GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Automatics and control of technical processes, PG_00057710						
Field of study	Green Technologies						
Date of commencement of studies	October 2024		Academic year of realisation of subject	2026/2027			
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 -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Bartosz Szulczyński					
	Teachers						

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						

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 familiarise students with the operating principles, design, metrological characteristics and applications of sensors and measuring instruments used to monitor technological process parameters, particularly in green technologies, waste management, and raw material and energy recovery. The course covers the selection and evaluation of measurement systems, signal processing and interpretation, as well as the fundamentals of process automation, including the structure of control and regulation systems, the operation of actuators, process dynamics modelling, controller tuning, and the analysis of control system stability and performance. Students acquire the knowledge and skills necessary to select measurement equipment and automation components and to analyse control systems used in technological and environmental processes.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[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	is able to use mathematical and physical methods as well as information and communication technologies to analyse the parameters and static and dynamic characteristics of sensors and measurement systems. The student is able to describe and analyse the dynamics of technological processes using mathematical models, block diagrams and methods for analysing automatic control systems.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools
[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	knows and understands the principles of measuring basic physicochemical quantities, such as temperature, pressure, flow rate, humidity, pH and conductivity, as well as the operating principles of sensors and measuring instruments used to monitor technological and environmental process parameters. The student is familiar with the applications of chemical sensors in monitoring media quality and supervising environmentally friendly processes.	[SW1] Assessment of factual knowledge
[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	is able to use analytical and experimental methods to solve problems related to physicochemical measurements and process automation. The student is able to apply the laws of physics and mathematical methods to process and interpret measurement results, determine the static and dynamic characteristics of sensors, and analyse the stability and performance of control systems. The student is able to assess the operation and suitability of selected technical solutions in measurement and control systems.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject
[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	knows and understands the operating principles, construction and basic metrological parameters of sensors and measuring instruments used to monitor technological process parameters. The student is familiar with basic automatic control system structures, the characteristics of control system components and the principles of their application in technological process control.	[SW1] Assessment of factual knowledge [SW3] Assessment of knowledge contained in written work and projects
[K6_K04] is ready to think and act in a creative and enterprising way, to negotiate, work in a team, assuming different roles	is prepared to approach engineering problems related to measurements and process automation creatively and independently, cooperate in a team while carrying out computational and laboratory tasks, and assume different roles and responsibilities for assigned tasks.	[SK1] Assessment of group work skills [SK3] Assessment of ability to organize work

Subject contents	Course content – lecture Fundamentals of metrology and process automation. Classification, design and operating principles of sensors and measuring instruments. Metrological parameters, static and dynamic characteristics of sensors, calibration and verification of measuring equipment. Methods of measuring temperature, pressure, flow rate, humidity, pH, conductivity and electrochemical potential. Gas chemical sensors and their application in technological process monitoring. Structure of automatic control systems, mathematical models of dynamic systems, analysis of stability and control performance. P, PI and PID controllers and methods of tuning their parameters. Course content – exercises Calculations related to temperature, pressure, flow rate, pH and electrical conductivity measurements. Analysis of sensor parameters and characteristics, sensitivity and linearity range. Determination of time constants and dynamic characteristics of controlled systems. Simplification of block diagrams, feedback analysis, calculation of control error and system stability assessment. Tuning of P, PI and PID controllers, including the Ziegler–Nichols method. Course content – laboratory Practical measurements and investigation of static and dynamic characteristics of temperature sensors and gas chemical sensors, including NDIR sensors for CO_2 measurement. Gas humidity measurement and control. Investigation of heat transfer dynamics and inertial systems. Experimental analysis of automatic controller performance and assessment of the stability and quality of technological process control.
Prerequisites and co-requisites	Basic knowledge of mathematics, physics and chemistry, particularly fundamental physical and chemical quantities and the laws describing physical phenomena and chemical processes. Familiarity with basic concepts related to technological processes and industrial equipment. Ability to perform mathematical calculations, including matrix algebra, differential and integral calculus (derivatives and integrals), and solving basic differential equations. Ability to interpret measurement results.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
lecture test	60.0%	60.0%
laboratory test	60.0%	20.0%
laboratory reports	100.0%	20.0%

Recommended reading

Basic literature	1. Johnson, C. D., Process Control Instrumentation Technology, 8th ed., Pearson, 2014. 2. Coughanowr, D. R., LeBlanc, S. E., Process Systems Analysis and Control, 3rd ed., McGraw-Hill, 2009. 3. Seborg, D. E., Edgar, T. F., Mellichamp, D. A., Doyle, F. J., Process Dynamics and Control, 4th ed., Wiley, 2016. 4. Bentley, J. P., Principles of Measurement Systems, 4th ed., Pearson Prentice Hall, 2005. 5. Bolton, W., Instrumentation and Control Systems, 2nd ed., Elsevier, 2015.
Supplementary literature	There is no requirement
eResources addresses	

Example issues/ example questions/ tasks being completed	• What are the operating principles and applications of temperature, pressure, flow and humidity sensors? • What metrological parameters are used to characterise sensors and measuring instruments? • What measurement methods are used to determine pH, conductivity and the concentration of gas components? • How can the static and dynamic characteristics of sensors be interpreted? • What are the operating principles of automatic control systems and feedback loops? • How can control system stability and performance be evaluated, and how can P, PI and PID controller parameters be tuned? • How can measurements and automation be used to monitor and control technological and environmental processes?
Practical activites within the subject	Not applicable

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