GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Digital control, PG_00055471						
Field of study	Mechatronics						
Date of commencement of studies	October 2023		Academic year of realisation of subject	2025/2026			
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	3		Language of instruction	Polish			
Semester of study	6		ECTS credits	2.0			
Learning profile	general academic profile		Assessment form	exam			
Conducting unit	Department of Mechanics and Mechatronics -> Faculty of Mechanical Engineering and Ship Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr hab. inż. Rafał Hein				
	Teachers						
Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	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	Presentation of theoretical knowledge of digital control systems. Gaining the skills to design and analyze digital control systems.						

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_W03] has organized and theoretically supported, advanced knowledge in the field of automation and control theory of stationary , continuous and discrete mechatronic systems, mechatronic design, developments and exploitation of mechatronic systems	Student has theoretical and practical knowledge in the field of digital and discrete control systems. He can apply it in practice to the analysis and design of one and multidimensional discrete control systems.	[SW1] Assessment of factual knowledge
[K6_U09] is able to formulate an algorithm, knows low and high level programming languages and appropriate IT tools for developing computer programmes to control mechatronic system	Student can apply the transformation methods of differential equations into the difference and recursive equations in creating algorithms for the numerical implementation of digital control systems.	[SU1] Assessment of task fulfilment
[K6_W09] knows and understands methods of mechatronic modelling and design of systems / stationary processes as well as utilized methods and techniques including structural modelling, modal analysis, optimal control, digital control and knows modelling languages as well as computer tools for design and simulation of systems / mechatronic processes	Student can distinguish between a discrete and digital control system. He knows the methods of analysis and design of discrete systems and knows how to apply them in practice.	[SW1] Assessment of factual knowledge
[K6_U04] is able to utilise known methods and mathematical models as well as analogue and digital measurement methods for analysing and assessment of stationary continuous and discrete mechatronics systems and processes	Student applies the known methods of discrete systems analysis to design, investigations and test digital control systems.	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents

LECTURE Analog, discrete and digital control systems. Sampling, quantization and coding. Structures of discrete control systems. Discrete signals in digital control systems. Numerical approximation of differential equations. Z transform. Frequency characteristics of discrete systems. Filtering and smoothing of signals. Sampling frequency. Discrete realization of analog controllers. Methods of transforming the mathematical description of analog controllers to the mathematical description of discrete controllers depending on the sampling frequency. Analog to digital and digital to analog conversion. Investigation of the stability of discrete control systems. The influence of sampling frequency on the methods of designing discrete control systems. Methods of designing discrete systems based on a given position of the roots of the characteristic equation on the z plane. State feedback controllers designing on the basis of pole placement.LABORATORY Solving differential equations. Converting differential equations to difference and recursive equations. Solving difference and recursive equations. The Z transform and its application to solving recursive equations. Preparation of frequency characteristics of discrete systems. Converting the transfer function of an analog controller to the corresponding transfer function of a discrete controller. Designing discrete control systems depending on the sampling frequency.

Prerequisites and co-requisites

Fundamentals of the control theory. Mathematics including linear algebra, matrix algebra, differential and integral calculus, linear differential equations.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Midterm colloquium	55.0%	40.0%
Written exam	55.0%	60.0%

Recommended reading

Basic literature	1. Brzózka J.: Regulatory cyfrowe w automatyce. MIKOM, Warszawa 2002 2. Budnicki Z.: Teoria i algorytmy sterowania. PWN, Warszawa 2005 3. Franklin G. F., Powell J.D., Workman M.: Digital control of Dynamics Systems, Addison Wesley Longman, Inc., 1998 4. Kaczorek T. i inni: Podstawy teorii sterowania. WNT, Warszawa 2005
Supplementary literature	1. K. Ogata: Discrete-Time Control Systems, Printice Hill, Englewood 1987
eResources addresses	Adresy na platformie eNauczanie:

Example issues/ example questions/ tasks being completed	1. Transform a differential equation to a difference equation and determine the solution in recursive form and using the Z transformation. 2. Transform the transfer function of an analog system to the corresponding transfer function of a discrete system using, among others, the methods of invariance impulse response, step response, equivalent zeros and poles. 3. Design a discrete control system depending on the given sampling frequency.
Work placement	Not applicable

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