GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Kalman Filters and Stochastic Control, PG_00048447					
Field of study	Automatic Control, Cybernetics and Robotics					
Date of commencement of studies	February 2023		Academic year of realisation of subject		2023/2024	
Education level	second-cycle studies		Subject group		Optional subject group 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		1.0	
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		prof. dr hab. inż. Maciej Niedźwiecki			
	Teachers		prof. dr hab. inż. Maciej Niedźwiecki			

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	0.0	0.0	0.0	15
	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	15	2.0	8.0	25

Subject objectives	Introducing design methods for regulation systems working in random conditions.

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	Students know basic kinds of random processes and Markow's decision problems	[SW1] Assessment of factual knowledge [SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SK5] Assessment of ability to solve problems that arise in practice
	[K7_W05] Knows and understands, to an increased extent, methods of process and function support, specific to the field of study.	The student has advanced knowledge about the method of supporting processes and functions related to the field of study	[SW1] Assessment of factual knowledge

Subject contents	1. Principles of minimum variance (MV) control 2. MV regulators for ARMAX systems 3. Stability of MV regulators 4. Diophantine equations and their solutions 5. MV tracking of a reference signal 6. Limitations and drawbacks of MV control 7. Moving average (MA) control 8. Linear quadratic (LQ) control principles 9. Design of LQ regulators 10. Principles of minimum variance estimation 11. Introduction to Kalman filtering – conditional densities of Gaussian variables 12. Prediction, filtration and smoothing of stochastic signals 13. Kalman predictor and Kalman filter 14. Properties of Kalman filter 15. Stationary Kalman filter – Wiener filter 16. Kalman filter as an optimal state observer 17. Application of Kalman filter to airplain tracking 18. Numerical safeguards used in Kalman filtering 19. Extended Kalman filter (EKF) 20. Application of EKF to localization of an automous guided vehicle 21. LQ regulators in state space 22. Separation theorem 23. Robustness of LQ regulators

Prerequisites and co-requisites	

Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Midterm colloquium	50.0%	100.0%

Recommended reading	Basic literature	Lewis F., "Optimal Estimation", Wiley, 1986
	Supplementary literature	No requirements
	eResources addresses	Adresy na platformie eNauczanie: Filtry Kalmana i sterowanie w warunkach losowych - sem. zim. 2023/2024 - Moodle ID: 33522 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33522

Example issues/ example questions/ tasks being completed	

Work placement	Not applicable