



Subject card

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| 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. | | | | | | |

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| 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 electrolysers 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: | |

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| 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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