

## § 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 Autom	atic Control ->	Faculty of Electronics, Telecommunications and Informatics						
Name and surname	Subject supervisor		prof. dr hab. ir	nż. Maciej Nieć	lźwiecki				
of lecturer (lecturers)	Teachers		prof. dr hab. i	nż. Maciej Niec	dźwieck	i			
Lesson types and methods	Lesson type	Lecture	Tutorial	Laboratory	Projec	:t	Seminar	SUM	
of instruction	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	earning activity Participation ir classes includ plan		i didactic Participation in ed in study consultation hours		Self-study S		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		Subj	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	<ol> <li>Principles of minimum variance (MV) control</li> <li>MV regulators for ARMAX systems</li> <li>Stability of MV regulators</li> <li>Diophantine equations and their solutions</li> <li>MV tracking of a reference signal</li> <li>Limitations and drawbacks of MV control</li> <li>Moving average (MA) control</li> <li>Linear quadratic (LQ) control principles</li> <li>Design of LQ regulators</li> <li>Principles of minimum variance estimation</li> <li>Introduction to Kalman filtering – conditional densities of Gaussian variables</li> <li>Prediction, filtration and smoothing of stochastic signals</li> <li>Kalman predictor and Kalman filter</li> <li>Properties of Kalman filter – Wiener filter</li> <li>Kalman filter as an optimal state observer</li> <li>Application of Kalman filter to airplain tracking</li> <li>Numerical safeguards used in Kalman filtering</li> <li>Extended Kalman filter (EKF)</li> <li>Application of EKF to localization of an automous guided vehicle</li> <li>LQ regulators in state space</li> <li>Separation theorem</li> <li>Robustness of LQ regulators</li> </ol>					
Prerequisites and co-requisites						
Assessment methods	Subject passing criteria	Passing threshold	Percentage of the final grade			
and criteria	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				
Example issues/ example questions/ tasks being completed						
Work placement	Not applicable					