GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Biomedical Engineering in Healthcare, PG_00067986		
Field of study	Biomedical Engineering		
Date of commencement of studies	October 2025	Academic year of realisation of subject	2025/2026
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study Subject group related to scientific research in the field of study
Mode of study	Full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Biomedical Engineering -> Faculty of Electronics Telecommunications and Informatics -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Mariusz Kaczmarek	
	Teachers	dr hab. inż. Mariusz Kaczmarek	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	15.0	30

E-learning hours included: 0.0

eNauczanie source addresses:

Moodle ID: 1132 Inżynieria biomedyczna w służbie zdrowia
https://enauczanie.pg.edu.pl/2025/course/view.php?id=1132

Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	30	2.0	18.0	50

Subject objectives

The aim of the course is to familiarize students with modern biomedical engineering, showing its importance in health care. During the classes, concepts will be introduced that show the importance of technology in modern medicine, starting from diagnostic systems, through systems monitoring the patient's condition, ending with systems supporting the conduct of surgical procedures and the therapeutic process. The presented issues will be developed during the studies. During the seminar classes, case studies illustrating the aspects presented during the lecture will be analyzed.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_K01] is ready to cultivate and disseminate models of proper behaviour in and outside the work environment; make independent decisions; critically evaluate actions of their own, teams they lead and organisations they are part of; take responsibility for results of these actions; responsibly perform professional roles, including:n - observing rules of professional ethics and require it from others,n - care for the achievements and traditions of the professionn	Is able to plan and co-organize an educational and informational project or workshops (e.g. "safe use of medical devices" or "basics of telemedicine") addressed to a selected social group, taking into account the selection of tasks, schedule and division of roles in the team.	[SK1] Assessment of group work skills [SK3] Assessment of ability to organize work
	[K6_W51] Knows and understands, to an advanced extent, selected aspects of biomedical diagnostics and human anatomy and physiology, constituting general knowledge related to the field of study	Understands the principles of operation of selected imaging diagnostic methods (USG, CT, MRI) and knows the limitations and causes of artifacts in these techniques. Furthermore, based on the basics of physiology, is able to select an appropriate sensor (e.g. pressure, flow, electrochemical) to measure a selected biological parameter and justify their choice.	[SW1] Assessment of factual knowledge
	[K6_K03] is ready to meet social obligations, co-organise activities for the social environment, initiate actions for the public interest, think and act in an entrepreneurial way	Is able to describe the importance of social aspects of the implementation of medical technologies, indicate the responsibilities of a biomedical engineer towards patients and local communities, and interpret the ethical and legal conditions for activities in the public interest.	[SK5] Assessment of ability to solve problems that arise in practice

<table>
<tr><td>Subject contents</td><td>
LECTURE:

1. 1. Basics of biomedical measurements and measuring devices
• Types of biological signals (ECG, EEG, EMG, blood pressure)
• Sensors and transducers principles of operation and characteristics
1. 2. Imaging diagnostics in medicine
• X-ray, computed tomography (CT), magnetic resonance imaging (MRI)
• Ultrasonography (USG) physics of ultrasonic waves
1. 3. Biosensors and health monitoring systems
• Enzymatic (e.g. glucose), optical, electrochemical biosensors
• Continuous monitoring systems (CGM, telemetry)
• Wearables and the Internet of Things (IoT) in e-health
1. 4. Telemedicine and e-health
• Architecture of telemedicine systems
• Examples of applications: remote consultations, teleradiology, remote monitoring
1. 5. Biomechanics and rehabilitation engineering
• Exoskeletons, prostheses and implants orthopedic
• Techniques supporting rehabilitation (medical robotics, VR/AR)
1. 6. Technologies supporting surgery
• Minimally invasive surgery systems (laparoscopic, endoscopic)
• Surgical robots (e.g. Da Vinci), basics of control and sensorics
• Surgical navigation and 3D models
1. 7. Medical informatics and data analysis
• Electronic patient records (EHR/EMR)
• Big Data and machine learning in clinical data analysis
1. 8. Artificial intelligence in imaging diagnostics
• Examples of applications: detection of neoplastic lesions, automatic measurements
1. 9. Technologies for point-of-care diagnostics (POC)
• Cryo- and microfluidics in rapidly disseminated tests (e.g. COVID-19)
• Lab-on-a-chip, strip immunoassays
1. 10. Trends and the future of biomedical engineering
• 3D printing in medicine: prostheses, implants, preoperative models
• Gene Therapies, CRISPR Technologies, Personalized Medicine
• Next Generation Wearables, Nanotechnologies in Drug Delivery

SEMINAR:
The seminar will include case studies illustrating the issues presented in the lecture. Example case studies:

1. Examples of errors in radiotherapy, e.g.: Therac-25 (19851987) - Patients received doses even 100x higher than planned, which led to burns, radiation sickness, and even deaths.
2. Health-promoting activities during the COVID-19 pandemic - the pandemic of the infectious disease COVID-19 caused by the coronavirus SARS-CoV-2
3. Standardization of standards in medicine - DICOM, HL7
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<tr><td>Prerequisites and co-requisites</td><td></td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Seminar/Report</td><td>51.0%</td><td>50.0%</td></tr>
<tr><td>test</td><td>51.0%</td><td>50.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>1. Inżynieria biomedyczna. Podstawy i zastosowania. Tom1-9: Wydawnictwo Exit, 2021
2. J. D. Bronzino, D. R. Peterson (red.), Biomedical Engineering Fundamentals, CRC Press, 3 ed., 2017</td></tr>
<tr><td>Supplementary literature</td><td>1. Portable and Wearable Sensing Systems: Techniques, Fabrication, and Biochemical Detection, Editor(s): Qingjun Liu, ISBN:9783527351831 |Online ISBN:9783527841080 |DOI: 10.1002/9783527841080, 2024 WileyVCH GmbH
2. Biomedical Imaging: Principles and Applications,Reiner Salzer (Editor), ISBN: 978-0-470-64847-6,2012
3. Grażyna Szpor, Irena Lipowicz, Marek Świerczyński, Telemedycyna i e-Zdrowie. Prawo i informatyka, Wolters Kluwer, 2019;</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td></td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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