GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Automatics and control of technical processes, PG_00057710		
Field of study	Automatyka i kontrola procesów technologicznych		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2025/2026
Education level	first-cycle studies	Subject group	Optional subject group 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	6.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Process Engineering and Chemical Technology -> Faculty of Chemistry -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Bartosz Szulczyński	
	Teachers	dr inż. Bartosz Szulczyński mgr inż. Dominik Dobrzyniewski	

Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	15.0	30.0	0.0	0.0	75
	E-learning hours included: 0.0						
	eNauczanie source addresses: Moodle ID: 2543 Automatyka i kontrola procesów technologicznych https://enauczanie.pg.edu.pl/2025/course/view.php?id=2543						

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	75	15.0	60.0	150

Subject objectives	The aim of the course is to provide knowledge on the principles of operation and application of automation and process control systems, with particular emphasis on energy efficiency and sustainable development. Students become familiar with methods of modeling, analysis, and control of heat and mass transfer processes, as well as with the use of control and measuring equipment for monitoring key operational parameters. The course develops the ability to practically apply knowledge of automation and measurement to solve theoretical and practical engineering problems related to the optimization and control of processes in green technologies.

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_W06] has a basic knowledge of chemical engineering, mechanical engineering and chemical equipment, knows and understands basic processes taking place in green, proenvironmental technologies	The student possesses knowledge of the principles of operation of automation and process control systems, with particular emphasis on their application in the implementation and optimization of green technologies. The student understands the importance of automation and monitoring of process parameters for improving energy efficiency and reducing the environmental impact of industrial processes.	[SW1] Ocena wiedzy faktograficznej
	[K6_K04] is ready to think and act in a creative and enterprising way, to negotiate, work in a team, assuming different roles	The student is prepared to act in a creative and entrepreneurial manner in solving problems related to automation and process control. The student is able to work effectively in a team, communicate efficiently, and assume various roles in the implementation of project and experimental tasks, demonstrating responsibility for shared outcomes.	[SK1] Ocena umiejętności pracy w grupie
	[K6_U05] can formulate and solve engineering tasks analytical methods, simulation as well as experimental, able to apply knowledge of basic physics and mathematics to analyze the results of experiments, is able to analyze and assess existing technical solutions	The student is able to apply analytical, simulation, and experimental methods to analyze and evaluate the performance of automation systems and control processes in industrial technologies. The student is capable of using knowledge of physics and mathematics to interpret measurement and simulation results and to formulate conclusions regarding the efficiency and stability of technological processes.	[SU4] Ocena umiejętności korzystania z metod i narzędzi
	[K6_W03] has a basic knowledge of soil, air and water pollutants, design and supervision of environmentally friendly technologies and technologies which do not produce waste, knows technology of cleaning and neutralization of industrial waste and wastewater management, has a basic understanding of the theoretical basis of methods and types of apparatus used in chemical analysis of environmental pollutants	The student possesses knowledge of the application of automation and control systems in environmental protection processes, including gas, water, and wastewater treatment technologies, and industrial waste management. The student understands the importance of monitoring environmental parameters and automatic control of processes for improving ecological efficiency and reducing pollutant emissions.	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym
	[K6_U03] is able to use information and communication technologies relevant to the common tasks of engineering, is able to use known methods and mathematical-physical models to describe and explain phenomena and chemical processes	The student is able to use information and communication technologies and engineering software for the analysis, modeling, and simulation of control and regulation processes in chemical technologies. The student applies mathematical and physical models to describe, interpret, and optimize processes occurring in technological systems, including those related to green technologies.	[SU3] Ocena umiejętności wykorzystania wiedzy uzyskanej w ramach przedmiotu [SU4] Ocena umiejętności korzystania z metod i narzędzi

Subject contents	Course content – lecture The lectures cover issues related to automation and control of technological processes in the context of modern and sustainable engineering solutions. The basic concepts of process automation, types of signals, control objects, and actuators are discussed. Particular attention is paid to the analysis of control system structures, the function of feedback, and the role of automation systems in the optimization of technological processes. The principles of mathematical modeling of technological processes are presented, including balance equations and dynamic models used in the analysis of unsteady states. Fundamental concepts of stability, accuracy, and control quality are discussed, along with methods for evaluating the behavior of dynamic systems in response to disturbances and external inputs. Further lectures present the components and devices used in measurement and control systems, including sensors, transducers, controllers, and actuators. Typical solutions for automatic control systems in industrial processes are analyzed, with particular emphasis on chemical and environmental technologies. Special attention is devoted to P, PI, and PID controllers, their characteristics, and tuning methods such as the ZieglerNichols method. Methods for improving system stability and control quality are also discussed, along with examples of applying controllers in heat exchange, flow, and chemical reaction processes. The lectures also cover issues related to industrial sensors and measurements, including the classification and operating principles of temperature, pressure, flow, level, conductivity, and physicochemical sensors. The metrological characteristics of sensors, methods of calibration and standardization, and the influence of process conditions on measurement accuracy are discussed. Examples of sensor applications in the monitoring and automatic control of technological processes are presented, particularly in chemical and environmental installations.
	Course content – exercises The exercises cover issues related to the analysis and calculation of signals generated by sensors used in measurement and control systems. Students perform calculations of metrological parameters such as sensitivity, measurement range, accuracy, and uncertainty, and analyze the influence of measurement errors and environmental conditions on measurement results. Methods of sensor calibration and signal processing in process automation systems are also discussed. The exercises also involve solving computational and problem-based tasks related to the analysis and design of automatic control systems for technological processes. Students learn to determine the responses of dynamic systems to disturbances, analyze system stability, and evaluate control accuracy and quality. The basic principles of block diagram reduction and simplification are discussed, along with the interpretation of dynamic characteristics of controlled systems and controllers. The course further includes analysis of various control system structures, including proportional (P), proportionalintegral (PI), and proportionalderivative (PD) control. Students perform calculations for selecting controller parameters using empirical and analytical methods, including the ZieglerNichols tuning method. Exercises also cover steady-state error analysis, response time, overshoot, and stability assessment using the Hurwitz criterion.
	Course content – laboratory Measurement and control of humidity in gases. Gas chemical sensors (NDIR CO sensor). Static characteristics of resistive metal thermometers. Dynamic characteristics of temperature sensors. Series connection of first-order inertial elements. Influence of convection type on the dynamic properties of a temperature sensor. Heat transfer dynamics.

	Investigation of automatic controllers.
Prerequisites and co-requisites	Movement of electrical charges, hydrostatic and hydrodynamics, heat transfer, physical quantities, basic units, basic concept of differential calculus

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Exercise test	60.0%	30.0%
Lecture test 2	60.0%	20.0%
Laboratory test	60.0%	30.0%
Lecture test 1	60.0%	20.0%

Recommended reading

Basic literature	There is no requirement
Supplementary literature	There is no requirement
eResources addresses	

Example issues/ example questions/ tasks being completed	Task 1. Determine the flow rate of dry air at 20 ° C, if the measuring orifice with 100 mm bore diameter installed in the DN200 pipeline, the pressure difference indicated by the differential transducer is 216 mbar. An expansion number of 0.85 should be assumed. Task 2. Determine the pressure difference indicated by the Pitot tube fitted on a plane flying at a speed of 460 km · h-1 at a cruising altitude of 10,000 m (t = -50 ° C, p = 197 mmHg). Task 3. Methane gas under a pressure of 2 bar at 32 ° C flows through the rotameter. The rotameter is scaled relative to air (20 ° C, 760 mmHg). The float indicates 200 dm3h-1. Determine the actual value of the methane flow rate.
Practical activites within the subject	Not applicable