet, WiFi a jejich praktická realizace), Internet - prohlížeče, používané standardy a jazyky, úvod do architektury TCP/IP, protokoly a adresování, propojování lokálních sítí, brány a směrovače, pojem server, architektura klient-server, nejčastěji používané protokoly síťové architektury TCP/IP: HTTP, FTP, DNS, DHCP, VPN.

F7PBBKZS	Conventional Imaging Systems	Z,ZK	4
F7PBBLAD	Linear Algebra and Differential Calculus	Z,ZK	6

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.

F7PBBLPZ1	Management of Health Care Technology	Z,ZK	4

Overview and categorization of medical (diagnostic devices) according to international directives (EU directives), including correct terminology. The electrical safety of medical equipment operation. Medical technology in clinical practice; Construction of diagnostic apparatus; Biosignal amplifiers, sensing electrodes, recording systems; Measurement of cardiac electrical activity (ECG) - electrocardiographs, vector cardiographs; Blood pressure monitors - NIBP; Blood pressure measuring instruments - IBP, PCWP; Dilution measurement of cardiac output, Swan-Ganz catheter; SpO2 pulse oximetry; Vital signs monitors, central monitoring systems. Special monitors for clinical practice - cardiotocographs, NIRS, BIS; Electroimpedance methods in clinical practice - a measurement of respiration by impedance method, EIT; Measurement of brain bioelectrical activity (EEG); Measurement of muscle bioelectric activity (EMG); Spirometry; Examination of the auditory system; Simulators and testers of diagnostic equipment.

F7PBBLPZ2	Medical Devices and Equipment II. (Therapeutical Devices)	Z,ZK	2
F7PBBLT	Clinical Laboratory Instrumentation	Z,ZK	4
F7PBBMAT	Marketing of Medical Technology	KZ	2
F7PBBMAZ	Management and Admininistration in Health Care	KZ	1
F7PBBMDT	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.

F7PBBMEC	Mechanics	Z,ZK	4

Students will get acquainted with the following areas of mechanics: General physical equations, Newton's laws, statics and dynamics. Force and moment effect - decomposition, replacement. Equilibrium of a force system in a plane and space - equation of equilibrium, systems into equilibrium. Reactions on statically determined systems - motion restrictions, spatial and planar constraints, solution of reactions. Static moment, center of gravity and center of area. Spatial moment of inertia - kinetic energy of rotational motion, product moment, momentum, law of conservation of momentum. Second moment of area - product moment, polar moment, Mohr circle, main moments of inertia, ellipse of inertia. Internal static effects - beam, system of plates, course of internal static effects, kinematic method, statically indeterminate problems. Mechanical properties of materials - tests of mechanical properties, stresses and deformations, Hooke's law. Stress and strain - uniaxial and biaxial stress state, simple bending, bending curve, torsional stress, cross-section design, thin-walled cross-sections, combined stress, nonlinear models. Buckling strength - critical load, stability of members, calculation of cross section. Tests of hardness, adhesion, toughness, tribological.

F7PBBMFJ	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.

F7PBBMS	Modelling and Simulation	Z,ZK	4

Basic concepts and consequences of modeling and simulation. Be able to use modeling and simulation methodologies. Emphasis is placed on a thorough understanding of compartmental models, physiological models, pharmacokinetics. Furthermore, continuous and discrete models of population dynamics, epidemiological models, models of venereal diseases.

F7PBBMT	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.

F7PBBMTB	Microprocessors in Biomedicine	KZ	2

We will explain the principle and building elements of a microprocessor system, the structure of a microprocessor, the connection of basic peripherals, the programming model of a microcomputer system in the form of a practically oriented explanation and demonstration tasks. Provide a basic overview of ATMega and ARM Cortex M architectures with practical examples of their programming with examples of use in biomedicine. Prerequisites and co-requisites: basic knowledge of digital technology and signal processing, basics of ISO C. Output knowledge, skills, abilities and competencies: The student is familiar with the selection and design of microprocessor system solutions for use in biomedicine. It manages the configuration and program control of these building blocks of the microprocessor system: digital inputs and outputs, A / D and D / A converters, serial and parallel communication, counters and timers, interrupt controller. Understands the basics of communication of microcomputers with the environment: interfaces for LCD displays, keyboards, RS232, Ethernet, WIFI, Bluetooth, XBee and mobile 3G / 4G communication, GPS / GLONAS localization.

F7PBBMVP	Research Methodology	KZ	2

The course introduces students to the basic methods of research work and the requirements for scientific communication. The course also introduces students to the principles of writing and presenting of bachelor's thesis.

F7PBBNMP	Project Proposal and Management	KZ	2

As part of the lectures, students will become familiar with topics such as project management (PM) according to IPMA, the certification process, project, program, portfolio, phases, and the project life cycle, as well as project initiation. They will learn about the feasibility study, project initiation, project identification document, and logical framework. Other topics include an introduction to project planning, scheduling, risk and risk analysis, project implementation, behavioral competencies in PM, project closure, and evaluation. Students will also gain practical insights from a hospital environment. During the exercises, students will master the following concepts and topics and develop relevant outputs: teamwork, feasibility study, identification document, logical framework, WBS (Work Breakdown Structure a hierarchical structure of tasks or activities), scheduling, risk analysis, project implementation, and a final test. As part of this course, students have the opportunity to obtain the IPMA Level D certification, which is intended for aspiring project managers, project coordinators, and team members. The certification is valid for five years.

F7PBBOIZ	Protection Against Ionizing Radiation	ZK	2
F7PBBPMS	Probability and Mathematical Statistics	Z,ZK	4

Objectives: to familiarize students with the basic principles of the theory of probability and mathematical statistics. Pre-requisites and entry requirements of the course: Knowledge of mathematics (linear algebra, differential and integral calculus) in the range of F7PBBLAD and F7PBBITP courses taught in the first year of study. Knowledge, skills, abilities and competencies: The student is acquainted with the probabilistic model, basic definitions of Kolmogorov theory of probability and inductive statistics. The student can apply these definitions

to practical problems that arise in other areas of professional work and can explain them sufficiently (e.g. doctors). The student is familiar with the basic methods of inductive statistics and can choose a suitable method for standard statistical problems.

F7PBBPNK	Design and Construction of Medical Devices/Practical Exercises	KZ	4

The aim of the practically oriented course is to acquaint students with the design process of the measuring part of the device, ie basic problem analysis, determination of functional blocks and their design, selection of suitable components and their values with emphasis on working with catalog sheets and application recommendations, preparation of electrical documentation and board design. printed circuit board, its mounting, soldering and revitalization. During the course, students will implement a functional device (mounting, soldering, recovery) electronic thermometer, which will consist of two functional units - analog part for temperature measurement and signal conditioning (equipped with THT components) and display element with diode bargraph (equipped with SMT components). For both products, students will implement the design of the diagram and PCB in the CAD environment EAGLE. In addition to the analog part of the device, an application for digitizing data from the analog device using NI-DAQ cards and a cheap solution with the help of Arduino will be implemented. The last part will be a service intervention in the device (monitor of vital functions) with emphasis on safe handling and measurement of test points.

F7PBBPP	First Aid	KZ	2
F7PBBPPM1	Programming in Matlab I.	KZ	1

Students will learn how to use Matlab, get knowledge of data structures and with data and working with data and their display. During the semester, they will gain knowledge of creating scripts in Matlab and the basics for their use in the processing of biomedical data.

F7PBBPPM2	Programming in Matlab II.	KZ	2

The aim of the course is to understand the topic of scripting languages and their applications, to understand their advantages and disadvantages and their complementarity with system languages. Students will become familiar with regular expressions and tools for word processing. The course focuses on the scripting languages within the Unix operating system and the scripting languages Python.

F7PBBPPP	Programming Tools	KZ	2

The aim of the course is to provide an overview of basic application software for GNU / Linux and MS Windows with examples and examples of use, including a comparison of parameters of individual programs. The areas of focus of individual program resources are selected with regard to the usability of FBMI students in other subjects and also in the preparation of qualification works and in subsequent professional employment in the field. The entry requirements of the course are knowledge of computer control at the secondary school level. After completing the course, students will gain the following output knowledge, skills, abilities and competencies: Routine control of common user programs in MS Windows and GNU / Linux, measured in the following areas: creation of technical documentation, processing of 2D graphics, audio, video, secure information sharing and network communication, creation and publication of personal web pages, processing and visualization of biomedical data, basics of scripting.

F7PBBPPS	Pacient and Device Simulators and Testers	Z,ZK	2

Patient and instrument simulators and testers. Basic principles of implementation, connections with other disciplines. Detailed description and implementation of a selected model of a subsystem. Design and implementation of patient and instrument simulator sub-blocks. Examples of circuit implementations of simulators and testers. Environment, scenario creation and other related procedures in manikin control, basic concepts and principles of anesthesiology. Other types of simulators and phantoms. Possibilities of use in clinical practice. Practical demonstration. Connection of the simulator with other medical equipment. Simulators and testers. Implementation of an established simulation scenario, scenario testing, creation of new scenarios. Collaboration between HPS and anaesthesia machine.

F7PBBPSL	Psychology	KZ	2

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

F7PBBPTI	Principles and Practice in Tissue Engineering	KZ	2
F7PBBRBL	Robotics in Medicine	KZ	2

Application of robotic principles of medicine, ie medicine and laboratory technology. Description of the kinematic chain of robots with regard to their use. Explains their kinematic analysis and synthesis. Thus, the investigation of the relationships between the position, speed and acceleration of individual kinematic pairs relative to the frame of the chain. And also the action of the prescribed movement (trajectory) of the end point of the chain. It introduces the methods of investigating the dynamics of kinematic chains of surgical and manipulative arms. Above all, it is a matter of finding such force effects in the drives of the kinematic pairs so that the end point of the chain performs the desired movement. Furthermore, the course explains the most commonly used paradigms of control of these arms. Especially in connection with the role of inverse kinematics and inverse dynamics. Due to the installation, the most frequently used sensors and actuators are listed, ie design and function. Finally, specific examples of the application of robotic principles of medicine will be given

F7PBBROP	Guided Practical Training	Z	2

Familiarization of students with the organization and provision of professional internships at the clinical workplace. Provision of contractual documents for the implementation of the ROP (supervised professional practice). The ROP will then enable the acquired practical skills and habits to be applied in the key subjects of the 3rd year. The student thus has an overview of the current technical level of hospital equipment; an overview of the organization of the work of biomedical technicians and engineers; can apply legal requirements to ensure the safe operation of medical equipment. He can communicate with technicians, but also medical staff. He is able to work in a team.

F7PBBSBP	Bachelor Thesis Seminar	Z	1

Objective(s): The aim of the course is to accentuate the realized outcomes of the projects solved in the 4th, 5th and 6th semesters of the Biomedical Technology Bachelor's degree study program. The aim of the course is also to prepare students for the defense of their bachelor thesis infront of the final state examination committee. Course entrance requirements: Prerequisite F7PBBMVP Exit Knowledge, Skills, Abilities and Competencies: Students are fully aware of the requirements for the requirements of professional reports and communications, they are proficient in the orientation in the professional literature. The students are able to understand the literature and literature on a given topic, apply scientific research methods to specific assignments. They present their proposed solutions and results, are able to interpret the results.

F7PBBSEL	Power Engineering	Z,ZK	5

Basics of power electronics, power supplies, including electrochemical sources, rectifiers, stabilizers, the most commonly used types of motors, basics of power distribution, types of electrical systems and connecting appliances with a focus on medical use. Emphasis is placed primarily on the physical nature of the problem and its understanding. knowledge will be verified on practical examples and in the laboratory.

F7PBBSJ	Scripting Languages	KZ	2

The aim of the course is to understand the topic of scripting languages and their applications, to understand their advantages and disadvantages and their complementarity to system languages. The course focuses on scripting languages in the Unix operating system and Python scripting languages.

F7PBBSM	Sensors in Medicine	Z,ZK	4

This subject provides information about basic electronic devices - sensors, describes their operation principle, basic circuit configuration and application. The stress is aid mainly on clarifying of basic principles and practical utilization. Integral part of this course is basic information about sensors of non-electric quantities and their read-out circuits eg. strain related sensors (force, pressure, torque, vibration, displacement, acceleration etc.) magnetic field sensors, temperature sensors, chemical sensors, optical sensors and biosensors. The stress is aid on miniaturization, integration

F7PBBSPR1	Semestral Project I.	KZ	1

The topic of the semester project (SPR1) must be in the field of biomedical engineering and must be related to the study field of the same name Biomedical Technician. The topics are available for the relevant academic year in the database projects.fbmi.cvut.cz Note: It is not possible to implement economic-managerial topics, topics based mainly on the creation of

	research, clean programming, topics purely in the field of biology, etc. The application must always be part of the work in accordance with the focus of the field. The topic must always be related to technology (medical devices, or the scope of work of a Biomedical Technician in clinical practice)! Entries that do not fall into the above areas will not be approved.		
F7PBBSPR2	Semestral Project II.	KZ	4
	The main idea is to start work on a project which can be improved in time and finish as a Bachelor thesis. In the course will be discussed topic as basic communication and presentation skills, including teamwork 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. The student solves topic (project) from the selection of the PROJECTS database - http://projects.fbmi.cvut.cz During the term, there are dedicated 2 hours every week for work under teacher supervising.		
F7PBBSPT	Research Methodology	Z,ZK	4
	The main objective of the course is to introduce students to the basic equipment of intensive care units (ICU) and anesthesiology and resuscitation departments of hospitals. These are devices to support vital functions, especially lung ventilation, as well as patient monitors, anesthesia machines and their parts and other equipment. Another objective of the course is to integrate knowledge and skills of students from the fields of science (especially physics, chemistry and physiology) and engineering (modeling, circuit theory, pneumatic elements, etc.) in the analysis of clinical technology and in the design and implementation of functional technical systems.		
F7PBBTA	Technical Audiology	KZ	2
	The aim of the course is to give students a basic overview of audiology, i.e. basic knowledge of biology, medicine and technology in relation to normal and impaired hearing, and all this in an interrelated context with emphasis on technical aspects. Motivation to work in clinical practice in audiology is also an integral part of this goal. workplace. Course entry requirements: These requirements are expressed as prerequisites and a detailed breakdown of the requirements is as follows: - nervous system - organisation and function of the CNS, internal environment of the CNS (blood-brain barrier, cerebrospinal formation, transport and function), neuroglia, motor nervous system, spinal cord (structure, reflexes), - nervous system - motor system, brainstem (structure, reflexes), cerebellum (structure, reflexes), basal ganglia (structure, reflexes), cerebral cortex (structure, rexlexes), physiology of movement control, - sensory nervous system - receptors, skin sensation, movement and position perception, vision, hearing, taste, smell, pain, autonomic nervous system, brain stem, hypothalamus, peripheral compartments: sympathetic and parasympathetic, - waves, types of waves, successive waves, interference, standing waves, sound, - types of signals, basic signal operations, signal decomposition, - harmonic analysis, Fourier transform for continuous and discrete signals, DFT, FFT, - convolution, - technical and biological systems, systems and their description, linear and non-linear system, - external description of continuous and discrete linear system - differential/differential equations, transfer functions, frequency characteristics, distribution of zeros and poles, time characteristics, - coupling of systems, feedback loops, - Characteristics of basic biosignals EEG, ECG, EOG, EP, EMG, artefacts, origin, sources, diagnostic applications, frequency range and bands, - Biological data acquisition and preprocessing, basic computer conversion chain, A/D converters, problems signal sampling and quantization, Nyquist theorem, conversion errors, signal conditioning, aliasing, filtering, trends, sensing options. Output knowledge, skills, abilities and competences: Students will acquire a basic understanding of acoustics, measurement and diagnosis of auditory functions, including technical principles. instrumentation and software, and hearing aids and replacements. The students will be able to orient themselves. They will be able to learn about these issues, learn about other areas of medical instrumentation and methods used in clinical practice, as well as motivated and ready to enter the field of audiology upon graduation and to add to this knowledge and advanced skills within the framework of the so-called certified course, which, according to Act 96/2004 Coll., allows for the acquisition of the so-called "certificate of audiology". Special professional competence Technical audiologist after graduation, i.e. after obtaining the so-called professional competence Biomedical technician under the Act.		
F7PBBTEL	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.		
F7PBBTZS	Tomographical Imaging Systems	Z,ZK	4
	CT systems (basic principle, schematic arrangement system, basic physical principle, developmental generations, basic principles of reconstruction). Imaging systems magnetic resonance. PET and SPECT principle. Specialized imaging systems (hybride). Ultrasound imaging systems. Doppler systems. Subject and especially laboratory exercises provide students with an insight into the principles of creating image data used in medicine, the principle of methods their scanning, digitization and subsequent processing, on the principle of function and properties of scanning image means in context, which is important especially in terms of interdisciplinarity of the subject and the field as a whole.		
F7PBBUSS	Introduction to Signals and Systems	Z,ZK	4
	The aim of the course is to acquaint students with the basics of signal processing, especially with time and frequency domain operations. Emphasis is placed on a thorough understanding of Fourier analysis. The second part of the course is focused on acquainting students with systems, their properties and description. Emphasis is placed on the external and internal description of linear dynamical systems.		
F7PBBVBI	Virtual Bioinstrumentation	KZ	2
	This subject deals with process of development of application in LabVIEW using Virtual Instrumentation concept. During the course will be explained basic concepts of programming like variables, data structures, cluster, loops, conditionals, typedefs, advanced coding concepts like event driven programming, multi-threaded application development, data queues and FIFOs, synchronisation, process of deployment, executable building, installer and upgrades. The students are able also to obtain the CLAD (Certificate LabVIEW Associate Developer) certificate. This certificate is first step in knowledge of VI.		
F7PBBZLN	Legislation in Health Care and Technical Standards	KZ	2
	Aims / aims: The aim of the course Legislation in Health Care and Technical Standards is to teach students the basic requirements and regulatory obligations in healthcare, especially in the field of medical devices. During the course, students will learn the basics of legislation process, as well as regulation related to the medical devices, lso with legislative regulations in the field of clinical trials and the operation of medical devices. Furthermore, students will learn the legal context of providing health care. The aim is to acquaint students with the rights and obligations arising from current legislation relating to health care issues.The emphasis is not on memorizing of the text of legal regulations, but on acquainting students with the main points and ideas contained in the laws, regulations and standards of the Czech Republic and EU directives in the field of healthcare. Prerequisites and co-requisites: To successfully complete the course, students should know the basics of the principles of medical devices due to the practical application of legislation in this area. Output knowledge, skills, abilities and competences: After completing the course, the student should have a comprehensive overview of health legislation. He should be able to orientate himself in a given problem related to legislation without any problems and he should know where he can find individual details related to legal issues in health care.		
F7PBBZOD	Image Data Processing	KZ	2
	The aim of the course is to provide basic knowledge about the principles of the digital image processing process (algorithms - implementation and realization). This goal also includes the issue of digitization and basic methods of image data analysis.		
F7PBBZP	Basics of Pathology	ZK	2

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