



Subject card

Subject name and code	Brain-Computer Interfaces, PG_00064472						
Field of study	Transport and Logistics						
Date of commencement of studies	February 2024		Academic year of realisation of subject		2024/2025		
Education level	second-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	2		Language of instruction		English		
Semester of study	3		ECTS credits		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Zakład Ekoinżynierii i Silników Spalinowych -> Institute of Energy -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Jacek Kropiwnicki				
	Teachers		prof. Alexandru Ianosi				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	0.0	0.0	0.0	0.0	30
	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	30		0.0		0.0	30
Subject objectives	The lecture introduces the basics of neurology, signal processing, machine learning and EEG measurements and experiments as part of the creation and use of brain-computer interfaces.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K7_U03] The student is able to make a detailed analysis of the results obtained, and to develop them in the form of a technical report or presentation, also in English		The student explains the functional, economic and social limitations and conditions for the use of solutions related to brain-computer interfaces in technology.		[SU1] Assessment of task fulfilment		
	[K7_U01] The student can obtain information from literature, databases and other, properly selected sources, also in English; is able to integrate the obtained information, interpret it, as well as draw conclusions and formulate and justify opinions		The student is able to communicate in English in professional matters in the area of brain – computer interfaces.		[SU1] Assessment of task fulfilment		
	[K7_W08] The student has a structured and extended knowledge of automation, control, management and energy efficiency in transport systems		The student explains the functional, economic and social limitations and conditions for the use of solutions related to brain-computer interfaces in technology.		[SW2] Assessment of knowledge contained in presentation		
Subject contents	Basic neuroscience; Underlying brain structures; Functions of nervous tissue; Anatomy of the brain; Electrode placement; Signal conditioning; Signal processing; Fourier transform; Wavelet transform; Hjorth parameters; Principal component analysis; Independent component analysis; Common spatial patterns; Basic machine learning techniques; Types of BCIs; Invasive and Semi-invasive BCI; Sensory Restoration.						
Prerequisites and co-requisites							
Assessment methods and criteria	Subject passing criteria		Passing threshold		Percentage of the final grade		
	Preparation of the study and presentation		50.0%		100.0%		

Recommended reading	Basic literature	<p>- Cohen, M. X. (2014). Analyzing neural time series data: Theory and practice. The MIT Press.</p> <p>- Geron, A. (2019). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow: Concepts, tools, and techniques to build intelligent systems. O'Reilly Media</p> <p>- Wolpaw, J.R & Wolpaw, E.W. (Eds.) (2012). Brain Computer Interfaces Principles and Practice. Oxford University Press</p>
	Supplementary literature	- Bear, M. F., Connors, B. W., & Paradiso, M. A. (2016). Neuroscience: Exploring the brain (4th edition). Wolters Kluwer.
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed	<p>- Describe succinctly the principles behind a motor-imagery based BCI paradigm.</p> <p>- Explain 2 methods for assesing the performance of a BCI system.</p> <p>- Which area of the brain is the EEG signal sampled from for a steady-state VEP BCI paradigm?</p> <p>- What is the P300 wave and why is it significant for building a BCI?</p> <p>- Enumerate and briefly explain 3 challenges for designing a BCI system.</p>	
Work placement	Not applicable	

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