GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Control Theory - Laboratory, PG_00067979		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2028/2029
Education level	first-cycle studies	Subject group	Obligatory subject group in the field of study 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	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Signals and Systems -> Faculty of Electronics Telecommunications and Informatics -> Faculties of Gdańsk University of Technology		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Piotr Kaczmarek	
	Teachers	dr inż. Piotr Kaczmarek	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	0.0	0.0	15.0	15.0	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	2.0	18.0	50

Subject objectives

The aim of the course is to prepare students for the design, analysis, and practical implementation of control systems for real physical processes using classical and modern control theory methods. Students develop skills in system identification, controller selection and tuning, as well as stability and performance evaluation, both in simulation and in microcontroller-based implementation.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U12] can analyze the operation of components, circuits and systems related to the field of study, as well as measure their parameters and examine technical specifications, and plan and conduct experiments related to the field of study, including computer simulations and measurements, and interpret obtained results and draw conclusions	The student can analyze the stability of control systems and select controller parameters to ensure the required stability margin.	[SU1] Assessment of task fulfilment
[K6_U03] can design, according to required specifications, and make a simple device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment	The student can design and implement control systems for linear and nonlinear plants using modern control theory methods.	[SU1] Assessment of task fulfilment

<table>
<tr><td>Subject contents</td><td>Course content – laboratory
As part of the laboratory, students complete 57 tasks involving the practical design and implementation of control algorithms for real physical systems such as DC motors, thermal processes, and liquid-level systems, using Arduino, ESP32, or STM32 modules. Students model the systems, perform parameter identification, and prepare models that are then used to design an appropriate controller. The laboratory covers classical P, PI, and PID controllers, including tuning, noise filtering, and control-signal limitation. Advanced methods are also introduced, including state-space controllers, observers, and relay (on-off) control. The course additionally includes elements of robust control based on sliding-mode techniques, implemented on microcontroller platforms.

Course content – project
Each team carries out a project that begins with the identification of a selected physical system, such as a DC motor, thermal process, or water tank, based on experimental measurements. A key element of the project is the closed-loop simulation, where students test and analyze the systems behavior under different parameters and operating conditions. Based on the identified model, advanced control algorithms are developed, including state-feedback control, sliding-mode control, and optionally a state observer. After the simulation stage, students implement the chosen control algorithm on a microcontroller (e.g., Arduino, ESP32, STM32) and conduct practical experiments. The final outcome includes stability analysis, comparison of control strategies, as well as documentation and presentation of the obtained results and conclusions.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Knowledge of control principles within the scope of the courses: Fundamentals of Automation and Control Theory.</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Lab tasks</td><td>60.0%</td><td>70.0%</td></tr>
<tr><td>Project</td><td>60.0%</td><td>30.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>Katsuhiko Ogata Modern Control Engineering</td></tr>
<tr><td>Supplementary literature</td><td>K. J. Åström, R. M. Murray Feedback Systems, An Introduction for Scientists and Engineers</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td></td></tr>
<tr><td>Practical activites within the subject</td><td>Not applicable</td></tr>
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