GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Modern Techniques in Control Theory, PG_00047410		
Field of study	Automatic Control, Cybernetics and Robotics		
Date of commencement of studies	October 2022	Academic year of realisation of subject	2022/2023
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	English
Semester of study	2	ECTS credits	5.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Automatic Control -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Piotr Kaczmarek	
	Teachers	dr inż. Piotr Kaczmarek	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	30.0	15.0	0.0	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	70.0	125

Subject objectives

Advanced control methods, in particular for MIMO plants: state-space control, predictive control, robust control.

Know fundamental limitations of control systems.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W04] Knows and understands, to an advanced extent, the principles, methods and techniques of programming and the principles of computer software development or programming devices or controllers using microprocessors or programmable elements or systems specific to the field of study, and organisation of systems using computers or such devices	The student understands basics of modeling.	[SU3] Assessment of ability to use knowledge gained from the subject
[K7_W05] Knows and understands, to an increased extent, methods of process and function support, specific to the field of study.	The student understands the application areas, advantages and disadvantages of different control approaches discussed in the course.	[SW1] Assessment of factual knowledge
[K7_W21] Knows and understands, to an advanced extent, methods and techniques of design and operation of automatic control systems, control and robotics systems, as well as the use of computers in the control and monitoring of dynamic objects	The student knows the concept of generalized plant and can represent typical control systems in this form. The student knows the concept of the minimal state-space realization and can find such a realization of a MIMO transfer function. The student knows the following controller synthesis methods: state-space controllers (including optimal controllers), predictive controller, robust controllers.	[SW1] Assessment of factual knowledge
[K7_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study by:n-appropriate selection of source information and its critical analysis, synthesis, creative interpretation and presentation,n-application of appropriate methods and toolsn	The student can implement a simulated control system that employs advanced controllers discussed during the course.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU1] Assessment of task fulfilment
[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	The student can model dynamic system using state space equations and transfer function matrices. The student knows the concepts of MIMO zeros, decoupling zeros, poles, directions. The student can specify uncertainty.	[SW1] Assessment of factual knowledge

Subject contents

State-space control: modeling, controlability, observability, controller and observer desigm separation principle.

Optimal control: LQR/LQG controllers, properties, loop transfer recovery method.

System norms, zeros and poles in MIMO systems, performance specification, generalized plant.

Limitations of control systems: Bode integral, nonminimumphase zeros, unstable poles, delay, uncertainty.

Robust control: robust stability and performance. Synthesis of robust controllers: DK-iteration, loop shaping.

Predictive control: DMC, GPC, MPS algorithms.

Prerequisites and co-requisites

Principles of automatic control, Analog control, Algebra, Calulus, Complex calculus.

Assessment methods and criteria

Subject passing criteria	Passing threshold	Percentage of the final grade
Exam	61.0%	50.0%
Exercises	61.0%	50.0%

Recommended reading	Basic literature	W.L. Brogan, Modern Control Theory, Prentice Hall, 1990. S. Skogestad, I. Postlethwaite, Multivariable Feedback Control: Analysis and Design, Wiley, 2005.
	Supplementary literature	N.S. Nise, Control Systems Engineering, Wiley
	eResources addresses	Adresy na platformie eNauczanie:
Example issues/ example questions/ tasks being completed		
Work placement	Not applicable	