GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Essentials of Automatics - Laboratory, PG_00067474						
Field of study	Podstawy automatyki - laboratorium						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2026/2027		
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	2		Language of instruction		Polish		
Semester of study	4		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 Fiertek				
	Teachers		dr inż. Piotr Kaczmarek				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	0.0	0.0	30.0	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		2.0	18.0		50
Subject objectives	The aim of the Fundamentals of Automation laboratory is to introduce students to the practical aspects of control system design. Students learn to identify parameters of linear dynamic models based on step responses and frequency characteristics, using criterion minimization methods. During the classes, they become familiar with PID controller tuning techniques and build analog control systems for physical object models. An important part of the laboratory is a simulation project in which students design P, PID, LEAD, and LAG controllers for a given system model.						

Learning outcomes	**Course outcome**	**Subject outcome**	**Method of verification**
	[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 using feedback.	[SU1] Ocena realizacji zadania
	[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 build mathematical models of controlled plants.	[SU1] Ocena realizacji zadania
	[K6_W03] knows and understands, to an advanced extent, the construction and operating principles of components and systems related to the field of study, including theories, methods and complex relationships between them and selected specific issues - appropriate for the curriculum	student knows the methods of stability tests and synthesis of control systems (linear and nonlinear)	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym
	[K6_W10] knows and understands, to an advanced extent, the parameters, functions, and methods of analysis, design, and optimization of electronic circuits and systems, the definitions of error and measurement uncertainty, measurement methods, including time, frequency, and phase measurements, the properties of converters, and methods of digital signal processing, as well as the basic processes occurring in the life cycle of technical devices, objects, and systems, and methods of supporting processes and functions, specific to the field of study	The student can apply advanced methods of control system synthesis to meet specified user requirements.	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym
Subject contents	Course content – laboratory The laboratory includes practical tasks involving the identification of linear system models based on step responses and frequency characteristics, using analytical methods and criterion minimization. Students analyze closed-loop systems with proportional control, examining stability, response parameters, and frequency characteristics. Part of the course focuses on tuning P, PI, PD, and PID controllers and evaluating the influence of their settings on system stability and control performance. An important component of the laboratory is the study of a servomechanism, which includes identifying the mathematical model of the system and implementing control using operational amplifiers.		
Prerequisites and co-requisites	A necessary requirement for participating in the laboratory is knowledge of the fundamentals of automation as well as circuit and signal theory.		
Assessment methods and criteria	**Subject passing criteria**	**Passing threshold**	**Percentage of the final grade**
	completion of exercisies	60.0%	100.0%
Recommended reading	Basic literature	B. C. Kuo and F. Golnaraghi *Automatic Control Systems*	
	Supplementary literature	K. Åström, R. Murray *Feedback Systems: An Introduction for Scientists and Engineers*	
	eResources addresses		

Example issues/ example questions/ tasks being completed	1. Design a P, PI, PD, PID, LEAD, and LAG controller operating in a closed-loop system with a given object and sensor model. A nonlinear element should be placed between the controller and the object (limiting the control signal value). Simulate the closed-loop system with the nonlinear element. When designing individual controllers, assume no nonlinear element design the controller as for a linear system. During the results verification stage, verify the difference in the behavior of the closed-loop system with and without the nonlinear element. Select the proportional controller to achieve the fastest closed-loop step response with limited overshoot. The PID controller can be designed numerically (criterion minimization, e.g., ITAE) or using the Ziegler-Nichols method. The LEAD-LAG controller should be designed using the root-line method and in the frequency domain. In the case of the root-line method, the object with a transport delay should be described by a simplified model (e.g., a second-order system with a non-minimum phase zero). 2. Design an analog controller using operational amplifiers to control a DC motor. A proportional controller, proportional with speed feedback (signal from a tachogenerator), PI, and PID should be implemented. 3. Tune the PID controller parameters to meet the design requirements. 4. Identify the parameters of the object model based on data obtained from the object's step response or frequency response.
Practical activites within the subject	Not applicable