GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Control System Structures, PG_00016960		
Field of study	STRUKTURY UKŁADÓW STEROWANIA		
Date of commencement of studies	February 2025	Academic year of realisation of subject	2025/2026
Education level	second-cycle studies	Subject group	
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	4.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Electric Drives and Energy Conversion -> Faculty of Electrical and Control Engineering -> Wydziały Politechniki Gdańskiej		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. inż. Marek Adamowicz	
	Teachers	dr hab. inż. Marek Adamowicz	

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	0.0	15.0	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	10.0	45.0	100

Subject objectives

The aim of the course is to equip students with the knowledge and skills to create control system structures for various types of control systems. Students will learn the principles of selecting the appropriate control system structure for a control system. Furthermore, students will acquire knowledge on defining the control purpose and control quality requirements, as well as knowledge on the design and modeling of control systems, and the study of control system characteristics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W14] has knowledge of mathematical modelling, identification, optimisation, decision suport decision-making and control, knows methods of implementing advanced control algorithms in industrial equipment	Builds a model of a given control object in the form of a transfer function or a system of differential equations, builds a simulation model and implements the given structure of a complex control system, taking into account constraints and parametric uncertainty	[SW3] Ocena wiedzy zawartej w opracowaniu tekstowym i projektowym [SW2] Ocena wiedzy zawartej w prezentacji
[K7_K06] is aware of the impact of engineering activities on the quality of applied solutions and the environment	Based on the acquired theoretical knowledge and simulation studies, it assesses the quality of the control system, compliance with requirements and the possibility of implementation on a physical object.	[SK5] Ocena umiejętności rozwiązywania problemów występujących w praktyce

Subject contents

Course content – lecture
- Feed-forward control.
- Cascade control system with trajectory generator and disturbance compensation.
- Delayed object control (Smith predictor).
- State-feedback control.
- Vibration damping methods.
- Adaptive control (MRAS).
- Sliding-mode control of a nonlinear object.
- Nonlinear control, nonlinear transformation of variables, and feedback linearization.
- Modal control.

Course content – laboratory
- Eliminating vibrations in poorly damped systems using an input shaping filter.
- A state-feedback control system.
- Using the Smith predictor to control an object with a delay.
- A model-based adaptive control system (MRAS, MRAC).
- Investigating a cascaded control system using a servo mechanism as an example.
- Robust servo control using sliding mode control.

Prerequisites and co-requisites	Basic knowledge of automation, including the elementary structures of P, I, PI, and PD controllers. Knowledge of the Laplace Transform and the definition of the transfer function.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Laboratory reports	60.0%	50.0%
Exam	50.0%	50.0%

Recommended reading

Basic literature	1. Kaczorek T., Dzieliński, Dąbrowski, Łopatka: Podstawy teorii sterowania, PWN 2009. 2. Tatjewski P.: Sterowanie zaawansowane obiektów przemysłowych. Struktury i Algorytmy. Warszawa. 3. Bubnicki: Teoria i algorytmy sterowania, PWN, 2005.
Supplementary literature	1. Åström, Wittenmark , H. Butler, Model-Reference Adaptive Control-From Theory to Practice, Prentice-Hall, 1992, 2. Bodgan Wilamowski; J. David Irwin: Control and mechatronics, CRC Press, Taylor&Francis Group, 2011. 3. Bogdan M. Wilamowski; J. David Irwin: Intelligent systems, CRC Press, Taylor&Francis Group, 2011. 4. Brok S.: Struktury odpornego sterowania elektrycznego napędu bezpośredniego z wykorzystaniem koncepcji sterowania ślizgowego, Politechnika Poznańska, Rozprawy nr 497, Poznań, 2013. 5. Ellis G.: Comparison of position control for industrial Applications, Danaher Motion, 2002. 6. Franklin G., Powell J. D., Emami-Naeini A.: Feedback Control of Dynamic Systems, Prentice Hall, 4 edition, 2002. 7. Malek. K, Makys P., Sturlajter M.: Feed Forward Control of Electrical Drives Rules and Limits, Power Engineering and Electrical Engineering, vol.9, no 1/2011
eResources addresses	

Example issues/ example questions/ tasks being completed	1. Discuss the properties of a cascaded control systema servomechanism: response to trapezoidal and sinusoidal setpoints, Bode plot. 2. Explain the structure of a MRAS and list the methods for parameter adaptation. 3. To what class of objects is sliding mode control applied? 4. Describe the principles of constructing a setpoint signal in open systems with input shaping.
Practical activites within the subject	Not applicable

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