



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	<ol style="list-style-type: none"> 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 airplane tracking 18. Numerical safeguards used in Kalman filtering 19. Extended Kalman filter (EKF) 20. Application of EKF to localization of an autonomous 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		