



Subject card

Subject name and code	Biosignals, PG_00068221						
Field of study	Biomedical Engineering, Biomedical Engineering, Biomedical Engineering						
Date of commencement of studies	October 2026	Academic year of realisation of subject				2028/2029	
Education level	first-cycle studies	Subject group				Optional subject group 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	3	Language of instruction				Polish	
Semester of study	5	ECTS credits				4.0	
Learning profile	general academic profile	Assessment form				assessment	
Conducting unit	Department of Biomedical Engineering -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. Marcin Gruszecki				
	Teachers		dr hab. Marcin Gruszecki				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	15.0	0.0	0.0	45
	E-learning hours included: 0.0						
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	45		4.0		51.0	100
Subject objectives	To familiarize students with the mechanisms responsible for the generation of signals and their properties						
Learning outcomes	Course outcome		Subject outcome			Method of verification	
	[K6_U09] can carry out a critical analysis of the functioning of existing technical solutions and assess these solutions, as well as apply experience related to the maintenance of technical systems, devices and facilities typical for the field of studies, gained in the professional engineering environment		Student evaluates recorded biosignals and proposes appropriate processing methods			[SU4] Assessment of ability to use methods and tools [SU2] Assessment of ability to analyse information	
	[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		The student knows: - Selected topics in biomedical diagnostics - The basics of human anatomy - The basics of human physiology - The importance of interdisciplinary knowledge in biomedical science.			[SW1] Assessment of factual knowledge	
	[K6_W02] knows and understands, to an advanced extent, selected laws of physics and physical phenomena as well as methods and theories explaining the complex relationships between them, constituting the basic general knowledge in the field of technical sciences related to the field of study		Student - Identifies processes be responsible for generation biopotentials - Differentiates the types of signals generated by the human body - Selects the appropriate method of signal analysis - Constructs processing algorithms and analysis of signals - Defines the characteristics of signals generated by the various tissues and organs			[SW1] Assessment of factual knowledge	

Subject contents	<p>Course content – lecture</p> <p>1. Introduction to Biosignals</p> <p>What are biosignals (ECG, EEG, EMG, EDA, PPG, BP) Parameters describing a biosignal: amplitude, frequency, phase Signal classification: time-domain, frequency-domain, stochastic</p> <p>2. Measurement Systems and Data Acquisition</p> <p>Structure of the measurement chain Electrodes, transducers, bioelectrical amplifiers Aliasing and the sampling theorem (Nyquist theorem)</p> <p>3. Analog and Digital Biosignal Processing</p> <p>Noise in biosignals: sources and characteristics Low-pass, high-pass, and band-pass filters FFT and spectral analysis of biosignals Time windows, power spectra Example: HRV (Heart Rate Variability) analysis</p> <p>5. ECG Signals</p> <p>Cellular potential. Heart cell model QRS detection in ECG, artifact detection Extraction of time-domain and frequency-domain features Feature-based classification</p> <p>6. Electroencephalographic Signals (EEG)</p> <p>Neuron cell model Structure and functions of EEG Band analysis: delta, theta, alpha, beta Applications: BCI, sleep, epilepsy</p> <p>7. Electromyography (EMG) and Muscle Biosignals</p> <p>Muscle cell potential EMG characteristics and measurement techniques Processing: filtering, RMS, contraction detection</p> <p>8. Signals from Photoplethysmographic Sensors (PPG)</p> <p>Operating principle, pulse oximetry HR and SpO measurement, motion artifacts</p> <p>9. Mechanical and Acoustic Biosignals</p> <p>Blood pressure (BP), phonocardiography, lung sounds Signal combinations: e.g., ECG + phonocardiogram</p> <p>10. Electrooculogram (EOG)</p> <p>11. Blood Pressure</p> <p>12. Blood Glucose Level</p> <p>13. Thermography</p> <p>14. Detection and Classification Using ML/AI</p> <p>Introduction to machine learning in biosignals Classification models: SVM, k-NN, decision trees Example: stress recognition based on PPG + EDA (electrodermal activity)</p>											
Prerequisites and co-requisites	Physics, mathematics											
Assessment methods and criteria	<table border="1"> <thead> <tr> <th>Subject passing criteria</th> <th>Passing threshold</th> <th>Percentage of the final grade</th> </tr> </thead> <tbody> <tr> <td>Midterm colloquium</td> <td>51.0%</td> <td>40.0%</td> </tr> <tr> <td>Practical exercise</td> <td>51.0%</td> <td>60.0%</td> </tr> </tbody> </table>			Subject passing criteria	Passing threshold	Percentage of the final grade	Midterm colloquium	51.0%	40.0%	Practical exercise	51.0%	60.0%
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Example issues/ example questions/ tasks being completed	Describe methods for obtaining information on heart rate variability (HRV) based on an electrocardiographic signal.											

Practical activities within the subject	Not applicable
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