GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Kalman Filters and Stochastic Control, PG_00047503		
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	English
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 the basics of Kalman filtration and various forms of implementation of filtration algorithms. Students are able to design minimal-variant controllers and linear-square controllers working in conditions of incomplete information about the state of the controlled object.	[SW1] Assessment of factual knowledge
[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	see table below
Recommended reading	see table below
Example issues/ example questions/ tasks being completed	
Work placement	Not applicable

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: Kalman filters and stochastic control - winter 2023/2024 - Moodle ID: 33523 https://enauczanie.pg.edu.pl/moodle/course/view.php?id=33523