



Subject card

Subject name and code	Modern Control Engineering and Robotics, PG_00061798						
Field of study	Automation, Robotics and Control Systems						
Date of commencement of studies	October 2020		Academic year of realisation of subject		2023/2024		
Education level	first-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	4		Language of instruction		Polish		
Semester of study	7		ECTS credits		3.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Katedra Inteligentnych Systemów Sterowania i Wspomagania Decyzji -> Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Michał Grochowski				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	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		5.0		40.0	75
Subject objectives	The aim of the course is to present modern technologies and tools currently operating in the field of automation, control and decision support systems and robotics. The course will also present the latest trends in this field and the prospects for its development, with particular emphasis on intelligent and digital technologies.						
Learning outcomes	Course outcome		Subject outcome		Method of verification		
	[K6_U01] can obtain information from literature, databases and other sources; integrate the information obtained, interpret it and draw conclusions, formulate and justify opinions		Student is able to obtain information from literature, databases and other sources; to integrate information obtained, interpret and draw conclusions, formulate and justify opinions		[SU2] Assessment of ability to analyse information		
	[K6_U03] can prepare and present a presentation on the problems and results of an engineering task		Student is able to prepare and deliver a presentation on the problems and results of an engineering task.		[SU4] Assessment of ability to use methods and tools		

Subject contents	Following the initial delivery of knowledge on a given topic, they will take the form of a focused and Instructor-inspired discussion with Students on the engineering problem undertaken, as well as important, current and forward-looking issues for automation, decision support and robotics professionals. Topics covered in Lectures:- Methods of obtaining the best quality and efficiency of control of complex objects - intelligent control methods, technologies of optimal, predictive, adaptive, hierarchical control; - Application of intelligent data analysis methods in modern decision-making systems - methods of artificial intelligence and machine learning (including deep learning technologies, evolutionary algorithms, computer vision algorithms) - e.g. analysis and exploration of knowledge from big data sets (Big data), object detection and classification, black box modelling;- Use of decision support methods in distributed, hierarchical, discrete systems and multi-criteria issues - multi-agent control, group decisions (e.g. decentralised control of extensive control objects, e.g. IT, energy, water supply networks);- Methods of determining the optimal trajectory of movement and its realisation (control) of dynamic objects in a known or unknown environment - e.g. control of autonomous vehicles, control of robot formations, exploration of an unknown environment and its mapping;- Modern methods of process monitoring and diagnostics - parameter estimation, reconstruction of state variables, detection and finding the causes of process anomalies using methods based on measurement data.		
Prerequisites and co-requisites			
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Laboratory	60.0%	50.0%
	Colloquium	50.0%	50.0%
Recommended reading	Basic literature	<ul style="list-style-type: none">Bonaccorso, G. Algorytmy uczenia maszynowego. Zaawansowane techniki implementacji. Helion, 2019;Szeliga, M. Data Science i uczenie maszynowe. Wydawnictwo Naukowe PWN, 2017.Grus, J. Data science od podstaw. Analiza danych w Pythonie. Helion, 2019.Rawlings J.B., D.Q. Mayne (2009). Model Predictive Control: Theory and Design. Nob-Hill Publishing.Grega W. (2004). Metody i algorytmy sterowania cyfrowego w układach scentralizowanych i rozproszonych. Wydawnictwa AGH, Kraków.Michalewicz Z. (1996). Genetic Algorithms + Data Structures = Evolution Programs. Springer-Verlag, Berlin, third edition.	
	Supplementary literature	<ul style="list-style-type: none">Bengio, Y., Courville A., Goodfellow I. Deep Learning. Systemy uczące się. Wydawnictwo Naukowe PWN, 2018.Tatjewski T (2002). Sterowanie zaawansowane obiektów przemysłowych. Akademicka Oficyna Wydawnicza EXIT, Warszawa.ROS, Robot Operating System (2024): https://www.ros.org/blog/getting-started/Matlab/Simulink ROS Toolbox (2024): https://www.mathworks.com/products/ros.htmlSlotine J.-J. E., Li W. (1991). Applied Nonlinear Control. Prentice Hall, Englewood Cliffs, New Jersey, US.Maciejowski J. M. (1989). Multivariable Feedback Design. Addison Wesley.Byrski W. (2007). Obserwacja i Sterowanie w Systemach Dynamicznych. Uczelniane Wydawnictwa Naukowo Dydaktyczne Akademii Górniczo Hutniczej w Krakowie.	
	eResources addresses	Adresy na platformie eNauczanie:	
Example issues/ example questions/ tasks being completed	<ul style="list-style-type: none">Choose measurement and control algorithms for an autonomous vehicle to navigate in an unknown environment - implementation in ROS (Robot Operating System) - Gazebo simulatorAnalyse the measurement data set for patterns of interestDetermine the parameters of the optimal control system for the selected object (INTECO family objects)		
Work placement	Not applicable		