



Lodz University
of Technology

Study programme

Faculty:	Faculty of Electrical, Electronic, Computer and Control Engineering
Major:	Biomedical Engineering
Level of study:	first-cycle programme (inżynier)
Form of study:	full-time studies
Academic year:	2026/27

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Basic information

Name of the field of study:	Biomedical Engineering
Level of study:	first-cycle programme (inżynier)
Study profile:	general academic
Form of studies:	full-time studies
Duration of studies (number of semesters):	7
The number of ECTS points required to complete studies:	210
Total number of hours of classes:	2630
The number of ECTS points a student obtains as part of classes conducted with the direct participation of academic teachers or other persons conducting classes:	105
Professional title awarded to graduates:	inżynier
ISCED code:	0788
Language of study:	polish

Assigning the course to the disciplines to which the learning outcomes relate

Discipline	Percentage share
Technical computing and telecommunications	54%
Material Engineering	41%
Biomedical engineering	5%

Learning outcomes (in relation to the PQF)

No.	Learning outcome code	Learning Outcome Content	Reference to the universal characteristics of the first level of PRK	Reference to the second-level characteristics of the PRK, taking into account the second-level characteristics enabling the acquisition of engineering competences
1	1IBM1	Knows and understands advanced concepts in mathematics, physics, chemistry, computer science, anatomy and physiology, necessary to describe, model and analyze biological systems and the operation of devices, systems and algorithms used in biomedical engineering.	P6U_W	P6S_WG
2	1IBM10	Is ready to act responsibly in accordance with the principles of professional ethics, respecting the well-being of the patient, the principles of sustainable development and economic rationality in the design and use of biomaterials, medical systems and biomedical technologies.	P6U_K	P6S_KO, P6S_KR
3	1IBM2	Knows the principles of design, construction and operation of complex biomedical devices and the basic processes of their life cycle, as well as knows the basic principles of creating and developing individual entrepreneurship.	P6U_W	P6S_WG, P6S_WK, P6S_WG_inž, P6S_WK_inž
4	1IBM3	Knows the structure, properties, methods of manufacturing and evaluating biomaterials and the principles of acquisition, processing, analysis and visualization of biomedical signals and images, including the use of embedded systems, textronics and machine learning methods.	P6U_W	P6S_WG
5	1IBM4	Knows the basic standards, norms and regulations regarding biomaterials and medical devices and assesses the impact of biomedical systems on health, the environment, the economy and society.	P6U_W	P6S_WG, P6S_WK
6	1IBM5	Is able to select and use IT, measurement and simulation tools to design, analyze and optimize biomedical systems, including electronic systems, sensors, biomaterials and signal and image processing algorithms.	P6U_U	P6S_UW, P6S_UW_inž
7	1IBM6	Is able to design, develop and adapt medical products (devices, biomedical or biomaterial systems) and solve complex and unusual problems, taking into account technical, biological, environmental, economic constraints and patient safety requirements.	P6U_U	P6S_UW, P6S_UW_inž
8	1IBM7	Is able to conduct experimental and simulation studies using signal acquisition methods, imaging, evaluation of biomaterials or biomedical systems, critically analyzes the results and prepares reports and technical documentation.	P6U_U	P6S_UW, P6S_UK, P6S_UW_inž
9	1IBM8	Is able to plan and organize individual work and collaborate effectively in interdisciplinary and international teams on projects related to biomedical systems, biomaterials, electronics or biomedical informatics, communicating and participating in discussions also in a foreign language at the B2 level.	P6U_U	P6S_UK, P6S_UO, P6S_UU
10	1IBM9	Is ready to critically evaluate his/her own knowledge and skills in the field of biomedical engineering, to consult with experts, and to communicate responsibly with the scientific, medical, and social communities.	P6U_K	P6S_KK

Matrix of course modules in relation to learning outcomes and curriculum content

No.	Course name	Program content	11BM1	11BM10	11BM2	11BM3	11BM4	11BM5	11BM6	11BM7	11BM8	11BM9
1	Material Science	Crystalline, amorphous and polycrystalline structure; structural defects; deformation of metals and alloys; mechanical properties and test methods; crystallization; iron alloys and transformations in steel; heat treatment; non-ferrous metals; sintered materials, ceramics, plastics, composites; wear and destruction of materials; selection of materials; micro- and macroscopic examination; hardness, impact strength, defectoscopy; recrystallization; welding and spot welding; Fe-Fe ₃ C diagram; Jomini test; founding; extrusion; polyamides; design material selection.	x			x						
2	Information Technology	Word processing, presentation creation, communication in IT systems, IT system architecture, AI solutions overview, secure data exchange, VPN, TOR, Firewall, OSI model, cybersecurity.	x					x				
3	Algorithms and Data Structures	Introduction to Python syntax, data structures, basic libraries.						x				
4	Fundamentals of Logical Thinking and Communication	The idea of critical thinking, types of names and the basis of conceptual analysis, forms and types of definitions, relations between sentences and the laws of propositional calculus, deductive and non-deductive reasoning, types of arguments, typical flaws in reasoning									x	x
5	Chemistry	Elements, chemical compounds, the periodic table, states of matter, solutions, physical and chemical properties of atoms and molecules, atomic and molecular mass, chemical formulas, the concept of the mole, concentrations, chemical equations, chemical bonds, identification of simple inorganic and organic compounds, acid-base titration, calorimetry, rates of chemical reactions, electrochemical cells, conductivity of electrolyte solutions, distillation, extraction, chromatography, synthesis of simple organic compounds, spectroscopic measurements.	x			x						
6	Physics	Electric charge. Electrostatic field. Coulomb's law. Electric field strength. Gauss's law. Conductors and dielectrics. Electric capacitance. Direct current. Magnetic field. Electromagnetic induction. Maxwell's equations.	x							x		
7	Mathematics I	Number sequences. Functions. Derivatives. Differential calculus. Integrals. Vector calculus. Matrix calculus.	x									
8	CAD Systems	Design process stages; computer-aided design; CAD system configuration; geometric objects and their correlations; 2D and 3D transformations; object presentation; CAD modeling methods; CAD user interface; CAD/CAM integration; CAD analytical systems; kinematic and strength analysis (FEM); virtual engineering; CAD system organization; part modeling and geometry editing; parametric models; assemblies and adaptive models; standard part libraries; technical drawing and design documentation.						x				
9	Fundamentals of Mechanics	Modelling of mechanical systems; statics and equilibrium conditions; friction and Coulomb's laws; moment of force, theorems of Varignon and Guldin-Pappus; beams, trusses and frames; spatial system of forces; centres of gravity; fundamentals of strength of materials; stresses and strains; tension, compression, bending and torsion; Hooke's law, de Saint-Venant's principle; T and Mg diagrams; moments of inertia and Steiner's theorem; combined strength and reduced stress; stability and buckling; finite element method (FEM).										

No.	Course name	Program content	11BM1	11BM10	11BM2	11BM3	11BM4	11BM5	11BM6	11BM7	11BM8	11BM9
10	Procedural Programming	Designing and implementing procedural programs in Python; Functions, modules, packages, classes; Exception handling and file management; Modular program structure and inter-module collaboration; Creating simple GUI applications using Tkinter or PyQt; Using selected Python libraries to solve programming and analytical problems; Code validation and debugging; Version control systems.						x				
11	Electronics	Signals - basic concepts; RC, RL, and RLC circuits; block diagrams of electronic circuits; properties of electronic components over a wide frequency range; semiconductor components; properties of amplifiers; basic circuits with field-effect transistors; basic circuits with bipolar transistors; operational amplifiers and their applications, power supply circuits.	x		x			x				
12	Metrology	Units of measurement and the SI system; approximate numbers and rounding; measurement methods; processing of experimental data; approximation and least squares; type A and B measurement uncertainties; statistics in metrology; random distributions, estimation; static and dynamic properties of instruments; calibration; signal filtration; measurement signal processing; measuring transducers; analog and digital electrical measurements; method uncertainty; systematic errors; multiple measurements; transducer characteristics; differential systems and measurement sensitivity.	x							x		
13	Modern Physics	The structure of solids, basics of band theory, electrical conductivity; thermal properties; classification of properties and applications of electrical and electronic materials (conductors, superconductors, semiconductors, dielectrics, magnetics), radiation sources and detectors, nanomaterials.	x							x		
14	Mathematics II	Numerical and functional series. Differential and integral calculus of functions of two variables. Implicit functions. Ordinary differential equations: concepts, theorems, and applications. Separable, first- and second-order linear equations. Laplace transform.	x									
15	English B2 module I	Part I of a business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills focused on the graduate's future work environment.									x	
16	English B2+ module I	Part I of a business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills focused on the graduate's future work environment.									x	
17	German B2 module I	Part I of a business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills focused on the graduate's future work environment.									x	
18	English C1 module I	Part I of a business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills focused on the graduate's future work environment.									x	
19	Biophysics	Theoretical foundations of biophysics; biothermodynamics; molecular, cellular, tissue and organ biophysics; the impact of physical factors on the body; statistical processing of data and measurement uncertainty; principles of laboratory reporting; biophysical apparatus; studying the properties of biomolecules and biological membranes; research techniques in biophysics.	x	x						x		

No.	Course name	Program content	1IBM1	1IBM10	1IBM2	1IBM3	1IBM4	1IBM5	1IBM6	1IBM7	1IBM8	1IBM9
20	Artificial Intelligence for Supporting Research and Design	Fundamentals and ecosystem of AI tools; Prompt engineerin; AI in working with information and technical literature; AI as an assistant in learning programming subjects; AI in designing and solving engineering problems; AI in the analysis of biomedical data and signals; AI in design work and biomedical documentation; Ethics, law and safety.		x				x				
21	Biostatistics	Probability and random events; conditional probability; discrete and continuous distributions; cumulative distribution and density; binomial and normal distributions; sampling distribution and central limit theorem; measures of distributions; multivariate random variables and correlation; survival analysis; data visualization (boxplot, percentile plots, ROC); hypothesis and significance testing; regression and biomedical applications; classification and cluster analysis; measures of classification quality; principal component analysis; biomedical data analysis in Python; statistical designs.	x					x				
22	Signal Processing	Biological signals and their classification; measurements and interference sources; linear systems and convolution; spectral analysis; sampling and quantization; digital signals; digital filtering; random signals and correlation analysis; A/D and D/A processing; biological signal analysis systems; signal processing in Python; data visualization and manipulation; FFT; digital filtering; biological signal analysis design.	x			x		x				
23	Robotics	Robotics in the context of biomedical engineering and basic concepts. Basic robot components and the kinematic unit. Coordinate system transformations. Homogeneous description of transformations. Notations for describing robot kinematics. Basic concepts of inverse kinematics. Direct and inverse kinematics for velocity. The Jacobian of a manipulator and singular configurations. Basic concepts of robot dynamics and control. Applications of robotics in biomedical engineering. Robot programming methods. Robot programming languages. Medical and special-purpose robots.	x					x	x			
24	Fundamentals Medical Rehabilitation	Basics of rehabilitation treatment. Kinesiotherapy and its neurophysiological basis. Basics of orthopedic equipment. Orthotic equipment. Exoskeleton. Physical therapy. Rehabilitation and support for the most common conditions for people in their third year of life. Musculoskeletal examination technique. Movement support, examples of reciprocal movement patterns. Sensory integration testing - sample disorders. Rehabilitation procedures for selected disease entities. General principles of therapeutic procedures, stimuli, factors, and reactions in physical therapy.	x									x
25	Anatomy and Physiology	Functional organization of the human body; Anatomical and functional division of the nervous system; Central nervous system; Structure of the peripheral nervous system; Sense organs. The musculoskeletal system; Bones and their connections; Structure, properties, and division of muscles; Cardiovascular system; Structure and organization of the circulatory system; Digestive and respiratory systems;	x							x		
26	English B2 module II	Part II of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	
27	English B2+ module II	Part II of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	
28	German B2 module II	Part II of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	

No.	Course name	Program content	1IBM1	1IBM10	1IBM2	1IBM3	1IBM4	1IBM5	1IBM6	1IBM7	1IBM8	1IBM9
29	English C1 module II	Part II of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	
30	Biomechanical Engineering	Fundamentals of thermodynamics; ideal and real gases; fluid mechanics and hemodynamics; Euler and Navier-Stokes equations; laminar and turbulent flow; blood viscosity models and CFD; circulatory and respiratory systems; blood flow modeling; artificial heart, valves, and vessels; spirometry; biomechanics of the musculoskeletal system; body posture and postural defects; muscle forces and moments; artificial muscles; thermovision; kinesiological EMG; body center of gravity; anthropometry; gait analysis; PBL/CBL laboratories in the field of hemodynamics, EMG, thermovision, anthropometry, and motion analysis.										
31	Introduction to Medical Sciences	The human body's response to stress; Carcinogenesis; Inflammatory and autoimmune diseases; Respiratory diseases; Cardiovascular and metabolic diseases; Brain aging and neurodegeneration; Application of medical imaging techniques.	x							x		
32	Aspects of Bioeconomy in Biomedical Engineering	Fundamentals of the bioeconomy and sustainable development. The circular economy in the context of biomedicine and healthcare. Modern bioproducts in the medical sector. Biotechnologies and biowaste in medical systems. Innovation and technology transfer in the biomedical bioeconomy.	x		x							
33	Biomaterials I	Fundamentals of biomaterials engineering address the principles of materials selection and evaluation for metal, ceramic, polymer, and composite materials used in medicine. Fundamental mechanical, chemical, and physical properties that determine a material's usefulness in the body.				x						
34	English B2 module III	Part III of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	
35	English B2+ module III	Part III of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	
36	German B2 module III	Part III of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	
37	English C1 module III	Part III of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	
38	Introduction to Object-Oriented Programming	Creating classes and objects, designing inheritance hierarchies; Using encapsulation and polymorphism in object-oriented programs; Handling exceptions and working with files; Designing simple console and GUI applications (Swing/JavaFX); Using data structures and built-in Java libraries; Modular code design and organization; Debugging and testing programs.						x				

No.	Course name	Program content	11BM1	11BM10	11BM2	11BM3	11BM4	11BM5	11BM6	11BM7	11BM8	11BM9
39	Image Processing and Computer Graphics	2D/3D raster and vector images; image processing tools and libraries; digital image acquisition, including biomedical images; image quality enhancement; image matching and segmentation; feature extraction and classification; lossy and lossless compression; computer graphics and vector formats; 3D rendering, affine transformations, projection, hidden surface removal; lighting models and shading; 2D/3D biomedical data visualization.				x		x		x		
40	Medical Electronics	Basics of biomedical measurements; bioelectric signals and sensors; electrodes and amplifier circuits; interference and data transmission in medical systems; design of measuring devices; medical imaging systems; design and measurements using Arduino systems and selected sensors.				x		x		x	x	
41	Human-Computer Interfaces	Types of interfaces. Basics of the psychophysiology of vision and hearing, ergonomics, and the role of memory and associative knowledge in interacting with complex systems. Principles of universal design. Selected methods and software tools for designing and modeling human-computer interfaces. Methods for analyzing selected biological signals in human-computer communication applications. Basics of mobile device programming. Graphical interfaces for mobile and embedded devices. Development trends. Modeling and implementing simple IT systems for human-computer communication.								x	x	
42	Machine Learning	A review of selected artificial intelligence and self-learning systems. Concepts of artificial intelligence, information ontology, expert systems, pattern recognition, structured and unstructured data, data extraction, feature (attribute) selection and dimensionality reduction, supervised and unsupervised learning, and classifier testing and validation. A review of selected machine learning algorithms, including data clustering, linear discriminant analysis, nearest neighbor classifiers, and artificial neural networks. Applications to data analysis in biomedical engineering.				x				x		
43	Medical Data Engineering	Collection, storage and processing of biological and medical data; Medical data formats; Use of databases in biomedical data analysis, medical imaging and modeling of biological processes.				x				x		
44	Technologies of Polymeric Biomaterials and Textronic Materials	Textronic materials – definition, division, requirements; manufacturing technologies (PVD, CVD, printing, nonwoven techniques); properties and testing of sensory sensitivity to physical, chemical and mechanical stimuli; material response mechanisms; textronics applications; polymeric biomaterials, textile techniques and biologically active biopolymers; EU requirements and biomaterials testing methods; laboratories: manufacturing of fibers and electrically conductive layers, track printing, conductivity measurements, sensory and physical testing of biomaterials.				x			x		x	
45	Manufacturing and Commercialization of Medical Devices	Definition and classification of medical devices; requirements, development directions and patient risk; ethical aspects and risk minimisation methods; implant manufacturing technologies; safety assessment and clinical trials; EU legal regulations, design, labelling and operations in the medical sector; intellectual property protection and patent law; models for commercialisation of medical devices; literature and patent database searching, data analysis.			x		x		x			x
46	Implants and Artificial Organs	Implant and prosthesis manufacturing technologies (vascular, bone, muscle, urogynecological); structure-property relationships of implants, material selection and sterilization; artificial organs (pancreas, liver, kidney, ear, skin, senses); insulin pumps, dialysis, detoxification systems; cell transplants, stem cells, regenerative medicine, blood products; prosthesis technology laboratories; team project on artificial organs in collaboration with clinicians and manufacturers.										

No.	Course name	Program content	1IBM1	1IBM10	1IBM2	1IBM3	1IBM4	1IBM5	1IBM6	1IBM7	1IBM8	1IBM9
47	English B2 module IV	Part IV of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	
48	English B2+ module IV	Part IV of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	
49	German B2 module IV	Part IV of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	
50	English C1 module IV	Part IV of the business language course with elements of industry-specific language; developing all language skills; developing and improving soft skills oriented around the graduate's future work environment.									x	
51	Biomedical Engineering Project	Analysis and solution of the presented problem, presentation of results, and free selection of methods and tools. Project management issues: planning, monitoring, team coordination, resource management, and communication. Elements of product lifecycle analysis. Basic principles of creating and developing various forms of individual entrepreneurship.			x		x		x		x	x
52	Law and Ethics in Biomedical Engineering	Bioethics, medical law; Examples of ethical and unethical research; Preparation, planning and conducting experiments involving human participants; Principles of operation of research ethics committees.		x								
53	Medical Imaging	Image Quality in Medical Diagnostics. Endoscopic Images. Visualization of Internal Organs and Functional Imaging. Physical Basis of Imaging Using Ionizing Radiation. Analog and Digital Radiography, Planar Imaging. Tomographic Imaging, Computed Tomography. Data Acquisition and Image Reconstruction. Nuclear Medicine Imaging. Physical Basis of Nuclear Magnetic Resonance. Magnetic Resonance Tomography and Its Applications. MRI Image Interpretation. Ultrasonography. Multimodal Imaging. Thermography and Its Applications in Medicine. The Future of Medical Imaging.				x		x		x		
54	Medical Informatics	Registration and recording of biomedical signals; Database outline; Database security; Software reliability; Data replication and distributed software; Fundamentals of quantum computers; Implementation of algorithms on quantum computers; New trends.				x		x		x		
55	Data Intensive Systems in Biomedicine	The Hadoop cluster; components of the Hadoop ecosystem and their applications; relational database management systems (RDBMS), data warehouses, unstructured big data, and keyed files, and how to apply them to typical biomedical data sets; the MapReduce paradigm for typical biomedical problems; processing personally identifiable information (PII); analysis of real-world biomedical problems; and practical use of biomedical data-intensive systems by learning how to use the tools and how to use them on real-world data.				x		x		x		

No.	Course name	Program content	1IBM1	1IBM10	1IBM2	1IBM3	1IBM4	1IBM5	1IBM6	1IBM7	1IBM8	1IBM9
56	Textronic Biomedical Systems	Applications of textronics in health and life protection; methods of manufacturing textronic materials (nonwovens, printing); biophysical and sensory properties of materials; mechanisms of response to physical and mechanical stimuli; sensory sensitivity studies; examples of medical applications; wireless data transmission; interaction of electromagnetic waves and legal regulations; manufacturing of electroconductive layers and embroidery; pneumography and selection of sensor layout; melt-blown technique; response to sweat; KES and FAST methods; design of a health monitoring system; microwave techniques; antenna and impedance measurements; simulations of antennas and microwave absorption by the body.				x			x		x	
57	Diploma Seminar	Research methodology, principles of writing a thesis and preparing for the presentation of its results, preparation for the competency examination and thesis defense. The competency examination tests knowledge and aggregated skills.									x	x
58	Drug and Bioactive Substance Carriers	Modern solutions and technologies in the design, manufacture, and characterization of drug and bioactive substance carriers; mechanisms for the delivery of active substances to the body and the controlled release of these substances; and the interaction of engineering materials with biological systems. Practical aspects related to the development of biocompatible and biodegradable drug and active substance delivery systems.			x	x		x	x			
59	Synthesis and Biointeractions of Nanomaterials	Synthesis and Biointeractions of Nanomaterials is a subject focused on advanced methods of producing nanostructures, including reduction, co-precipitation and electrochemical techniques; biological assessment of the interactions of nanomaterials with human cells.			x	x		x	x			
60	Medical Engineering	The impact of engineering on the development of medicine from the dawn of civilization to the 21st century. The evolution of medical tools, biomaterials, implants, biomechanics, and diagnostic equipment. How technological progress has shaped treatment, diagnosis, and the quality of human life.			x	x		x	x			
61	Elements of Natural Medicine	The foundations of a holistic approach to health. Natural methods of supporting the body, such as herbal medicine, diet therapy, relaxation techniques, and preventative health care, are explored. This course teaches conscious attention to physical and mental balance and the use of natural methods to support well-being, including in conjunction with traditional healing methods. Cultural knowledge, verified by contemporary scientific research, will be utilized.			x	x		x	x			
62	Preventing of Medical Devices Wear	Technical and biological aspects of medical device wear, with particular emphasis on friction, corrosion, and degradation of materials used in their construction. Issues related to the lifespan of medical devices, their connection to living tissue, various types of wear and tear, and their determinants, as well as modern technologies for preventing wear, from coatings to implant surface structuring.			x	x		x	x			
63	Introduction to Project Management with Elements of Project Implementation Methodology	An introduction to the fundamentals of project management: the project lifecycle, roles and stakeholders, defining goals, planning, scheduling, and risk. An overview of methodologies: waterfall, Agile, Scrum, and PRINCE2. Project tools and techniques, communication, progress monitoring, documentation fundamentals, and results evaluation.			x	x		x	x			

No.	Course name	Program content	11BM1	11BM10	11BM2	11BM3	11BM4	11BM5	11BM6	11BM7	11BM8	11BM9
64	Biomaterials' Research Techniques	A review of biomaterial characterization methods: analysis of structure, mechanical, chemical, and surface properties. Microscopic, spectroscopic, thermal, and biological techniques.			x	x		x	x			
65	Medical Data Bases	Databases as network services: servers and clients, database management systems, connection ports, and access data. Databases as models of the real world: relational and object-relational models, tables, views, indexes, sequences, keys, triggers and their interdependencies, and integrity constraints. Data types and methods for storing large text documents and multimedia data. SQL: basic language constructs for generating database structure (DDL) and for selecting and modifying data (DML). Database programming fundamentals: stored functions and procedures.			x	x		x	x			
66	Mobile Systems	Mobile operating systems. Mobile device programming languages - an overview. Application distribution methods. Limitations in mobile device programming. Fundamentals and architecture of a selected mobile system. Designing intuitive user interfaces. Utilizing hardware resources and sensors built into mobile devices. Installing and configuring development environments. Creating software, installation versions, and managing software for mobile devices. Designing software with graphical and audio user interfaces. Utilizing built-in mobile device resources.			x	x		x	x			
67	Biomedical Modelling and Simulation	Introduction to modeling methodology. Control in physiology and medicine. Deconvolution methods. Estimation of physiological process parameters. Perfusion modeling based on CT and MRI imaging. Blood flow modeling. Gas exchange modeling. MRI modeling and simulation.			x	x		x	x			
68	Digital Accessibility and Universal Design	Introducing the basic principles of accessibility and universal design. Understanding the main types of disabilities and related assistive technologies, as well as adaptive methods and strategies. W3C Recommendations. The process of designing applications or products for people with disabilities.			x	x		x	x			
69	Textronics in Healthcare	Healthcare projects; The use of textronic products; Humans as objects of measurement and sources of biological signals – electrical and non-electrical signals; Identification of multidimensional problems based on description. Projects: systems, programming, and clothing construction.			x	x		x	x			
70	Classical and Minimally Invasive Surgical Treatment Methods	A review of classical and minimally invasive surgical techniques. Patient qualification, preparation for surgery, safety, and surgical standards. Laparoscopic, endoscopic, and robotic methods. A comparison of advantages, limitations, and indications. Basics of assessing effectiveness, complications, and modern trends in surgery.			x	x		x	x			
71	Final Project	Struktura pracy dyplomowej: wstęp, cel i zakres, część teoretyczna, część badawcza, wnioski, bibliografia. Charakter pracy – eksperymentalny lub obliczeniowy, realizacja zgodnie z wymaganiami programu studiów. Prezentacja wyników i ich interpretacja w kontekście założonych celów.	x			x			x	x	x	x
72	Internship	Gaining practical knowledge and developing new professional competencies in a real working environment.	x								x	
73	Medical Device Expertise	Aspects of medical device expertise: analysis of technical and clinical documentation, assessment of compliance with MDR requirements, risk identification and analysis, functional and material testing, analysis of damage and non-conformities, and safety assessment, preparation of expert opinions for certification, market and legal proceedings purposes.				x				x	x	

No.	Course name	Program content	1IBM1	1IBM10	1IBM2	1IBM3	1IBM4	1IBM5	1IBM6	1IBM7	1IBM8	1IBM9
74	Surface Engineering	Characteristics of material surfaces and surface layers; physicochemical mechanisms (adsorption, diffusion, adhesion, catalysis); operational properties (tribological, anti-corrosion, strength); coatings – types, parameters and manufacturing methods; surface engineering technologies (plasma, laser, ion implantation, PVD, CVD, hardening); engineering applications; analysis of bioengineering solutions; team project of material surface modification.				x		x				
75	The Effect of the Impact of Organisms on Biomaterials	Interaction of living organisms with abiotic materials and biomaterials; cell-surface interactions; influence of body fluids; biocorrosion and microbiological corrosion; changes in the surface layer in contact with cells; biodegradation of materials; biophysical and biochemical mechanisms; surface studies after biological exposure, artificial saliva, cell interaction, biocorrosion and biodegradation of biomaterials.				x		x		x		
76	Biomaterials II	The use of modern technologies to create implants. Advanced biocompatibility testing based on biological models. New directions in biomaterials development, including nanomaterials, hybrid materials inspired by biological structures, and personalized materials.				x			x			
77	Additive Technologies in Biomedicine	Additive methods in biomedicine – possibilities and limitations; 3D printing vs 3D bioprinting; applications of 3D printing in medicine (dentistry, orthopedics, reconstruction, cardiology, urology); 3D printing in medical education; indirect and direct bioprinting; tissue engineering, scaffolds, implants and organs; lab-on-a-chip and organ-on-a-chip; 3D printing in drug testing and an alternative to animal testing.				x				x		
78	Biomeasurements and Biosensors	Fundamentals of biomeasurements and biosensors. Classification and principles of biosensor operation, biosensor sensitivity and selectivity. Biological elements and signal transducers. Methods for measuring biological signals (electrochemical, optical, mechanical). Analysis and processing of measurement data. Applications of biomeasurements in diagnostics, monitoring physiological parameters, and biotechnology.				x			x		x	
79	Modeling in Implant Design	Implant design – material and structural requirements and solutions; technical documentation; application of ANSYS and finite element methods; laboratories: SpaceClaim, geometry modeling and modification, Sheet Metal, ANSYS Static Structural, stress and strain analysis, individual projects.							x	x		
80	Bio and Nanotechnologies	Fundamentals of biotechnology; methods of cellular and molecular biology; biotechnological installations; applications of industrial, medical, and agri-food biotechnology; introduction to nanotechnology; nanoparticles, nanostructures, and nanomaterials; properties of nanoscale structures; methods of manufacturing and identifying nanomaterials; applications of nanotechnology; directions of development and assessment of environmental benefits and risks.				x			x	x		
81	Hybrid Biomaterials	Hybrid biomaterials – definition, properties, manufacturing methods and applications, interactions with the body, drug carriers; implant design – selection of hybrid biomaterial based on a literature review to improve functionality; seminar – analysis of case studies of hybrid biomaterials, use of DT, patent and literature databases to develop case studies.				x		x	x			

No.	Course name	Program content	11BM1	11BM10	11BM2	11BM3	11BM4	11BM5	11BM6	11BM7	11BM8	11BM9
82	Methods to Assess the Physicochemical Properties of Biomaterials	Physicochemical properties of biomaterials; surface analysis (optical microscopy, SEM, AFM, TEM, roughness); tribological and mechanical tests (hardness, coating adhesion); contact angle and surface energy; X-ray spectroscopy and diffraction; ion release; biomedical nanomaterials; laboratories: SEM/EDS, AFM, tribology, hardness, contact angle, FTIR, Raman, XRD, nanoindentation, polymer properties; preparation and presentation of papers with the assessment of physicochemical properties of biomaterials.						x	x	x	x	
83	Biological Methods for the Assessment of Biomaterials	Biocompatibility of materials - definitions and basics; biomaterial-tissue interactions, the body's response to an implant; legal standards and regulatory bodies; selection of tests and reference materials; in vitro, in vivo and animal studies, surrogate methods; blood, genotoxicity, allergy, microorganism, degradation and cytotoxicity tests; laboratories: platelet, proliferation, cytotoxicity, microorganism, electrophoresis, genotoxicity tests; development of procedures and planning of a biomaterial biocompatibility test cycle.				x					x	

ECTS - subjects

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
1	Material Science	4				
2	Information Technology	3				
3	Algorithms and Data Structures	5			5	
4	Fundamentals of Logical Thinking and Communication	3	3			
5	Chemistry	4				
6	Physics	4				
7	Mathematics I	7				
8	CAD Systems	4				
9	Fundamentals of Mechanics	3				
10	Procedural Programming	3			3	
11	Electronics	4				
12	Metrology	4				
13	Modern Physics	3				
14	Mathematics II	7				
15	English B2 module I	2		2		
16	English B2+ module I	2		2		
17	German B2 module I	2		2		
18	English C1 module I	2		2		
19	Biophysics	4			4	
20	Artificial Intelligence for Supporting Research and Design	2			2	

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
21	Biostatistics	4			4	4
22	Signal Processing	6			6	
23	Robotics	4				
24	Fundamentals Medical Rehabilitation	4				
25	Anatomy and Physiology	4				
26	English B2 module II	2		2		
27	English B2+ module II	2		2		
28	German B2 module II	2		2		
29	English C1 module II	2		2		
30	Biomechanical Engineering	5			5	
31	Introduction to Medical Sciences	4				
32	Aspects of Bioeconomy in Biomedical Engineering	2				
33	Biomaterials I	5			5	
34	English B2 module III	2		2		
35	English B2+ module III	2		2		
36	German B2 module III	2		2		
37	English C1 module III	2		2		
38	Introduction to Object-Oriented Programming	3		3	3	
39	Image Processing and Computer Graphics	5		5	5	
40	Medical Electronics	4		4	4	
41	Human-Computer Interfaces	4		4	4	

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
42	Machine Learning	5		5	5	
43	Medical Data Engineering	4		4	4	
44	Technologies of Polymeric Biomaterials and Textronic Materials	7		7	7	
45	Manufacturing and Commercialization of Medical Devices	3			3	
46	Implants and Artificial Organs	4			4	
47	English B2 module IV	3				
48	English B2+ module IV	3				
49	German B2 module IV	3				
50	English C1 module IV	3				
51	Biomedical Engineering Project	9			9	
52	Law and Ethics in Biomedical Engineering	2	2			
53	Medical Imaging	5		5	5	
54	Medical Informatics	4		4	4	
55	Data Intensive Systems in Biomedicine	5		5	5	
56	Textronic Biomedical Systems	5		5	5	
57	Diploma Seminar	3				
58	Drug and Bioactive Substance Carriers	3		3	3	
59	Synthesis and Biointeractions of Nanomaterials	3		3	3	
60	Medical Engineering	3		3	3	
61	Elements of Natural Medicine	3		3	3	
62	Preventing of Medical Devices Wear	3		3	3	

No.	Course name	ECTS	Subjects in the field of humanities and social sciences	Elective subjects	Profile items	Classes in a foreign language
63	Introduction to Project Management with Elements of Project Implementation Methodology	3		3	3	
64	Biomaterials' Research Techniques	3		3	3	
65	Medical Data Bases	3		3	3	
66	Mobile Systems	3		3	3	
67	Biomedical Modelling and Simulation	3		3	3	
68	Digital Accessibility and Universal Design	3		3	3	
69	Textronics in Healthcare	3		3	3	
70	Classical and Minimally Invasive Surgical Treatment Methods	3		3	3	
71	Final Project	15			15	
72	Internship	6				
73	Medical Device Expertise	3		3	3	
74	Surface Engineering	5		5	5	
75	The Effect of the Impact of Organisms on Biomaterials	4		4	4	
76	Biomaterials II	4		4	4	
77	Additive Technologies in Biomedicine	5		5	5	
78	Biomeasurements and Biosensors	5		5	5	
79	Modeling in Implant Design	4		4	4	
80	Bio and Nanotechnologies	2		2	2	
81	Hybrid Biomaterials	6		6	6	
82	Methods to Assess the Physicochemical Properties of Biomaterials	7		7	7	
83	Biological Methods for the Assessment of Biomaterials	6		6	6	

ECTS indicators

Name	brak	brak
The total number of ECTS credits that a student must obtain through elective courses (amounting to no less than 30% of the total ECTS credits required to obtain the qualification corresponding to the given level of study)	63/210 (30%)	63/210 (30%)
The total number of ECTS credits to be earned by a student through courses in the fields of humanities or social sciences	5	5
The total number of ECTS credits that a student must obtain from courses related to research conducted at the university, amounting to more than 50% of the total ECTS credits required to graduate from a given level of study	122/210 (58.1%)	122/210 (58.1%)

Methods of verifying and assessing learning outcomes

The verification of achieved learning outcomes requires the use of diverse assessment methods appropriate to the categories of knowledge, skills, and social competencies to which these outcomes pertain. The selection of suitable tools also depends on the specific nature of the subject and the format of the classes and is described in detail in the course syllabi. The achievement of the required learning outcomes is assessed through:

1. Written assignments (exams, quizzes, reports, essays, projects, posters, thesis, etc.);
2. Oral assessments (oral exams, public speaking, e.g., delivering a paper, presentation, etc.);
3. Practical and/or project-based tasks (both individual and group work);
4. Observation and evaluation of students' participation and activity during classes;
5. Self-assessment and peer evaluation (especially in the case of group projects);
6. Competency exams and final diploma examinations.

Verification can be formative (partial, conducted multiple times during the course) and/or summative (final grade assessment). The final verification result is given according to the currently applicable grading scale.

The course coordinator or instructor is required to present the course syllabus during the first class and to clearly define and formally communicate the assessment methods and conditions for verifying learning outcomes.

Professional internships

Duration: 6 weeks

ECTS credits: 6

Internships are carried out in accordance with the study program in a format adapted to the profile and specifics of the field of study, following the regulations set by the faculty and the university.

Specializations/degree paths offered within the study program

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Characteristics of the course

Graduate profile

A graduate of the first-cycle Biomedical Engineering program has a solid knowledge of mathematics, physics, chemistry, computer science, anatomy and physiology, enabling the description, modeling and analysis of biological systems and the operation of devices, systems and algorithms used in medical technologies. He is able to use modern equipment and diagnostic and therapeutic systems using ICT, IT, electronic and material methods, techniques and technologies. He is also able to optimally select materials for medical devices depending on their application, as well as to test their mechanical and biological properties. He knows the manufacturing methods and principles of introducing products such as implants, medical tools and rehabilitation equipment to the market. In terms of interpersonal skills, the graduate is able to plan and organize his own work and cooperate effectively in interdisciplinary and international teams, communicating also in a foreign language at least at the B2 level, including the use of specialized vocabulary. He is ready to critically evaluate his own knowledge and skills, use expert consultations and communicate responsibly with the scientific, medical and social communities. He acts in accordance with

The graduate is prepared to work in hospitals, clinical and outpatient facilities, diagnostic laboratories, medical device companies, design, research and development, and certification institutions, as well as healthcare administration institutions. They may perform roles related to the design, testing, quality control, implementation, and operation of medical devices and biomedical systems. They are also prepared to continue their education in second-cycle studies.

The relationship between the field of study and the university's strategy

The University's mission and main strategic goals are defined and precisely outlined in the Lodz University of Technology Development Strategy for 2025-2030. This strategy is based on the implementation of the COOPERATION concept, whose key strategic areas include:

- IMPACT on the socio-economic environment;
- INTERNATIONALIZATION;
- INNOVATION and technology transfer;
- management and organizational culture (LEADERSHIP);
- SCIENCE;
- INFRASTRUCTURE;
- STAFF;
- TALENTS;
- sustainable development (SUSTAINABILITY);
- EDUCATION;
- STUDENTS.

The priorities of the University's strategy include conducting groundbreaking research, developing the potential of scientists and cooperating with businesses to transfer knowledge and technology, preparing students and doctoral candidates for the challenges of the labor market by developing research, entrepreneurial and social competences, building the university's international reputation through cooperation, academic exchange and participation in global projects, and creating a friendly, ethical and modern working and studying environment, respecting the principles of sustainable development.

The undergraduate program in Biomedical Engineering addresses the University's mission in particular through:

- a curriculum based on combining general knowledge necessary for the engineering profession with skills in medical informatics, medical electronics, engineering biomechanics, and biomaterials engineering. Specific learning outcomes have been defined, including those that build knowledge, creativity, and professionalism in student performance. In addition to the outcomes related to the area of knowledge, these include: the ability to obtain information from literature, databases, and other sources; the ability to draw conclusions and formulate and justify opinions; the ability to work individually and in a team; the ability to prepare documentation; the ability to prepare and present presentations; the ability to prepare and conduct experiments; an understanding of the need for continuous learning; and entrepreneurial thinking. The implemented study programs are systematically monitored to ensure high quality education, in accordance with applicable national and European quality standards in higher education, in particular the Polish Qualifications Framework. Practical verification of the effectiveness of the achieved results takes place through the active participation of students of Biomedical Engineering in classes improving their competences, in which tasks/projects are carried out, also in cooperation with industry, e.g. diploma theses carried out in cooperation with Ortopro or Medgal sp. z o.o.
- Part of the education is conducted in English, preparing students to utilize the extensive English-language literature and function in an international environment. A separate portion of the classes is taught by specialist physicians from the Medical University of Lodz. This allows students to become familiar with the medical aspects of biomedical engineering and its

applications in prevention, diagnosis, treatment, and rehabilitation, ensuring the interdisciplinarity of the acquired knowledge and skills.

- Specialized education within the Biomedical Informatics and Textronics and Biomaterials Engineering diploma paths provides substantive preparation for future engineers to work in domestic and international companies related to biomedical engineering in its broadest sense.

The specific learning outcomes are directly related to the concept and profile of education, which are aligned with the University's mission and strategy. They are encompassed in the field of engineering and technology and the scientific disciplines of Technical Informatics and Telecommunications, Materials Engineering, and Biomedical Engineering.

Educational objectives and employment and continuing education opportunities

The educational concept in the Biomedical Engineering field of study is based on the following pillars:

- a. Research in the disciplines of Technical Computer Science and Telecommunications and Materials Engineering.
- b. Education in the theoretical and practical aspects of computer science, electronics, and materials engineering related to biomedical engineering at the basic, specialized, and specialist levels.
- c. Meeting employers' needs for a large number of practical classes in the program, such as laboratories (working with specialized equipment used in medicine and biomaterial production), exercises (developing abstract thinking skills), projects (aimed at preparing students for independent problem-solving and teamwork), seminars (preparing students to plan their work and present their results, critically evaluate their work, and participate in discussions), and a wide range of specialized education in diploma tracks and elective blocks.
- d. Language competencies
- e. Social competencies

Key areas of education include: physics, chemistry, theoretical foundations Computer science and algorithms, software engineering, programming and databases, artificial intelligence, biomedical signal and image processing, biomaterials, biomaterial surface engineering, legal basis for the implementation of medical devices, artificial implants and organs, and additive technologies in medicine. Graduates of this program are prepared for work in: IT companies designing, implementing, and maintaining medical information systems; design, construction, and technological units developing medical products such as diagnostic equipment, implants, and medical tools; healthcare facilities, where they can participate in the integration, operation, and maintenance of diagnostic and therapeutic devices and systems; and research and development institutions conducting work at the intersection of technical and biomedical sciences. The qualifications obtained also enable graduates to continue their education in second-cycle studies in fields related to biomedical engineering and technical sciences.

Description of the process and outcome of consultations on the proposed study program with the socio-economic environment

In developing the educational concept and curriculum for the Biomedical Engineering (IB) program, consultations were held with students and alumni employed by IB-affiliated companies in the Łódź region (e.g., Tricomed, AptVision, Central Institute for Labor Protection, MDH). Members of the Biomedical Engineering program council also participated in events organized by the Łódź ICT Cluster, which brings together over 40 IT companies operating in the Łódź region. This allows for an understanding of the current labor market needs in computer science, which is the leading scientific discipline in the Biomedical Engineering program. Cooperation with medical centers in Poland (e.g. Norbert Barlicki Hospital in Łódź, Copernicus Hospital in Łódź, Władysław Biegański Hospital in Łódź, University Clinical Hospital named after the Military Medical Academy - Central Veterans Hospital in Łódź, Clinical and Didactic Center of the Łódź Medical University, Jagiellonian University Medical College, Polish Mother's Memorial Hospital Institute in Łódź) and companies dealing with medical equipment servicing, sterilization and decontamination (Iacobus sp. z o.o.), individual orthopedic supplies (production of lower and upper limb prostheses) and the production of orthopedic implants and technologies used in implantation (Medgal, Proteo, Otropro) allows us to become familiar with the latest trends and needs of the medical market, and the program of study in this field is modified on this basis.

Description of competencies expected from a candidate applying for admission to studies

In accordance with the recruitment resolution for a given academic year.

The unit organizing education

Faculty of Electrical, Electronic, Computer and Control Engineering

Education program

Semester 1

Course	Number of hours	ECTS points	Form of verification	Obligatory
Material Science	Laboratory classes: 30 Lecture: 15	4	Graded assignment	Obligatory
Information Technology	Laboratory classes: 30 E-learning: 15	3	Graded assignment	Obligatory
Algorithms and Data Structures	Laboratory classes: 45 Project work: 15	5	Graded assignment	Obligatory
Fundamentals of Logical Thinking and Communication	Tutorials: 30	3	Graded assignment	Obligatory
Chemistry	Laboratory classes: 30 Lecture: 15	4	Graded assignment	Obligatory
Physics	Laboratory classes: 15 Lecture: 30	4	Exam	Obligatory
Mathematics I	Tutorials: 45 Lecture: 45	7	Exam	Obligatory
Sum	360	30		

Semester 2

Course	Number of hours	ECTS points	Form of verification	Obligatory
CAD Systems	Laboratory classes: 45 Lecture: 15	4	Graded assignment	Obligatory
Fundamentals of Mechanics	Tutorials: 15 Lecture: 30	3	Graded assignment	Obligatory
Procedural Programming	Laboratory classes: 30 Lecture: 15	3	Graded assignment	Obligatory

Course	Number of hours	ECTS points	Form of verification	Obligatory
Electronics	Tutorials: 15 Laboratory classes: 15 Lecture: 20	4	Graded assignment	Obligatory
Metrology	Laboratory classes: 15 Lecture: 30	4	Graded assignment	Obligatory
Modern Physics	Laboratory classes: 15 Lecture: 30	3	Graded assignment	Obligatory
Mathematics II	Tutorials: 45 Lecture: 45	7	Exam	Obligatory
Foreign Language Module 1		2	Graded assignment	Obligatory group
The student chooses 1 module				
English B2 module I	Tutorials: 30	2	Graded assignment	Optional
English B2+ module I	Tutorials: 30	2	Graded assignment	Optional
German B2 module I	Tutorials: 30	2	Graded assignment	Optional
English C1 module I	Tutorials: 30	2	Graded assignment	Optional
Physical Education 1	Tutorials: 30	0	Pass	Obligatory
Sum	440	30		

Semester 3

Course	Number of hours	ECTS points	Form of verification	Obligatory
Biophysics	Laboratory classes: 30 Lecture: 20	4	Graded assignment	Obligatory
Artificial Intelligence for Supporting Research and Design	Laboratory classes: 20 Project work: 10	2	Graded assignment	Obligatory

Course	Number of hours	ECTS points	Form of verification	Obligatory
Biostatistics	Laboratory classes: 15 Project work: 15 Lecture: 30	4	Graded assignment	Obligatory
Signal Processing	Laboratory classes: 30 Project work: 15 Lecture: 30	6	Exam	Obligatory
Robotics	Laboratory classes: 30 Lecture: 30	4	Graded assignment	Obligatory
Fundamentals Medical Rehabilitation	Laboratory classes: 30 Lecture: 15	4	Graded assignment	Obligatory
Anatomy and Physiology	Laboratory classes: 30 Lecture: 15	4	Graded assignment	Obligatory
Foreign Language Module 2		2	Graded assignment	Obligatory group
The student chooses 1 module				
English B2 module II	Tutorials: 30	2	Graded assignment	Optional
English B2+ module II	Tutorials: 30	2	Graded assignment	Optional
German B2 module II	Tutorials: 30	2	Graded assignment	Optional
English C1 module II	Tutorials: 30	2	Graded assignment	Optional
Physical Education 2	Tutorials: 30	0	Pass	Obligatory
Sum	425	30		

Semester 4

Course	Number of hours	ECTS points	Form of verification	Obligatory
Biomechanical Engineering	Laboratory classes: 30 Lecture: 30	5	Graded assignment	Obligatory

Course	Number of hours	ECTS points	Form of verification	Obligatory
Introduction to Medical Sciences	Seminar: 10 Laboratory classes: 10 Lecture: 30	4	Graded assignment	Obligatory
Aspects of Bioeconomy in Biomedical Engineering	Seminar: 15 Lecture: 15	2	Graded assignment	Obligatory
Biomaterials I	Laboratory classes: 30 Lecture: 30	5	Exam	Obligatory
Foreign Language Module 3		2	Graded assignment	Obligatory group
The student chooses 1 module				
English B2 module III	Tutorials: 30	2	Graded assignment	Optional
English B2+ module III	Tutorials: 30	2	Graded assignment	Optional
German B2 module III	Tutorials: 30	2	Graded assignment	Optional
English C1 module III	Tutorials: 30	2	Graded assignment	Optional
Physical Education 3	Tutorials: 30	0	Pass	Obligatory
Sum	260	18		

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Course	Number of hours	ECTS points	Form of verification	Obligatory
Introduction to Object-Oriented Programming	Laboratory classes: 30 Project work: 15	3	Graded assignment	Obligatory specialization courses
Image Processing and Computer Graphics	Laboratory classes: 30 Project work: 15 Lecture: 30	5	Graded assignment	Obligatory specialization courses
Medical Electronics	Laboratory classes: 15 Project work: 15 Lecture: 30	4	Graded assignment	Obligatory specialization courses
Sum	180	12		

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Course	Number of hours	ECTS points	Form of verification	Obligatory
Medical Device Expertise	Project work: 45	3	Graded assignment	Obligatory specialization courses
Surface Engineering	Laboratory classes: 30 Project work: 15 Lecture: 30	5	Graded assignment	Obligatory specialization courses
The Effect of the Impact of Organisms on Biomaterials	Laboratory classes: 30 Lecture: 30	4	Graded assignment	Obligatory specialization courses
Sum	180	12		

Semester 5

Course	Number of hours	ECTS points	Form of verification	Obligatory
Manufacturing and Commercialization of Medical Devices	Seminar: 30 Lecture: 15	3	Graded assignment	Obligatory
Implants and Artificial Organs	Laboratory classes: 15 Project work: 15 Lecture: 20	4	Graded assignment	Obligatory
Foreign Language Module 4		3	Exam	Obligatory
The student chooses 1 module				
English B2 module IV	Tutorials: 30	3	Exam	Obligatory
English B2+ module IV	Tutorials: 30	3	Exam	Obligatory
German B2 module IV	Tutorials: 30	3	Exam	Obligatory
English C1 module IV	Tutorials: 30	3	Exam	Obligatory
Sum	125	10		

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Course	Number of hours	ECTS points	Form of verification	Obligatory
Human-Computer Interfaces	Laboratory classes: 10 Project work: 30 Lecture: 15	4	Graded assignment	Obligatory specialization courses
Machine Learning	Laboratory classes: 15 Project work: 15 Lecture: 30	5	Graded assignment	Obligatory specialization courses
Medical Data Engineering	Laboratory classes: 20 Project work: 20 Lecture: 10	4	Graded assignment	Obligatory specialization courses
Technologies of Polymeric Biomaterials and Textronic Materials	Laboratory classes: 30 Project work: 15 Lecture: 45	7	Graded assignment	Obligatory specialization courses
Sum	255	20		

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Course	Number of hours	ECTS points	Form of verification	Obligatory
Biomaterials II	Laboratory classes: 30 Lecture: 20	4	Graded assignment	Obligatory specialization courses
Additive Technologies in Biomedicine	Seminar: 30 Laboratory classes: 15 Lecture: 20	5	Graded assignment	Obligatory specialization courses
Biomeasurements and Biosensors	Seminar: 30 Laboratory classes: 15 Lecture: 15	5	Graded assignment	Obligatory specialization courses
Modeling in Implant Design	Laboratory classes: 40 Lecture: 15	4	Graded assignment	Obligatory specialization courses

Course	Number of hours	ECTS points	Form of verification	Obligatory
Bio and Nanotechnologies	Seminar: 15 Lecture: 15	2	Graded assignment	Obligatory specialization courses
Sum	260	20		

Semester 6

Course	Number of hours	ECTS points	Form of verification	Obligatory
Biomedical Engineering Project	Project work: 90 Lecture: 15	9	Graded assignment	Obligatory
Law and Ethics in Biomedical Engineering	Seminar: 30	2	Graded assignment	Obligatory
Sum	135	11		

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Course	Number of hours	ECTS points	Form of verification	Obligatory
Medical Imaging	Laboratory classes: 30 Lecture: 30	5	Graded assignment	Obligatory specialization courses
Medical Informatics	Laboratory classes: 30 Lecture: 20	4	Graded assignment	Obligatory specialization courses
Data Intensive Systems in Biomedicine	Laboratory classes: 15 Project work: 30 Lecture: 15	5	Graded assignment	Obligatory specialization courses
Textronic Biomedical Systems	Laboratory classes: 30 Lecture: 30	5	Graded assignment	Obligatory specialization courses
Sum	230	19		

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Course	Number of hours	ECTS points	Form of verification	Obligatory
Hybrid Biomaterials	Seminar: 30 Project work: 15 Lecture: 30	6	Graded assignment	Obligatory specialization courses
Methods to Assess the Physicochemical Properties of Biomaterials	Seminar: 30 Laboratory classes: 30 Lecture: 25	7	Graded assignment	Obligatory specialization courses
Biological Methods for the Assessment of Biomaterials	Seminar: 30 Laboratory classes: 25 Lecture: 15	6	Graded assignment	Obligatory specialization courses
Sum	230	19		

Semester 7

Course	Number of hours	ECTS points	Form of verification	Obligatory
Diploma Seminar	Seminar: 45	3	Graded assignment + exam	Obligatory
Elective Courses 1		6	Graded assignment	Obligatory group
The student chooses 2 subjects				
Drug and Bioactive Substance Carriers	Seminar: 5 Laboratory classes: 15 Lecture: 15	3	Graded assignment	Optional
Synthesis and Biointeractions of Nanomaterials	Seminar: 10 Laboratory classes: 15 Project work: 10	3	Graded assignment	Optional
Medical Engineering	Seminar: 20 Lecture: 15	3	Graded assignment	Optional
Elements of Natural Medicine	Tutorials: 15 Lecture: 20	3	Graded assignment	Optional

Course	Number of hours	ECTS points	Form of verification	Obligatory
Preventing of Medical Devices Wear	Seminar: 15 Project work: 10 Lecture: 10	3	Graded assignment	Optional
Introduction to Project Management with Elements of Project Implementation Methodology	Tutorials: 25 Lecture: 10	3	Graded assignment	Optional
Biomaterials' Research Techniques	Tutorials: 35	3	Graded assignment	Optional
Medical Data Bases	Laboratory classes: 20 Project work: 15	3	Graded assignment	Optional
Mobile Systems	Laboratory classes: 15 Project work: 10 Lecture: 10	3	Graded assignment	Optional
Biomedical Modelling and Simulation	Laboratory classes: 15 Project work: 10 Lecture: 10	3	Graded assignment	Optional
Digital Accessibility and Universal Design	Project work: 25 Lecture: 10	3	Graded assignment	Optional
Textronics in Healthcare	Project work: 25 Lecture: 10	3	Graded assignment	Optional
Classical and Minimally Invasive Surgical Treatment Methods	Seminar: 15 Lecture: 20	3	Graded assignment	Optional
Final Project	Diploma Thesis: 0	15	Pass	Obligatory
Internship	Internship: 0	6	Pass	Obligatory
Sum	115	30		