Study plan

Name of study plan: Prospectus - bakalářský

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: 0
Elective courses credits: 0
Sum of credits in the plan: 0
Note on the plan:

Name of the block: pomocná
Minimal number of credits of the block: 0
The role of the block: !

Code of the group: PRO-B-2
Name of the group: Courses that will be open if at least five students are registered
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
Note on the group:

Code	Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors, **authors** and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
17AVAUBME	**Introduction to Biomedical Engineering** *Jiří Hozman, Evgeniia Karnoub **Jiří Hozman** Jiří Hozman (Gar.)*	Z	2	1P+1C	Z	!

Characteristics of the courses of this group of Study Plan: Code=PRO-B-2 Name=Courses that will be open if at least five students are registered

17AVAUBME	Introduction to Biomedical Engineering	Z	2

The main goal of the course is to implement an introduction to the field of study, including the relationship between the content of biomedical engineering, the study plan, the requirements of Czech legislation and clinical practice. The partial goals are motivation for the non-medical health profession, a description of the content of studies and controlled professional practice, as well as the possibilities of other professional activities of students. The course also includes a description of the disciplines of biomedical engineering and a demonstration of selected relevant instrumentation, including a simulated ICU and artificial patients. At the end of the course, the specific role of the biomedical technician (profession) in health care will be described in connection with the legislation of the Czech Republic and international relationships and possible applications, including the role of professional societies in the Czech Republic. From the organizational point of view, the subject will be taught after 2 hours and for that reason only 7 topics of lectures and 7 topics of exercises are mentioned.

Code of the group: PRO-B-0
Name of the group: Courses that will certainly be open
Requirement credits in the group:
Requirement courses in the group:
Credits in the group: 0
Note on the group:

Code	Name of the course / Name of the group of courses *(in case of groups of courses the list of codes of their members)* *Tutors, **authors** and guarantors (gar.)*	Completion	Credits	Scope	Semester	Role
F7ABBALP	**Algorithmic and Programming Theory** *Lenka Hanáková, Pavel Smrčka, Tomáš Veselý, Christiane Malá **Pavel Smrčka** Pavel Smrčka (Gar.)*	KZ	4	2P+2C	Z	!
F7ABBAF1	**Anatomy and Physiology I.** *Anastasiya Lahutsina, Ksenia Sedova Ksenia Sedova (Gar.)*	Z,ZK	4	2P+1C+1L	Z	!
F7ABBAF2	**Anatomy and Physiology II.** *Anastasiya Lahutsina, Ksenia Sedova, Anastasia Sedova **Anastasiya Lahutsina** Ksenia Sedova (Gar.)*	Z,ZK	4	2P+1C+1L	L	!

F7ABBA3A	**English Language IIIA (part 1)** *Eva Motyčková **Eva Motyčková** Eva Motyčková (Gar.)*	KZ	2	2C	Z	!
F7ABBA3B	**English Language IIIB (part 2)** *Eva Motyčková **Eva Motyčková** Eva Motyčková (Gar.)*	KZ	2	2C	L	!
F7ABOBP	**Bachelor Thesis**	Z	10	4XT	L	!
F7ABOBV	**Binocular Vision** *Přemysl Kučera, Ondřej Policar **Přemysl Kučera** Markéta Žáková (Gar.)*	Z,ZK	7	2P+4C	Z	!
F7ABBBCH	**Biochemistry** *Martina Turchichová, Anna Ludvíková **Martina Turchichová** Martina Turchichová (Gar.)*	Z,ZK	2	1P+1L	Z	!
F7ABBBFT	**Biophotonics** *Jan Mikšovský, Jan Remsa **Jan Remsa** Jan Mikšovský (Gar.)*	KZ	2	2P	Z	!
F7ABBBLS	**Biological Signals** *Václava Piorecká, Marek Piorecký **Václava Piorecká** Václava Piorecká (Gar.)*	Z,ZK	4	2P+2L	L	!
F7ABBBLG	**Biology** *Veronika Vymětalová **Veronika Vymětalová** Veronika Vymětalová (Gar.)*	Z,ZK	4	2P+2L	Z	!
F7ABBBB	**Biomechanics and Biomaterials** *Matej Daniel, Petr Volf **Petr Volf** Matej Daniel (Gar.)*	Z,ZK	4	2P+2L	Z	!
F7ABBCHM	**Chemistry** *Iveta Horáčková, Libor Holík **Iveta Horáčková***	Z,ZK	4	2P+1C+1L	L	!
F7ABOKC1	**Contact Lenses I.**	Z,ZK	3	2P+2C	L	!
F7ABOKC2	**Contact Lenses II.** *Jiří Michálek, Libor Eichenmann, Iva Klimešová **Jiří Michálek** Jiří Michálek (Gar.)*	Z,ZK	5	2P+2C	Z	!
F7ABOKRV	**Correction of Refractive Errors**	ZK	1	1P	L	!
17AVACC	**Czech for Foreigners** *Eva Motyčková, Hana Rogalewiczová, Vladimír Rogalewicz **Eva Motyčková** Eva Motyčková (Gar.)*	KZ	3	4C	Z,L	!
F7ABBEM	**Electrical Measurements** *Jan Vrba, Roman Matějka **Jan Vrba** Jan Vrba (Gar.)*	Z,ZK	4	2P+2C	Z	!
F7ABBELF	**Electrophysiology** *Ksenia Sedova, Anastasia Sedova **Anastasia Sedova** Ksenia Sedova (Gar.)*	Z,ZK	2	1P+1L	Z	!
F7ABBEMP	**Electromagnetic Fields of Living Organisms** *Jan Vrba, Ondřej Fišer **Ondřej Fišer** Jan Vrba (Gar.)*	KZ	2	1P+1L	L	!
F7ABBEO	**Electronic Circuits** *Ondřej Fišer, Pavel Máša, Tomáš Dřížďal **Ondřej Fišer** Pavel Máša (Gar.)*	Z,ZK	4	2P+2C	Z	!
F7ABBEBI	**Ethics in Biomedical Engineering** *Václav Navrátil **Václav Navrátil** Martina Dingová Šliková (Gar.)*	ZK	2	2P	L	!
F7ABBESP	**Management of Health Care Technology** *Jiří Hozman **Jiří Hozman** Jiří Hozman (Gar.)*	Z,ZK	2	1P+1C	L	!
F7ABOZFO	**Foundations of Physiological Optics**	ZK	2	2P	L	!
F7ABBFVP	**Multivariable Calculus** *Petr Maršálek **Petr Maršálek** Petr Maršálek (Gar.)*	KZ	2	1P+1C	Z	!
F7ABBFY1	**Physics I.** *Jan Mikšovský, Petr Písařík **Petr Písařík** Jan Mikšovský (Gar.)*	Z,ZK	4	2P+1C+1L	Z	!
F7ABBFY2	**Physics II.** *Jan Mikšovský **Petr Písařík** Jan Mikšovský (Gar.)*	Z,ZK	6	2P+2C+2L	L	!
F7ABBFCH	**Physical Chemistry** *Libor Holík, Karel Roubík **Karel Roubík** Karel Roubík (Gar.)*	Z,ZK	4	2P+1C+1L	Z	!
F7ABOOGB	**Geometric and Opthalmic Optics**	Z,ZK	5	3P+2C	L	!
F7ABBHE	**Hygiene and Epidemiology** *Anastasia Sedova **Anastasia Sedova** Emil Pavlík (Gar.)*	ZK	1	1P	L	!
F7ABBISZ	**Information Systems in Health Care** *Zoltán Szabó, David Jirsa **Zoltán Szabó** Zoltán Szabó (Gar.)*	Z,ZK	4	2P+2C	Z	!
F7ABBITP	**Integral Calculus** *Jiří Neustupa, Tomáš Parkman, Lukáš Liebzeit **Tomáš Parkman** Tomáš Parkman (Gar.)*	Z,ZK	4	2P+2C	L	!
F7ABBKT	**Communication Technology** *Christiane Malá, Martin Vítězník, Karel Hána, Jan Mužík, Tomáš Funda **Karel Hána** Karel Hána (Gar.)*	Z,ZK	2	1P+1C	Z	!
F7ABBKZS	**Conventional Imaging Systems** *Jiří Hozman, Tomáš Dřížďal, Martin Rožánek, Martin Čapek **Jiří Hozman** Jiří Hozman (Gar.)*	Z,ZK	4	2P+1C+1L	L	!
F7ABBLT	**Clinical Laboratory Instrumentation** *Martina Turchichová **Martina Turchichová** Martina Turchichová (Gar.)*	Z,ZK	4	2P+2L	L	!
F7ABBLPZ1	**Medical Devices and Equipment I. (Diagnostic Devices)** *Karel Roubík, Martin Rožánek, Petr Kudrna **Petr Kudrna** Martin Rožánek (Gar.)*	Z,ZK	4	2P+2L	Z	!
F7ABBLPZ2	**Medical Devices and Equipment II. (Therapeutical Devices)** *Petr Kudrna, Václav Ort, Ladislav Bís **Petr Kudrna** Petr Kudrna (Gar.)*	Z,ZK	2	1P+1L	L	!
F7ABBLAD	**Linear Algebra and Differential Calculus** *Petr Maršálek, Jiří Neustupa, Tomáš Parkman **Jiří Neustupa** Tomáš Parkman (Gar.)*	Z,ZK	6	2P+4C	Z	!
F7ABBMAZ	**Management and Admininistration in Health Care** *Václav Navrátil **Václav Navrátil** Václav Navrátil (Gar.)*	KZ	1	1P	Z	!

F7ABBMAT	**Marketing of Medical Technology** *Petra Hospodková **Petra Hospodková** Petra Hospodková (Gar.)*	KZ	2	2P	L	!
F7ABBMEC	**Mechanics** *Matej Daniel, Tomáš Goldmann **Matej Daniel** Matej Daniel (Gar.)*	Z,ZK	4	2P+2L	L	!
F7ABBMT	**Medical Terminology** *Václav Navrátil **Václav Navrátil** Václav Navrátil (Gar.)*	Z	1	1C	Z	!
F7ABBMVP	**Research Methodology** *Marek Novák, Jakub Ráfl **Jakub Ráfl** Jakub Ráfl (Gar.)*	KZ	2	1P+1C	Z	!
F7ABBMTB	**Microprocessors in Biomedicine** *Lenka Hanáková, Pavel Smrčka, Karel Hána, Jan Broulím **Karel Hána** Pavel Smrčka (Gar.)*	KZ	2	1P+1L	Z	!
F7ABBMDT	**Microwave Diagnostics and Therapy** *Jan Vrba, David Vrba **Jan Vrba** Jan Vrba (Gar.)*	KZ	2	1P+1L	L	!
F7ABBMS	**Modelling and Simulation** *Václav Petrák **Václav Petrák** Václav Petrák (Gar.)*	Z,ZK	4	2P+2C	L	!
F7ABBMFJ	**Physical Phenomena Modeling in COMSOL MULTIPHYSICS** *Jan Vrba, David Vrba **David Vrba** David Vrba (Gar.)*	KZ	2	1P+1C	Z	!
F7ABBNMP	**Project Proposal and Management** *Václav Bláha **Václav Bláha** Václav Bláha (Gar.)*	KZ	2	1P+1C	L	!
F7ABBOIZ	**Protection Against Ionizing Radiation** *Tomáš Veselský **Tomáš Veselský** Jana Hudzietzová (Gar.)*	ZK	2	2P	L	!
F7ABOPO	**OPT Project** ***Markéta Žáková***	KZ	5	4C	Z,L	!
F7ABOOFP	**Opthalmology Instruments**	ZK	3	3P	Z	!
F7ABBPPS	**Patient and Device Simulators and Testers** *Martin Rožánek, Petr Kudrna, Lenka Horáková **Petr Kudrna** Petr Kudrna (Gar.)*	Z,ZK	2	1P+1L	Z	!
F7ABBPPP	**Programming Tools** *Christiane Malá, Martin Vítězník **Christiane Malá***	KZ	2	2C	L	!
F7ABBPPM1	**Programming in Matlab I.** *Christiane Malá **Radim Krupička** Christiane Malá (Gar.)*	KZ	1	1C	Z	!
F7ABBPPM2	**Programming in Matlab II.** *Christiane Malá **Radim Krupička** Radim Krupička (Gar.)*	KZ	2	2C	L	!
F7ABBPNK	**Design and Construction of Medical Devices/Practical Exercises** *Roman Matějka, Jana Matějková **Jana Matějková** Roman Matějka (Gar.)*	KZ	4	4L	Z	!
F7ABBPTI	**Principles and Practice in Tissue Engineering** *Roman Matějka **Roman Matějka** Roman Matějka (Gar.)*	KZ	2	0P+2C	L	!
F7ABBPMS	**Probability and Mathematical Statistics** *Marek Piorecký, Jan Štrobl, Michaela Mrázková, Filip Černý **Michaela Mrázková** Marek Piorecký (Gar.)*	Z,ZK	4	2P+2C	Z	!
F7ABBPP	**First Aid** *Martin Staněk **Martin Staněk** Martin Staněk (Gar.)*	KZ	2	1P+1C	L	!
F7ABBPSL	**Psychology** *Olga Shivairová **Olga Shivairová** Olga Shivairová (Gar.)*	KZ	2	1P+1C	Z	!
F7ABBSPR1	**Semestral Project I.** *Petr Kudrna **Petr Kudrna** Petr Kudrna (Gar.)*	KZ	1	1C	L	!
F7ABBSPR2	**Semestral Project II.** *Petr Kudrna **Petr Kudrna** Petr Kudrna (Gar.)*	KZ	4	4C	Z	!
F7ABBSM	**Sensors in Medicine** *Tomáš Pokorný, David Vrba, Jan Rédr **David Vrba** David Vrba (Gar.)*	Z,ZK	4	2P+2L	L	!
F7ABBSEL	**Power Engineering** *Jiří Hozman, Ondřej Fišer, Marek Novák, David Vrba **David Vrba** David Vrba (Gar.)*	Z,ZK	5	2P+3L	L	!
F7ABBSJ	**Scripting Languages** *Tomáš Krajča **Radim Krupička** Radim Krupička (Gar.)*	KZ	2	2C	L	!
F7ABBSPT	**Equipment for Anaesthesiology and Resuscitation** *Karel Roubík, Václav Ort, Jakub Ráfl, Šimon Walzel **Jakub Ráfl** Václav Ort (Gar.)*	Z,ZK	4	2P+2L	L	!
F7ABOSUR1	**Subjective Refraction I.** *Přemysl Kučera, Markéta Žáková **Markéta Žáková** Markéta Žáková (Gar.)*	Z,ZK	4	2P+2C	Z	!
F7ABOSUR2	**Subjective Refraction II.**	Z,ZK	4	2P+4C	L	!
F7ABBTEL	**Theory of Electrical Engineering** *Pavel Máša, Tomáš Dřížďal, Marek Novák **Tomáš Dřížďal** Pavel Máša (Gar.)*	Z,ZK	4	2P+2C	L	!
F7ABBTZS	**Tomographical Imaging Systems** *Jiří Hozman, Evgeniia Karnoub, Tomáš Dřížďal, Martin Rožánek **Martin Rožánek** Jiří Hozman (Gar.)*	Z,ZK	4	2P+1C+1L	Z	!
F7ABBUSS	**Introduction to Signals and Systems** *Jan Kauler **Jan Kauler** Jan Kauler (Gar.)*	Z,ZK	4	2P+2C	Z	!
17AVARP1	**Research Project I.** *Jiří Hozman, Evgeniia Karnoub, Petr Kudrna, Hana Děcká **Petr Kudrna** Petr Kudrna (Gar.)*	KZ	10	8D+2S	L,Z	!
17AVARP2	**Research Project II.** *Jiří Hozman, Evgeniia Karnoub, Petr Kudrna, Hana Děcká **Petr Kudrna** Petr Kudrna (Gar.)*	KZ	10	8D+2S	L,Z	!

17AVARP3	**Research Project III.** *Jiří Hozman, Evgeniia Karnoub, Petr Kudrna, Hana Děcká, Martin Otáhal* ***Petr Kudrna*** *Petr Kudrna (Gar.)*	KZ	10	8D+2S	L,Z	!
F7ABBZP	**Fundamentals of Pathology** *Richard Becke* ***Richard Becke*** *Richard Becke (Gar.)*	ZK	2	2P	L	!
F7ABBZLN	**Legislation in Health Care and Technical Standards** *Vojtěch Kamenský, Peter Kneppo* ***Vojtěch Kamenský*** *Peter Kneppo (Gar.)*	KZ	2	1P+1C	Z	!
F7ABBZOD	**Image Data Processing** *Zoltán Szabó* ***Zoltán Szabó*** *Zoltán Szabó (Gar.)*	KZ	2	1P+1C	Z	!

Characteristics of the courses of this group of Study Plan: Code=PRO-B-0 Name=Courses that will certainly be open

F7ABBALP	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.

F7ABBAF1	Anatomy and Physiology I.	Z,ZK	4

Anatomy and physiology I covers functional aspects of particular organs and their systems.

F7ABBAF2	Anatomy and Physiology II.	Z,ZK	4

Anatomy and physiology II links to Anatomy and Physiology I. The subject covers functional aspects of particular organs and their systems.

F7ABBA3A	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.

F7ABBA3B	English Language IIIB (part 2)	KZ	2

Teaching activities in the summer semester are project-based.

F7ABOBP	Bachelor Thesis	Z	10

Work of the student under the guidance of the supervisor and possible consultant on the assigned BP topic, using knowledge and skills from previous courses and in the allotted time. Outcome knowledge, skills, abilities and competences: The student is able to work on the assigned topic in a defined format, in a defined time and is able to work under the guidance of the 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.

F7ABOBV	Binocular Vision	Z,ZK	7

This course builds on courses dealing with refraction of the eye and visual functions. Topics include: theory of binocular vision and conditions of its origin, development of visual functions, disorders of binocular vision, practical examination of binocular vision, heterophoria and fixation disparity, relationship of accommodation and vergence, vergence disorders and visual training.

F7ABBBCH	Biochemistry	Z,ZK	2

Course participants will be introduced to the basics of Biochemistry. The course builds on the knowledge gained in general chemistry and extends this knowledge about the chemistry of living systems. The interpretation goes through the basic building structures of biological systems (amino acids, peptides, proteins, lipids, carbohydrates, nucleic acids), biological membranes and molecular genetics to the most important metabolic processes. Particular attention is paid to the aspects necessary for understanding the methods of work in the biochemical and clinical laboratory, which are part of the follow-up chemical discipline. The laboratories are focused on broadening the topics discussed in the lectures and their practical training, especially on the determination of biomolecules and the verification of their properties. Students should become familiar with the basic laboratory techniques of Biochemistry.

F7ABBBFT	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.

F7ABBBLS	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.

F7ABBBLG	Biology	Z,ZK	4

Basic information about the cellular level of organisms - from acelullar through prokaryotic to eukaryotic. The viruses. Prokaryotic cells. Bacteria. Bacterial diseases and their control. Eukaryotic cells. Plant and animal cell structure and function. Structure and conformation of biopolymers (nucleid acids and proteins). The nucleus, plastids, mitochondria. Cytoplasm. Endomembrane system: endoplasmic reticulum, the Golgi apparatus, lysosomes, vacuoles. Semiautonomic organelles: mitochondria, sites of respiration and chloroplasts, sites of photosynthesis. The origin of eukaryotes: endosymbiotic hypothesis. Ribosomes. The cytoskeleton: microtubules, microfilaments. The cell cycle: mitotic (M) phase and interphase (G1, S and G2 phases). The division of cell nucleus - amitosis, mitosis, phases of mitosis, the mitotic spindle; meiosis. The cell division - cytokinesis. Cell differentiation. Cell death. Apoptosis and necrosis. Mendelian and modern genetics: structure, function and inheritance of genes. Includes the chemistry and structure of chromatin and chromosomes. Animal tissue histology. Animal cells and tissues. Human genetics. Chromosomal aberrations, genetic disorders and diseases. Genetic engineering. GMO organisms.

F7ABBBB	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.

F7ABBCHM	Chemistry	Z,ZK	4

Introduction to chemistry, categorization and properties of substances, chemical bonds, chemical reactions, elements in periodic table, organic chemistry fundamentals, natural substances, polymers, analytical methods - instrumental analysis, chemical calculations, chemical equations

F7ABOKC1	Contact Lenses I.	Z,ZK	3

Contact lens history and development. Contact lens terminology. Manufacturing methods. Classification of contact lenses and their materials. Material properties. Contact lens designs. Different methods of contact lens wearing and replacement. Contact lens care: composition and principles of action. Indications and contraindications of contact lenses. Spherical soft and rigid lenses. Instrumentation of contact lens practice. Patient history, basic examination and contact lens selection. Instructions regarding handling and contact lens care. Contact lens insertion and removal.

F7ABOKC2	Contact Lenses II.	Z,ZK	5
Toric contact lenses, Bifocal and multifocal lenses and other methods of presbyopia correction. Contact lenses for children. Coloured, cosmetic and prosthetic contact lenses. Therapeutic use of contact lenses. Special types of contact lenses. Special uses of contact lenses (sports, demanding occupations and environments, patients with general diseases, etc.). Drug interactions with contact lenses. Complications of contact lenses and their solutions. Application of soft and rigid spherical lenses. Application of contact lenses in astigmatism and presbyopia. Basic and specific care of contact lenses. Inspection of patients with contact lenses.			
F7ABOKRV	Correction of Refractive Errors	ZK	1
Subject is focused on theory and practical examination of refractive errors and various possibilities of correction of refractive errors. Optical and surgical correction of refractive errors. Objective methods of refraction. Subjective methods of refraction. Correction of myopia. Correction of hypermetropia. Correction of astigmatism. Correction of presbyopia. Determination of binocular balance. Basic techniques of surgical correction of refractive errors. Refractive surgery. Methods of laser keratorefractive surgery. Implantation of intraocular lenses.			
17AVACC	Czech for Foreigners	KZ	3
Survival Czech			
F7ABBEM	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.			
F7ABBELF	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.			
F7ABBEMP	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.			
F7ABBEO	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.			
F7ABBEBI	Ethics in Biomedical Engineering	ZK	2
An overview of basic ethical concepts and theories in the context of applied ethics with respect to the professional orientation, maintenance, and development of humanities in technically oriented students. Prerequisites and co-requisites: Knowledge of humanities in the scope of secondary school studies (basics of philosophy, history, psychology). Acquired knowledge, skills, abilities, and competencies: Knowledge of basic concepts and controversial topics in theoretical and applied ethics, the ability to critically think, discuss, argue and defend their own views in ethical dilemma situations, developing the ability to work with literature, enhance empathy skills.			
F7ABBESP	Management of Health Care Technology	Z,ZK	2
F7ABOZFO	Foundations of Physiological Optics	ZK	2
Fundamentals of optical imaging. Physiological structure of human eye, its geometric and physical properties. Visual perception. Sensitivity of eye. Optical system of human eye. Axes and pupils of eye. Schematic optical models of human eye. Photometric parameters of optical system of eye. Accommodation and aging of eye. Monochromatic and chromatic aberrations of human eye. Resolving power and depth of field. Influence of aberrations on image quality. Contrast sensitivity. Ametropy. Astigmatism. Aphakia. Amblyopy. Physiology of eye movement, methods of eye tracking. Basic principles of binocular and stereoscopic vision.			
F7ABBFVP	Multivariable Calculus	KZ	2
F7ABBFY1	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.			
F7ABBFY2	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.			
F7ABBFCH	Physical Chemistry	Z,ZK	4
Physical and chemical properties of substances. Basic calculations. Principles and behavior of systems of gases and liquids. Chemical bonds. Properties of solvents. Electrolytes. Dissociation of substances. Phase equilibria, multiface systems. Behavior and properties of vapors, evaporation. Electrochemical potential, electrodes. Electrodes of first and second kind. Referent and indication electrodes, electrodes for EKG, EEG, EMG etc. Redox potential. Inert electrodes. Membranes - types, properties and applications. Osmotic pressure. Ion selective electrodes. Acidity and basicity of solutions, pH. pH measurement. Stability of materials, corrosion. Passivation and self-passivation. Electrolysis and conductivity of solutions and its measurements. Polarography. Further methods of analysis of gases and solutions in BME (Biomedical Engineering.) Optical absorption. Spectrophotometry. Fluorescence and phosphorescence. Sensors for measuring of pH, pO2, pCO2, and SaO2 working on the basis of fibre optic cables and absorption or fluorescence. Advanced analytical devices. Mass spectroscopy, nuclear magnetic resonance, flame spectroscopy. Thermodynamics of reaction systems, basic calculations.			
F7ABOOGB	Geometric and Opthalmic Optics	Z,ZK	5
This course focuses on basics of geometrical optics and its applications in the field of optical design of simple optical elements and systems (lenses, mirrors, prisms, telescopes, etc.). The second part of the course deals with a description and analysis of a human eye as an optical imaging system. The design and analysis of various types of spectacle lenses for correction of refraction errors is presented.c			
F7ABBHE	Hygiene and Epidemiology	ZK	1
Students should learn theoretical basics of Epidemiology and Hygiene disciplines in depth covered by lecture topics. As result of this subject, student should be familiar with targets and working methods used in all disciplines of infectious and non-infectious epidemiology, environmental epidemiology and in solving of priorities and problems of Public Health Protection. Outcoming knowledge, skills, abilities and competences: Knowledge of basic methods used in preventive medical disciplines and legislation.			
F7ABBISZ	Information Systems in Health Care	Z,ZK	4
Lectures are oriented on medical informatics definition and basic characteristic of the different specialized areas. The relations between IS and health care structure, financing and controlling are analyzed as well. Some basic information technology, HW and SW tools are described in relation to IS design. A special attention is paid to medical data coding and interpretation, data and communication standards. Different types and features of clinical and hospital IS, decision support systems and regional health care IS are analyzed and discussed. Methodology of IS development, implementation and support are presented as well.			

F7ABBITP	Integral Calculus	Z,ZK	4
The subject is an introduction to integral calculus and integral transforms. Integral calculus: anti-derivative, indefinite integral, properties and methods of integration (integration by parts and by substitution, partial fractions), definite integral, properties, Newton-Leibnitz fundamental theorem, simple applications of both indefinite and definite integrals, improper integral, solving differential equations (ODEs) (1st order ODEs with separable variables, linear 1st order homogenous as well as non-homogenous ODEs, 2nd order linear homogenous and non-homogenous ODEs with constant coefficients),intro to multiple integrals, particularly double integral and applications. Integral transforms: Laplace transform and inverse Laplace transform and their application for solving nth order linear ODEs with constant coefficients.			
F7ABBKT	Communication Technology	Z,ZK	2
The aim of the course is to teach the student to understand the basic principles of the function of personal computers, their peripherals and communication interfaces. They will be able to configure the network interface and configure and connect a peripheral type of a standard medical devices equipped with a wired or wireless interface.			
F7ABBKZS	Conventional Imaging Systems	Z,ZK	4
Electromagnetic radiation spectrum and relationship to the modalities of medical diagnostic imaging systems. Fundamentals of imaging theory. Application of 2D FT. Transmission properties of imaging systems. Optical imaging systems including microscopic. Television imaging systems (including video endoscopic imaging systems). Basic digital image pre-processing methods. Infrared imaging systems (thermal imaging/IR imaging systems). X-ray imaging systems. Gamma imaging systems. Lectures and especially the laboratory exercises provide students with an overview of the principles of image formation in medicine for conventional imaging systems and methods. There are described methods for image data sensing, digitization and subsequent processing and principles of function and properties of sensing image devices in context, which is especially relevant from the interdisciplinary point of view of the whole course and study specialization. Knowledge, skills and competences: The student is able to explain the basic physical principle of the given modalities and knows its layout including the principle of image formation. The student is able to assess, on the basis of standard definition of technical parameters that imaging system meets the physician requirements for selected modality. Such knowledge is a prerequisite to the correct process technology selection and application of the modalities as well as the minimum necessary to ensure the required quality of the resulting image data.			
F7ABBLT	Clinical Laboratory Instrumentation	Z,ZK	4
Clinical laboratory instrumentation introduces principles of bioanalytical methods used in clinical diagnostics. Emphasis is put on optical methods (UV-VIS spectrophotometry, IR spectroscopy, AAS, AES, fluorimetry), NMR and X-ray analysis, electrochemical and electromigration methods (ion electrodes, biosensors, electrophoresis, isoelectric focusing), imunoassays and genetic methods (ELISA, PCR) as well as on chromatography and mass spectrometry. Contribution of lab automation to clinical diagnostics will be also discussed. During the laboratory course students will be introduced into the basics of work in bioanalytical laboratory and lab data processing.			
F7ABBLPZ1	Medical Devices and Equipment I. (Diagnostic Devices)	Z,ZK	4
Medical devices categories. Electrical safety of medical devices. Biopotentials amplifiers. Electrocardiographs, electromyographs and electroencephalographs. Dilution methods of blood flow and cardiac output measurement. Blood pressure measurement. Cardiac frequency measurement. Phonocardiography. Pulse oximetry. Medical monitors. Electrostimulation and electrosurgery medical devices. Therapeutic medical devices. Implantable medical devices. Telemetry. Medical devices for audiology.			
F7ABBLPZ2	Medical Devices and Equipment II. (Therapeutical Devices)	Z,ZK	2
Medical devices categories. The electrical safety of therapeutical medical devices. Artificial ventilation, introduction. Conventional ventilation. High-frequency ventilation. Extracorporeal membrane oxygenation. Hemodialysis. Drug infusion pumps (volumetric, syringe). Artificial cardiac pacemaker. Defibrillators (external, implantable). Cochlear implant. Electrosurgery units. Therapeutic ultrasound. Electro-therapy. Magneto-therapy.			
F7ABBLAD	Linear Algebra and Differential Calculus	Z,ZK	6
The course is introduction to differential calculus and linear algebra. Differential calculus - sets of numbers, sequences of real numbers, real functions (function properties, limits, continuity and derivative of a function investigation of function behavior), Taylor's formula, real number series. Linear algebra - vector spaces, matrices and determinants, systems of linear algebraic equations (solvability and solution), eigenvalues and eigenvectors of matrices, applications.			
F7ABBMAZ	Management and Admininistration in Health Care	KZ	1
Getting to know the structure of the health sector and financing models Health. Zoom administrative management issues various types of medical workplaces, their necessary interconnection. Orientation in the specific features of health facilities and European systems of health care workplaces.			
F7ABBMAT	Marketing of Medical Technology	KZ	2
Marketing fundamentals, products management, basic knowledge concerning export activities in the field of marketing and commercial health care technology. Practical cases are presented including health care technology companies from the Czech Republic. Discussion and analysis of the real products are included in the exercises.			
F7ABBMEC	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.			
F7ABBMT	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.			
F7ABBMVP	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.			
F7ABBMTB	Microprocessors in Biomedicine	KZ	2
The aim is to explain the principles and building blocks 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.			
F7ABBMDT	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.			
F7ABBMS	Modelling and Simulation	Z,ZK	4
Basic concepts. Aims and consequences of modeling and simulation. The methodology of modeling and simulation. Inverse problem. Proposal for a new, respectively. additional experiment. Compartmental models. Physiological models. Pharmacokinetics. Continuous and discrete models of population dynamics. Epidemiological models. Veneral disease models.			

F7ABBMFJ	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.

F7ABBNMP	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.

F7ABBOIZ	Protection Against Ionizing Radiation	ZK	2

The aim of the course is to give students an overview of the issues of protection against ionizing radiation and dosimetry in general and in a specialized medical workplace. Student will studied properties of basic types of ionizing radiation, sources of ionizing radiation, interaction of gamma radiation with matter, interaction of charged particles with matter, photon and electron beam passage through the matter, units used in dosimetry and radiation protection, operational units for working and environment monitoring, dose measurement, internal contamination, shielding of simple sources. Special attention is paid to the exposure control of workers, residents and patients. In course students will give invormation about legislative interpretation of dosage limits. Entry requirements of the course: Structure of matter, basic types of nuclear transformations. Properties of basic types of ionizing radiation, sources of ionizing radiation. Interaction of gamma radiation with matter, interaction of charged particles with matter, passage of photon and electron beams through matter. Detection of ionizing radiation. Output knowledge, skills, abilities and competences: Units used in dosimetry and radiation protection. Principles and goals of radiation protection. Basic principles of protection against external ionizing radiation and protection against internal contamination. Dose limitation system, ionizing radiation in legislation of Czech Republic. Ionizing radiation use in healthcare.

F7ABOPO	OPT Project	KZ	5

The aim of the course is methodical guidance of students in scientific research or development activities in the field of Optics, Optometry or Ophthalmology. Control of continuous activity on the topic of the project, which will lead to the final Bachelor's Thesis (BP). The secondary objective of the course is to guide students in the systematic activity of documenting the solution of the assigned task, applying the practices of the field to the tasks or projects solved by the students, as well as deepening the communication skills of the students. Last but not least, deepening the knowledge of typographic rules, including proofreading marks, etc.

F7ABOOFP	Opthalmology Instruments	ZK	3

Functional principles of different diagnostic and therapeutic ophthalmic devices will be discussed. Students will be able to test most of machines during practical lessons at clinical department. Overview, physical principles, technical construction and parameters of following devices and methods will be studied: slit lamp, ophthalmoscope (direct and indirect, confocal scanning), retinoscope, refractometer, tonometer, campimeter, Heidelberg retinal tomograph, optical coherence tomography, retinal nerve fibre layer analysis (GDx), specular (endothelial) microscope, devices for subjective investigation of astigmatism, devices for investigation of ocular movements, corneal topohraphs, testing of refractive balance, eikonometer, POLA-test, ortopic machines, Hertel exophthalmometer, devices for color vision testing.

F7ABBPPS	Patient 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.

F7ABBPPP	Programming Tools	KZ	2

Introduction to software tools on MS Windows platform and GNU/Linux platform. Short introduction of several software tools (MS Word, Excel, LateX, Powerpoint) and programming languages (Python, R, Java, CSS, bash) .

F7ABBPPM1	Programming in Matlab I.	KZ	1

The aim of the course is to acquaint students with the Matlab environment and language. Students will learn how to create functions and scripts in Matlab language, they will learn about data structures and work with data and their vizualization. The course is followed by the course Programming in Matlab II.

F7ABBPPM2	Programming in Matlab II.	KZ	2

During the course the students will consolidate and widen their previous knowledge with the Matlab environment, programming language and with basic toolboxes. The course requires Matlab basics from course Programming in Matlab I. The students will learn how to create functions and scripts in Matlab, how to manipulate and visualize data and how to work with the basic toolboxes. As well the students will learn to create basic user interfaces.

F7ABBPNK	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.

F7ABBPTI	Principles and Practice in Tissue Engineering	KZ	2
F7ABBPMS	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.

F7ABBPP	First Aid	KZ	2

The course gives a brief overview of the main principles and procedures of providing emergency first aid with special attention to the procedures for failure of basic vital functions and life threatening situations. The subject also includes situations of mass casualty of victims in crisis situations and emergencies, including the phenomenon of CBRN.

F7ABBPSL	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.			
F7ABBSPR1	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.			
F7ABBSPR2	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.			
F7ABBSM	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			
F7ABBSEL	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.			
F7ABBSJ	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 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.			
F7ABBSPT	Equipment for Anaesthesiology and Resuscitation	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.			
F7ABOSUR1	Subjective Refraction I.	Z,ZK	4
Basic knowledges about refraction of the eye. Techniques of the subjective refraction perform testing frame or the phoropter.Techniques of the examination near vision.			
F7ABOSUR2	Subjective Refraction II.	Z,ZK	4
During the lectures, students deepen their theoretical knowledge and practical skills of subjective refraction with the test frames and test sets of glasses. Further tests will follow on binocular balance, practice working with phoropter and other techniques.			
F7ABBTEL	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.			
F7ABBTZS	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.			
F7ABBUSS	Introduction to Signals and Systems	Z,ZK	4
To introduce students to basics of theory of signals and systems. To explain main principles on applications from biology and medicine. To become acquainted with basic mutual relations in computer laboratories by means of MATLAB.			
17AVARP1	Research Project I.	KZ	10
Methodology study Outputs (written text and presentations using required templates, both in English):methodology (background, SOTA, statement of the project objectives hypothesis and aims, methods, potential significance and applications, time schedule, outline of the project content, relationship between student and supervisor, relevant courses (optional only), internal and external collaboration, financing budget for project, list of references based on the ISO690 and ISO 690-2 standard) Registration and limitations: There are no prerequisites and this course can be registered by students within the student exchange programme Erasmus+ only. Formal administration: The formal assignment of the selected topic in English approved within the system PROJECTS is required.			
17AVARP2	Research Project II.	KZ	10
Simulation/implementation study Outputs (written text and presentations using required templates, both in English): full description of the model, description of the simulation steps and optimizations and/or design of the electrical circuits and other components (phantoms), design of printed boards, *.stl file for 3D printing and/or SW implementation Registration and limitations: There are no prerequisites and this course can be registered by students within the student exchange programme Erasmus+ only. Formal administration: The formal assignment of the selected topic in English approved within the system PROJECTS is required.			
17AVARP3	Research Project III.	KZ	10
Experimental study Outputs (written text and presentations using required templates, both in English): block scheme of measurement, measurement protocol (see relevant template) and/or SW verification, results, data statistical processing, discussion Registration and limitations: There are no prerequisites and this course can be registered by students within the student exchange programme Erasmus+ only. Formal administration: The formal assignment of the selected topic in English approved within the system PROJECTS is required.			

F7ABBZP	Fundamentals of Pathology	ZK	2

The main goal of the course is represented by continuous enlargement of anatomical, physiological and multi-disciplinary consequences in human health and disease. At the very beginning of the course the fundamentals of cell structure disorders and metabolic paths disturbances are provided to understand pathology of organ systems and complexity of disease origin and causes. The course provides a wide overview of morphological and functional conditions in pathology. The knowledge is then simply transformable to clinical and technical disciplines used in examination and health monitoring of the patients. The Course Requirements: The enrolment to the course is contingent on successful finishing of the course Anytomy and Physiology II. Release and Results: The students obtain basic outline of pathological processes in the human body. Their skills comprise definition of disease, comprehension and description of pathological changes in organs and body structure. The theoretical basis of the course is oriented to use in technical branches of biomedical engineering.

F7ABBZLN	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.

F7ABBZOD	Image Data Processing	KZ	2

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

List of courses of this pass:

Code	Name of the course	Completion	Credits
17AVACC	Czech for Foreigners Survival Czech	KZ	3
17AVARP1	Research Project I.	KZ	10

Methodology study Outputs (written text and presentations using required templates, both in English):methodology (background, SOTA, statement of the project objectives hypothesis and aims, methods, potential significance and applications, time schedule, outline of the project content, relationship between student and supervisor, relevant courses (optional only), internal and external collaboration, financing budget for project, list of references based on the ISO690 and ISO 690-2 standard) Registration and limitations: There are no prerequisites and this course can be registered by students within the student exchange programme Erasmus+ only. Formal administration: The formal assignment of the selected topic in English approved within the system PROJECTS is required.

17AVARP2	Research Project II.	KZ	10

Simulation/implementation study Outputs (written text and presentations using required templates, both in English): full description of the model, description of the simulation steps and optimizations and/or design of the electrical circuits and other components (phantoms), design of printed boards, *.stl file for 3D printing and/or SW implementation Registration and limitations: There are no prerequisites and this course can be registered by students within the student exchange programme Erasmus+ only. Formal administration: The formal assignment of the selected topic in English approved within the system PROJECTS is required.

17AVARP3	Research Project III.	KZ	10

Experimental study Outputs (written text and presentations using required templates, both in English): block scheme of measurement, measurement protocol (see relevant template) and/or SW verification, results, data statistical processing, discussion Registration and limitations: There are no prerequisites and this course can be registered by students within the student exchange programme Erasmus+ only. Formal administration: The formal assignment of the selected topic in English approved within the system PROJECTS is required.

17AVAUBME	Introduction to Biomedical Engineering	Z	2

The main goal of the course is to implement an introduction to the field of study, including the relationship between the content of biomedical engineering, the study plan, the requirements of Czech legislation and clinical practice. The partial goals are motivation for the non-medical health profession, a description of the content of studies and controlled professional practice, as well as the possibilities of other professional activities of students. The course also includes a description of the disciplines of biomedical engineering and a demonstration of selected relevant instrumentation, including a simulated ICU and artificial patients. At the end of the course, the specific role of the biomedical technician (profession) in health care will be described in connection with the legislation of the Czech Republic and international relationships and possible applications, including the role of professional societies in the Czech Republic. From the organizational point of view, the subject will be taught after 2 hours and for that reason only 7 topics of lectures and 7 topics of exercises are mentioned.

F7ABBA3A	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.

F7ABBA3B	English Language IIIB (part 2) Teaching activities in the summer semester are project-based.	KZ	2
F7ABBAF1	Anatomy and Physiology I. Anatomy and physiology I covers functional aspects of particular organs and their systems.	Z,ZK	4
F7ABBAF2	Anatomy and Physiology II. Anatomy and physiology II links to Anatomy and Physiology I. The subject covers functional aspects of particular organs and their systems.	Z,ZK	4
F7ABBALP	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.

F7ABBBB	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.

F7ABBBCH	Biochemistry	Z,ZK	2

Course participants will be introduced to the basics of Biochemistry. The course builds on the knowledge gained in general chemistry and extends this knowledge about the chemistry of living systems. The interpretation goes through the basic building structures of biological systems (amino acids, peptides, proteins, lipids, carbohydrates, nucleic acids), biological membranes and molecular genetics to the most important metabolic processes. Particular attention is paid to the aspects necessary for understanding the methods of work in the biochemical and clinical laboratory, which are part of the follow-up chemical discipline. The laboratories are focused on broadening the topics discussed in the lectures and their practical training, especially on the determination of biomolecules and the verification of their properties. Students should become familiar with the basic laboratory techniques of Biochemistry.

F7ABBBFT	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.

F7ABBBLG	Biology	Z,ZK	4

Basic information about the cellular level of organisms - from acelullar through prokaryotic to eukaryotic. The viruses. Prokaryotic cells. Bacteria. Bacterial diseases and their control. Eukaryotic cells. Plant and animal cell structure and function. Structure and conformation of biopolymers (nucleid acids and proteins). The nucleus, plastids, mitochondria. Cytoplasm. Endomembrane system: endoplasmic reticulum, the Golgi apparatus, lysosomes, vacuoles. Semiautonomic organelles: mitochondria, sites of respiration and chloroplasts, sites of photosynthesis. The origin of eukaryotes: endosymbiotic hypothesis. Ribosomes. The cytoskeleton: microtubules, microfilaments. The cell cycle: mitotic (M) phase and interphase (G1, S and G2 phases). The division of cell nucleus - amitosis, mitosis, phases of mitosis, the mitotic spindle; meiosis. The cell division - cytokinesis. Cell differentiation. Cell death. Apoptosis and necrosis. Mendelian and modern genetics: structure, function and inheritance of genes. Includes the chemistry and structure of chromatin and chromosomes. Animal tissue histology. Animal cells and tissues. Human genetics. Chromosomal aberrations, genetic disorders and diseases. Genetic engineering. GMO organisms.

F7ABBBLS	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.

F7ABBCHM	Chemistry	Z,ZK	4

Introduction to chemistry, categorization and properties of substances, chemical bonds, chemical reactions, elements in periodic table, organic chemistry fundamentals, natural substances, polymers, analytical methods - instrumental analysis, chemical calculations, chemical equations

F7ABBEBI	Ethics in Biomedical Engineering	ZK	2

An overview of basic ethical concepts and theories in the context of applied ethics with respect to the professional orientation, maintenance, and development of humanities in technically oriented students. Prerequisites and co-requisites: Knowledge of humanities in the scope of secondary school studies (basics of philosophy, history, psychology). Acquired knowledge, skills, abilities, and competencies: Knowledge of basic concepts and controversial topics in theoretical and applied ethics, the ability to critically think, discuss, argue and defend their own views in ethical dilemma situations, developing the ability to work with literature, enhance empathy skills.

F7ABBELF	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.

F7ABBEM	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.

F7ABBEMP	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.

F7ABBEO	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.

F7ABBESP	Management of Health Care Technology	Z,ZK	2
F7ABBFCH	Physical Chemistry	Z,ZK	4

Physical and chemical properties of substances. Basic calculations. Principles and behavior of systems of gases and liquids. Chemical bonds. Properties of solvents. Electrolytes. Dissociation of substances. Phase equilibria, multiface systems. Behavior and properties of vapors, evaporation. Electrochemical potential, electrodes. Electrodes of first and second kind. Referent and indication electrodes, electrodes for EKG, EEG, EMG etc. Redox potential. Inert electrodes. Membranes - types, properties and applications. Osmotic pressure. Ion selective electrodes. Acidity and basicity of solutions, pH. pH measurement. Stability of materials, corrosion. Passivation and self-passivation. Electrolysis and conductivity of solutions and its measurements. Polarography. Further methods of analysis of gases and solutions in BME (Biomedical Engineering.) Optical absorption. Spectrophotometry. Fluorescence and phosphorescence. Sensors for measuring of pH, pO2, pCO2, and SaO2 working on the basis of fibre optic cables and absorption or fluorescence. Advanced analytical devices. Mass spectroscopy, nuclear magnetic resonance, flame spectroscopy. Thermodynamics of reaction systems, basic calculations.

F7ABBFVP	Multivariable Calculus	KZ	2
F7ABBFY1	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.

F7ABBFY2	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.

F7ABBHE	Hygiene and Epidemiology	ZK	1
Students should learn theoretical basics of Epidemiology and Hygiene disciplines in depth covered by lecture topics. As result of this subject, student should be familiar with targets and working methods used in all disciplines of infectious and non-infectious epidemiology, environmental epidemiology and in solving of priorities and problems of Public Health Protection. Outcoming knowledge, skills, abilities and competences: Knowledge of basic methods used in preventive medical disciplines and legislation.			
F7ABBISZ	Information Systems in Health Care	Z,ZK	4
Lectures are oriented on medical informatics definition and basic characteristic of the different specialized areas. The relations between IS and health care structure, financing and controlling are analyzed as well. Some basic information technology, HW and SW tools are described in relation to IS design. A special attention is paid to medical data coding and interpretation, data and communication standards. Different types and features of clinical and hospital IS, decision support systems and regional health care IS are analyzed and discussed. Methodology of IS development, implementation and support are presented as well.			
F7ABBITP	Integral Calculus	Z,ZK	4
The subject is an introduction to integral calculus and integral transforms. Integral calculus: anti-derivative, indefinite integral, properties and methods of integration (integration by parts and by substitution, partial fractions), definite integral, properties, Newton-Leibnitz fundamental theorem, simple applications of both indefinite and definite integrals, improper integral, solving differential equations (ODEs) (1st order ODEs with separable variables, linear 1st order homogenous as well as non-homogenous ODEs, 2nd order linear homogenous and non-homogenous ODEs with constant coefficients),intro to multiple integrals, particularly double integral and applications. Integral transforms: Laplace transform and inverse Laplace transform and their application for solving nth order linear ODEs with constant coefficients.			
F7ABBKT	Communication Technology	Z,ZK	2
The aim of the course is to teach the student to understand the basic principles of the function of personal computers, their peripherals and communication interfaces. They will be able to configure the network interface and configure and connect a peripheral type of a standard medical devices equipped with a wired or wireless interface.			
F7ABBKZS	Conventional Imaging Systems	Z,ZK	4
Electromagnetic radiation spectrum and relationship to the modalities of medical diagnostic imaging systems. Fundamentals of imaging theory. Application of 2D FT. Transmission properties of imaging systems. Optical imaging systems including microscopic. Television imaging systems (including video endoscopic imaging systems). Basic digital image pre-processing methods. Infrared imaging systems (thermal imaging/IR imaging systems). X-ray imaging systems. Gamma imaging systems. Lectures and especially the laboratory exercises provide students with an overview of the principles of image formation in medicine for conventional imaging systems and methods. There are described methods for image data sensing, digitization and subsequent processing and principles of function and properties of sensing image devices in context, which is especially relevant from the interdisciplinary point of view of the whole course and study specialization. Knowledge, skills and competences: The student is able to explain the basic physical principle of the given modalities and knows its layout including the principle of image formation. The student is able to assess, on the basis of standard definition of technical parameters that imaging system meets the physician requirements for selected modality. Such knowledge is a prerequisite to the correct process technology selection and application of the modalities as well as the minimum necessary to ensure the required quality of the resulting image data.			
F7ABBLAD	Linear Algebra and Differential Calculus	Z,ZK	6
The course is introduction to differential calculus and linear algebra. Differential calculus - sets of numbers, sequences of real numbers, real functions (function properties, limits, continuity and derivative of a function investigation of function behavior), Taylor's formula, real number series. Linear algebra - vector spaces, matrices and determinants, systems of linear algebraic equations (solvability and solution), eigenvalues and eigenvectors of matrices, applications.			
F7ABBLPZ1	Medical Devices and Equipment I. (Diagnostic Devices)	Z,ZK	4
Medical devices categories. Electrical safety of medical devices. Biopotentials amplifiers. Electrocardiographs, electromyographs and electroencephalographs. Dilution methods of blood flow and cardiac output measurement. Blood pressure measurement. Cardiac frequency measurement. Phonocardiography. Pulse oximetry. Medical monitors. Electrostimulation and electrosurgery medical devices. Therapeutic medical devices. Implantable medical devices. Telemetry. Medical devices for audiology.			
F7ABBLPZ2	Medical Devices and Equipment II. (Therapeutical Devices)	Z,ZK	2
Medical devices categories. The electrical safety of therapeutical medical devices. Artificial ventilation, introduction. Conventional ventilation. High-frequency ventilation. Extracorporeal membrane oxygenation. Hemodialysis. Drug infusion pumps (volumetric, syringe). Artificial cardiac pacemaker. Defibrillators (external, implantable). Cochlear implant. Electrosurgery units. Therapeutic ultrasound. Electro-therapy. Magneto-therapy.			
F7ABBLT	Clinical Laboratory Instrumentation	Z,ZK	4
Clinical laboratory instrumentation introduces principles of bioanalytical methods used in clinical diagnostics. Emphasis is put on optical methods (UV-VIS spectrophotometry, IR spectroscopy, AAS, AES, fluorimetry), NMR and X-ray analysis, electrochemical and electromigration methods (ion electrodes, biosensors, electrophoresis, isoelectric focusing), imunoassays and genetic methods (ELISA, PCR) as well as on chromatography and mass spectrometry. Contribution of lab automation to clinical diagnostics will be also discussed. During the laboratory course students will be introduced into the basics of work in bioanalytical laboratory and lab data processing.			
F7ABBMAT	Marketing of Medical Technology	KZ	2
Marketing fundamentals, products management, basic knowledge concerning export activities in the field of marketing and commercial health care technology. Practical cases are presented including health care technology companies from the Czech Republic. Discussion and analysis of the real products are included in the exercises.			
F7ABBMAZ	Management and Admininistration in Health Care	KZ	1
Getting to know the structure of the health sector and financing models Health. Zoom administrative management issues various types of medical workplaces, their necessary interconnection. Orientation in the specific features of health facilities and European systems of health care workplaces.			
F7ABBMDT	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.			
F7ABBMEC	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.			
F7ABBMFJ	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.			

F7ABBMS	Modelling and Simulation	Z,ZK	4
Basic concepts. Aims and consequences of modeling and simulation. The methodology of modeling and simulation. Inverse problem. Proposal for a new, respectively. additional experiment. Compartmental models. Physiological models. Pharmacokinetics. Continuous and discrete models of population dynamics. Epidemiological models. Veneral disease models.			
F7ABBMT	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.			
F7ABBMTB	Microprocessors in Biomedicine	KZ	2
The aim is to explain the principles and building blocks 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.			
F7ABBMVP	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.			
F7ABBNMP	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.			
F7ABBOIZ	Protection Against Ionizing Radiation	ZK	2
The aim of the course is to give students an overview of the issues of protection against ionizing radiation and dosimetry in general and in a specialized medical workplace. Student will studied properties of basic types of ionizing radiation, sources of ionizing radiation, interaction of gamma radiation with matter, interaction of charged particles with matter, photon and electron beam passage through the matter, units used in dosimetry and radiation protection, operational units for working and environment monitoring, dose measurement, internal contamination, shielding of simple sources. Special attention is paid to the exposure control of workers, residents and patients. In course students will give invormation about legislative interpretation of dosage limits. Entry requirements of the course: Structure of matter, basic types of nuclear transformations. Properties of basic types of ionizing radiation, sources of ionizing radiation. Interaction of gamma radiation with matter, interaction of charged particles with matter, passage of photon and electron beams through matter. Detection of ionizing radiation. Output knowledge, skills, abilities and competences: Units used in dosimetry and radiation protection. Principles and goals of radiation protection. Basic principles of protection against external ionizing radiation and protection against internal contamination. Dose limitation system, ionizing radiation in legislation of Czech Republic. Ionizing radiation use in healthcare.			
F7ABBPMS	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.			
F7ABBPNK	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.			
F7ABBPP	First Aid	KZ	2
The course gives a brief overview of the main principles and procedures of providing emergency first aid with special attention to the procedures for failure of basic vital functions and life threatening situations. The subject also includes situations of mass casualty of victims in crisis situations and emergencies, including the phenomenon of CBRN.			
F7ABBPPM1	Programming in Matlab I.	KZ	1
The aim of the course is to acquaint students with the Matlab environment and language. Students will learn how to create functions and scripts in Matlab language, they will learn about data structures and work with data and their vizualization. The course is followed by the course Programming in Matlab II.			
F7ABBPPM2	Programming in Matlab II.	KZ	2
During the course the students will consolidate and widen their previous knowledge with the Matlab environment, programming language and with basic toolboxes. The course requires Matlab basics from course Programming in Matlab I. The students will learn how to create functions and scripts in Matlab, how to manipulate and visualize data and how to work with the basic toolboxes. As well the students will learn to create basic user interfaces.			
F7ABBPPP	Programming Tools	KZ	2
Introduction to software tools on MS Windows platform and GNU/Linux platform. Short introduction of several software tools (MS Word, Excel, LateX, Powerpoint) and programming languages (Python, R, Java, CSS, bash) .			
F7ABBPPS	Patient 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.			
F7ABBPSL	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.

F7ABBPTI	Principles and Practice in Tissue Engineering	KZ	2
F7ABBSEL	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.

F7ABBSJ	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 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.

F7ABBSM	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

F7ABBSPR1	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.

F7ABBSPR2	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.

F7ABBSPT	Equipment for Anaesthesiology and Resuscitation	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.

F7ABBTEL	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.

F7ABBTZS	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.

F7ABBUSS	Introduction to Signals and Systems	Z,ZK	4

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

F7ABBZLN	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.

F7ABBZOD	Image Data Processing	KZ	2

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

F7ABBZP	Fundamentals of Pathology	ZK	2

The main goal of the course is represented by continuous enlargement of anatomical, physiological and multi-disciplinary consequences in human health and disease. At the very beginning of the course the fundamentals of cell structure disorders and metabolic paths disturbances are provided to understand pathology of organ systems and complexity of disease origin and causes. The course provides a wide overview of morphological and functional conditions in pathology. The knowledge is then simply transformable to clinical and technical disciplines used in examination and health monitoring of the patients. The Course Requirements: The enrolment to the course is contingent on successful finishing of the course Anytomy and Physiology II. Release and Results: The students obtain basic outline of pathological processes in the human body. Their skills comprise definition of disease, comprehension and description of pathological changes in organs and body structure. The theoretical basis of the course is oriented to use in technical branches of biomedical engineering.

F7ABOBP	Bachelor Thesis	Z	10

Work of the student under the guidance of the supervisor and possible consultant on the assigned BP topic, using knowledge and skills from previous courses and in the allotted time. Outcome knowledge, skills, abilities and competences: The student is able to work on the assigned topic in a defined format, in a defined time and is able to work under the guidance of the 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.

F7ABOBV	Binocular Vision	Z,ZK	7
This course builds on courses dealing with refraction of the eye and visual functions. Topics include: theory of binocular vision and conditions of its origin, development of visual functions, disorders of binocular vision, practical examination of binocular vision, heterophoria and fixation disparity, relationship of accommodation and vergence, vergence disorders and visual training.			
F7ABOKC1	Contact Lenses I.	Z,ZK	3
Contact lens history and development. Contact lens terminology. Manufacturing methods. Classification of contact lenses and their materials. Material properties. Contact lens designs. Different methods of contact lens wearing and replacement. Contact lens care: composition and principles of action. Indications and contraindications of contact lenses. Spherical soft and rigid lenses. Instrumentation of contact lens practice. Patient history, basic examination and contact lens selection. Instructions regarding handling and contact lens care. Contact lens insertion and removal.			
F7ABOKC2	Contact Lenses II.	Z,ZK	5
Toric contact lenses, Bifocal and multifocal lenses and other methods of presbyopia correction. Contact lenses for children. Coloured, cosmetic and prosthetic contact lenses. Therapeutic use of contact lenses. Special types of contact lenses. Special uses of contact lenses (sports, demanding occupations and environments, patients with general diseases, etc.). Drug interactions with contact lenses. Complications of contact lenses and their solutions. Application of soft and rigid spherical lenses. Application of contact lenses in astigmatism and presbyopia. Basic and specific care of contact lenses. Inspection of patients with contact lenses.			
F7ABOKRV	Correction of Refractive Errors	ZK	1
Subject is focused on theory and practical examination of refractive errors and various possibilities of correction of refractive errors. Optical and surgical correction of refractive errors. Objective methods of refraction. Subjective methods of refraction. Correction of myopia. Correction of hypermetropia. Correction of astigmatism. Correction of presbyopia. Determination of binocular balance. Basic techniques of surgical correction of refractive errors. Refractive surgery. Methods of laser keratorefractive surgery. Implantation of intraocular lenses.			
F7ABOOFP	Opthalmology Instruments	ZK	3
Functional principles of different diagnostic and therapeutic ophthalmic devices will be discussed. Students will be able to test most of machines during practical lessons at clinical department. Overview, physical principles, technical construction and parameters of following devices and methods will be studied: slit lamp, ophthalmoscope (direct and indirect, confocal scanning), retinoscope, refractometer, tonometer, campimeter, Heidelberg retinal tomograph, optical coherence tomography, retinal nerve fibre layer analysis (GDx), specular (endothelial) microscope, devices for subjective investigation of astigmatism, devices for investigation of ocular movements, corneal topohraphs, testing of refractive balance, eikonometer, POLA-test, ortopic machines, Hertel exophthalmometer, devices for color vision testing.			
F7ABOOGB	Geometric and Opthalmic Optics	Z,ZK	5
This course focuses on basics of geometrical optics and its applications in the field of optical design of simple optical elements and systems (lenses, mirrors, prisms, telescopes, etc.). The second part of the course deals with a description and analysis of a human eye as an optical imaging system. The design and analysis of various types of spectacle lenses for correction of refraction errors is presented.c			
F7ABOPO	OPT Project	KZ	5
The aim of the course is methodical guidance of students in scientific research or development activities in the field of Optics, Optometry or Ophthalmology. Control of continuous activity on the topic of the project, which will lead to the final Bachelor's Thesis (BP). The secondary objective of the course is to guide students in the systematic activity of documenting the solution of the assigned task, applying the practices of the field to the tasks or projects solved by the students, as well as deepening the communication skills of the students. Last but not least, deepening the knowledge of typographic rules, including proofreading marks, etc.			
F7ABOSUR1	Subjective Refraction I.	Z,ZK	4
Basic knowledges about refraction of the eye. Techniques of the subjective refraction perform testing frame or the phoropter.Techniques of the examination near vision.			
F7ABOSUR2	Subjective Refraction II.	Z,ZK	4
During the lectures, students deepen their theoretical knowledge and practical skills of subjective refraction with the test frames and test sets of glasses. Further tests will follow on binocular balance, practice working with phoropter and other techniques.			
F7ABOZFO	Foundations of Physiological Optics	ZK	2
Fundamentals of optical imaging. Physiological structure of human eye, its geometric and physical properties. Visual perception. Sensitivity of eye. Optical system of human eye. Axes and pupils of eye. Schematic optical models of human eye. Photometric parameters of optical system of eye. Accommodation and aging of eye. Monochromatic and chromatic aberrations of human eye. Resolving power and depth of field. Influence of aberrations on image quality. Contrast sensitivity. Ametropy. Astigmatism. Aphakia. Amblyopy. Physiology of eye movement, methods of eye tracking. Basic principles of binocular and stereoscopic vision.			

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