

GDAŃSK UNIVERSITY

Subject card

Subject name and code	Random Processes and Mathematical Statistics, PG_00048458								
Field of study	Automatic Control, Cybernetics and Robotics								
Date of commencement of studies	February 2023		Academic year of realisation of subject			2022/2023			
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	1		ECTS credits			2.0			
Learning profile	general academic profile		Assessment form			exam			
Conducting unit	Department of Teleinformation Networks -> Faculty of Electronics, Telecommunications and Informatics						ormatics		
Name and surname	Subject supervisor		dr inż. Mariusz Domżalski						
of lecturer (lecturers)	Teachers		dr inż. Mariusz Domżalski						
Lesson types and methods	Lesson type	Lecture	Tutorial	Laboratory	Projec	t	Seminar	SUM	
of instruction	Number of study hours	15.0	15.0	0.0	0.0		0.0	30	
	E-learning hours included: 0.0								
Learning activity and number of study hours	Learning activity	Participation in classes includ plan	n didactic ed in study	Participation in consultation hours		Self-study		SUM	
	Number of study hours	30		4.0		16.0		50	
Subject objectives	Knowledge of basic methods of random processes analysis and basics of mathematical statistics.								
Learning outcomes	Course outcome		Subject outcome			Method of verification			
	[K7_U03] can design, according to required specifications, and make a complex device, facility, system or carry out a process, specific to the field of study, using suitable methods, techniques, tools and materials, following engineering standards and norms, applying technologies specific to the field of study and experience gained in the professional engineering environment		Student identifies, classifies and describes basic types of random processes, analyses their properties, calculates parameters and characteristics of random processes. Student describes principles of parameter estimation, properties of estimators, principles of hypotheses verification, calculates estimates and verifies statistical hypotheses.			[SU4] Assessment of ability to use methods and tools [SU1] Assessment of task fulfilment			
	[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		Student identifies, classifies and describes basic types of random processes, analyses their properties, calculates parameters and characteristics of random processes. Student describes principles of parameter estimation, properties of estimators, principles of hypotheses verification, calculates estimates and verifies statistical hypotheses.			[SW1] Assessment of factual knowledge			

Subject contents	1. One-dimensional random variables- discrete, analog, mixed- common description with the aid of generalized probability density function, statistical moments, cumulants, characteristc function, generating function 2. Random vectors- real and complex, description methods, statistical moments- auto-correlation matrix and auto-covariance matrix and their properties; cross-correlation matrix and cross-covariance matrix and their properties 3. Linear transformations of random vectors and their properties 4. Diagonalization of auto-covariance matrix with the aid of unitary method; use of singular value decomposition of data matrix 5. Diagonalization of auto-correlation matrix and auto-covariance matrix with the aid of triangular method; use of QR decomposition of data matrix. 6. Definition and classification of random processes (RP); ensemble of realizations averaging method; cumulative probability distribution function, probability density function of RP. 7. Moments of RP, autocorrelation function, probability density function of RP. 7. Moments of RP, autocorrelation function, autocovariance function, cross-correlation and cross-covariance functions, RP stationarity in wide-and strict-sense; other stationarity definitions; RP ergodicity; time-averages. 8. RP examples- Bernoulli, binomial, random walking, discrete Wiener, Markov . Periodic RP, cycle-stationary RP. Gauss RP. 9. Markov chains (MC)- homogenity and stationarity of MC, classification of states; Kolmogorov-Chapman equation, random walking RP as MC. 10. Description of RP in frequency domain- power spectral density and its properties, investige and walker equations. 14. Properties of MA, AR and ARMA RP- autocorrelation function, Youle-Walker equations. 14. Properties of MA, AR and ARMA RP- autocorrelation function, youle-Walker equations. 14. Properties of MA, AR and ARMA RP- power density functions. 15. Methods of estimation, point and interval estimation, estimation of autocorrelation function matrix. 17. Estimation of power density function of RP- cor						
Prerequisites and co-requisites	No requirements						
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade				
	Midterm colloquium	50.0%	100.0%				
Recommended reading	Basic literature	A. Papoulis, Probability, Random Variables, and Stochastic Processes, McGraw-Hill, 1991 Hwei P. Hsu, Theory and Problems of Probability, Random Variables and Random Processes, McGraw-Hill, 1997					
	Supplementary literature	Therrien, C. W. Discrete Random Signals and Statistical Signal Processing. Prentice-Hall, 1992.					
	eResources addresses	Adresy na platformie eNauczanie:					
Example issues/ example questions/ tasks being completed	For random process $\underline{X}(t)=\underline{A} \sin(\omega_0 t)+\underline{B} \cos(\omega_0 t)$, where \underline{A} and \underline{B} are independent random variables calculate mean value, auto-correlation function, auto-covariance function and answer the question: is this random process wide-sense stationary?						
Work placement	Not applicable						