GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Digital Control, PG_00048421		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2025/2026
Education level	second-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	1	Language of instruction	Polish
Semester of study	2	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Decision Systems and Robotics -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Janusz Kozłowski	
	Teachers	dr inż. Janusz Kozłowski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	0.0	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 course is to master the knowledge of methods for modeling of dynamic processes as objects subject to automatic control, as well as mathematical transformations and the methods of control system design.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W02] knows and understands, to an increased extent, selected laws of physics and physical phenomena, as well as methods and theories explaining the complex relationships between them, constituting advanced general knowledge in the field of technical sciences related to the field of study	The student understands the methods and techniques of design and operation of automatic control systems and control and robotics, as well as the use of computers in the control and monitoring of dynamic objects.	[SW1] Assessment of factual knowledge
[K7_U02] can perform tasks related to the field of study as well as formulate and solve problems applying recent knowledge of physics and other areas of science	Student gets acquainted with the basic problems of modelling computer-controlled systems and designing systems of direct digital control.	[SU3] Assessment of ability to use knowledge gained from the subject [SU4] Assessment of ability to use methods and tools
[K7_U03] can design, according to required specifications, and make a complex 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	Student is able to design and make a device or system, using methods, techniques and tools and materials, using standards and norms, using appropriate technologies	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information

<table>
<tr><td>Subject contents</td><td>1. Analysis and synthesis of digital control systems: making system discrete and analog (discretization and analogization); continuous and discrete modeling. 2. Discretization and discrete-time modeling of continuous-time systems;Analogization and continuous-time modeling of discrete-time systems. 3. System approaches: discretization i analogization. 4. Discrete-time approximation as a model approach. 5. Analog to digital processing (ADC conversion). 6. Rules of conversion (sampling, quantization, coding). 7. Deterministic approaches to setting ADC parameters. 8. Probabilistic approaches to setting ADC parameters. 9. Digital to analog processing (DAC conversion): Rules of conversion (decoding and signal generation). 10. Positional and incremental DAC decoding. 11. Generating continuous-time signals: rules, and current methods (extrapolators). 12. Generating continuous-time signals: block methods (interpolators). 13. Analysis of digital control systems for continuous-time processes. 14. Analysis: equivalent models. 15. Analysis: transfer function models. 16. Analysis: state-space models. 17. Digital system synthesis via discrete approximation method. 18. Discrete approximation methods. 19. Time response invariance methods. 20. Frequency characteristic invariance. Relations between the s- and z-planes. 21. Synthesis of discrete-time controllers: Basic tasks of regulation and methods of control system design. 22. Synthesis: Compensation methodology: Realizability. 23. Synthesis: Compensation methodology: Stability of non-observable and non-controllable modes. 24. Synthesis: Compensation methodology: astatism, and finite (minimal) settling time. 25. Synthesis of discrete-time controllers: Parameter optimization approaches. 26. State-space controllers: Pole placement. Regulator-form approach. 27. State-space controllers: Modal control. 28. State-space controllers: Finite settling-time controllers. 29. State-observer based control: dual design. 30. State observers.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>Completing the subjects of the previous semester</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>Written exam</td><td>50.0%</td><td>100.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>W.L. Brogan: Modern control theory, Prentice Hall, Englewood Cliffs, 1974. K.J. Astrom, B Wittenmark: Computer-controlled systems. Prentice Hall, Upper Saddle River, 1997</td></tr>
<tr><td>Supplementary literature</td><td>No requirements</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td>1. Describe practical methods for selection of the sampling time of analogue signals.

2. Characterise different methods of the digital-to-analogue conversion.

3. Introduce digital implementations of the PID controller.

4. Describe advantages of the state feedback.

5. Explain, how the state observer can be utilised in implementation of the state feedback.</td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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