



Subject card

Subject name and code	Mobile Robots Control, PG_00065892						
Field of study	Hydrogen Technologies and Electromobility						
Date of commencement of studies	October 2022		Academic year of realisation of subject		2024/2025		
Education level	first-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	3		Language of instruction		Polish		
Semester of study	6		ECTS credits		4.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Department of Control Engineering -> Faculty of Electrical and Control Engineering						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Paweł Kowalski				
	Teachers		dr inż. Paweł Kowalski				
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	20.0	0.0	0.0	40.0	0.0	60
	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	60		6.0		34.0	100
Subject objectives	The aim of the course is to develop practical skills in programming STM32 microcontrollers and designing mobile robot control systems. The course covers motor and servo control methods, sensor handling, and communication. A key element is the implementation of a project involving the construction and programming of a mobile robot in a selected competition category.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_W08] has knowledge in the field of energy storage systems: mechanical, thermal, electrical and others, knows the basics of thermodynamics and fluid mechanics, as well as the construction and operation of thermal energy equipment, hydrogen installations, process equipment, including renewable energy sources	Selects the power source for a mobile robot.	[SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects
	[K6_W18] knows the construction and operation of high-temperature fuel cells and electrolyzers powered by hydrogen and other fuels and their practical application for energy generation and storage	Selects energy storage solutions for powering mobile robots.	[SW2] Assessment of knowledge contained in presentation [SW3] Assessment of knowledge contained in written work and projects
	[K6_U08] can design and build systems and devices related to automation systems, mechatronics and robotics in energy storage devices and in hydrogen installations	Designs and builds a remote control system for a mobile robot and a line detection system for a Line Follower robot.	[SU1] Assessment of task fulfilment
	[K6_U05] can use analytical and simulation methods, prepare and for the formulation and solution of tasks in the field of hydrogen technologies, automation and robotics, electrical engineering, use various techniques to carry out engineering tasks related to electrical devices, hydrogen installations, control and robotics systems	Prepares engineering solutions in the field of microcontroller programming and mobile robot control.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject
	[K6_K02] can work in a group taking on different roles in it	Collaborates within a team in the development and programming of mobile robots.	[SK2] Assessment of progress of work [SK3] Assessment of ability to organize work
	[K6_W13] knows the properties of materials used in the field of hydrogen energy and electromobility	Knows materials used for building mobile robots.	[SW3] Assessment of knowledge contained in written work and projects
	[K6_W17] knows the methods of researching engineering materials, has knowledge in the field of materials science and is able to relate the properties of materials with their structure and composition	Selects materials used in the construction of mobile robots.	[SW3] Assessment of knowledge contained in written work and projects
	[K6_U12] can formulate a specification of simple engineering tasks of a practical nature related to the field of study	Formulates design requirements for a mobile robot.	[SU1] Assessment of task fulfilment [SU5] Assessment of ability to present the results of task
Subject contents	The theoretical part of the course focuses on providing knowledge of microcontroller programming and mobile robot control. Students will be introduced to the basics of programming STM32 microcontrollers. Topics related to electronics and robot control will also be covered, including techniques used for speed control and sensor handling. The lectures also cover the basics of using sensors in mobile robotics, such as ultrasonic, reflective, and color-detecting sensors, and their application in practical projects. The project part focuses on the practical use of the acquired knowledge in building and programming mobile robots. Students work in groups to complete a project that involves designing, building, and programming a mobile robot. The project includes selecting appropriate components, such as microcontrollers, motors, and sensors, and integrating them into a system. During the project, students develop control algorithms, including speed control, obstacle detection, and autonomous line following. At the end of the project, students test and optimize the robot's performance, preparing it for presentation.		
Prerequisites and co-requisites	Active participation in the course on mobile robot design.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Project	50.0%	60.0%
	Lecture assignments	50.0%	40.0%
Recommended reading	Basic literature	Description of STM32F4 HAL and low-layer drivers, https://www.st.com/resource/en/user_manual/um1725-description-of-stm32f4-hal-and-lowlayer-drivers-stmicroelectronics.pdf	
	Supplementary literature	Common Microcontroller Software Interface Standard, https://arm-software.github.io/CMSIS_6/latest/General/index.html	
	eResources addresses	Adresy na platformie eNauczanie:	

Example issues/ example questions/ tasks being completed	<ul style="list-style-type: none"> • Designing electronics for controlling a mobile robot. • Controlling the robot's speed using timers in PWM mode. • Obstacle detection using ultrasonic sensors. • Monitoring the battery status of the mobile robot. • Using reflective sensors to detect color. • Autonomous tracking of a path defined by a line.
Work placement	Not applicable

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