GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Automatics and Measurement of Physical Quantity, PG_00060849		
Field of study	Chemical Technology		
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	3	ECTS credits	3.0
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	15.0	0.0	30.0	0.0	0.0	45

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	45	5.0	40.0	90

Subject objectives

Discussion of the operating principle and application of sensors and measuring devices for controlling basic process parameters in the chemical industry. Presentation of the possibilities of using the mathematical description of fluid flow and heat transfer to analyze unsteady states of processes. Familiarization of students with basic concepts related to control, steering and automatic regulation of chemical industry process operations.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U08] Is able to select elements of automatic control systems for simple technological processes and use computer programs to control and optimize chemical processes.	The student is able to design a simple measurement and control system for a selected process, justify the selection of components and control parameters, and use appropriate computer software to analyse, simulate, and verify the operation of the designed system.	[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment
[K6_W04] Possesses the technical knowledge necessary to analyze processes and design installations in the chemical industry.	The student possesses knowledge of the operating principles of sensors, measurement and control instrumentation, and automation components, enabling the analysis of technological processes and the preliminary design of measurement and control systems in chemical installations.	[SW1] Assessment of factual knowledge

Subject contents

Course content – lecture
The lectures cover issues related to the measurement of physicochemical quantities and process automation in the chemical industry. The course begins with an introduction to basic concepts in metrology and automation, as well as the role of measurements and control in ensuring the quality and safety of technological processes. Students become familiar with the classification of sensors, the principles of measuring key process variables, and the structure of typical measurement and control systems. Metrological parameters of sensors, their static and dynamic characteristics, as well as methods of calibration and verification of measurement instruments are presented.
Subsequent lectures address methods and devices used for measuring temperature, pressure, flow, conductivity, pH, and electrochemical potential, with particular emphasis on their design, operating principles, accuracy, and application conditions. Issues related to gas chemical sensors and their role in monitoring technological processes are also discussed.
The next part of the course focuses on the fundamentals of process automation. It includes the structure of an automatic control system, types of signals and controlled objects, and the rules for constructing and simplifying block diagrams. Students learn methods of mathematical modelling of dynamic systems, analysis of their responses to external inputs, and interpretation of control error and its impact on system accuracy. Further topics include the stability of control systems, with an introduction to key criteria (e.g., Hurwitz) and the importance of component parameters in shaping the systems dynamic characteristics. The course also covers automatic controllers (P, PI, PID), their operating principles, characteristics, tuning methods, and their effect on control performance. Special attention is given to empirical tuning methods, such as the ZieglerNichols method.

Course content – laboratory
The laboratory classes involve practical measurements and the analysis of the static and dynamic properties of sensors and components used in process automation systems. During the laboratory sessions, students become familiar with methods of measuring and controlling humidity in gases, as well as with the operating principle of gas chemical sensors, illustrated by the example of an NDIR sensor for carbon dioxide concentration measurement. The static characteristics of resistive metal thermometers and the dynamic characteristics of temperature sensors under various measurement conditions are examined and discussed. Students analyse the influence of convection conditions on the dynamic behaviour of temperature sensors and investigate heat transfer dynamics in systems with different inertia parameters. Another component of the laboratory work involves determining the characteristics of systems composed of series-connected first-order inertial elements and analysing the responses of such systems to external excitations.
In the final part of the course, students conduct experiments related to the operation of automatic controllers, determining their influence on the stability and quality of process control.

Prerequisites and co-requisites

Movement of electric charges, hydrostatics and hydrodynamics, heat movement, physical quantities, basic units, basic concepts of differential calculus

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Lab test	60.0%	30.0%
Lecture Test	60.0%	70.0%

Recommended reading

Basic literature	1. Dunn William: Fundamentals of Industrial Instrumentation and Process Control, 2. Gregory K. Mcmillan, P. Hunter Vegas: Process / Industrial Instruments and Controls Handbook 3. Dale R. Patrick;Stephen W. Fardo: Industrial Process Control Systems 4. Katariya Sanjay B: Industrial Automation Solutions for Plc, Scada, Drive and Field Instruments: Easy to Learn Industrial Automation
Supplementary literature	There are no requirements
eResources addresses	

Example issues/ example questions/ tasks being completed

1. The first-order inertial object transfer function has the form
2. Describe the Hurwitz stability criterion
3. Determine the Laplace transform of the given function
4. Determine the dependence of the signal on the measured quantity for resistive temperature sensors

Practical activites within the subject

Not applicable

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