GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Random Processes, PG_00047425		
Field of study	Electronics and Telecommunications		
Date of commencement of studies	October 2023	Academic year of realisation of subject	2024/2025
Education level	second-cycle studies	Subject group	Obligatory subject group in the field of study 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	2	Language of instruction	English
Semester of study	3	ECTS credits	2.0
Learning profile	general academic profile	Assessment form	assessment
Conducting unit	Department of Teleinformation Networks -> Faculty of Electronics, Telecommunications and Informatics		
Name and surname of lecturer (lecturers)	Subject supervisor	dr inż. Bartosz Czaplewski	
	Teachers	dr hab. inż. Roman Rykaczewski dr inż. Bartosz Czaplewski	

Lesson types and methods of instruction

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
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 didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	30	4.0	16.0	50

Subject objectives

Knowledge of basic properties of random processes and obtaining skills of computing and analysing of random processes characteristics.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K7_W01] Knows and understands, to an increased extent, mathematics to the extent necessary to formulate and solve complex issues related to the field of study.	Student knows basic kinds and properties of random processes	[SW1] Assessment of factual knowledge
[K7_U01] can apply mathematical knowledge to formulate and solve complex and non-typical problems related to the field of study by:n- appropriate selection of source information and its critical analysis, synthesis, creative interpretation and presentation,n- application of appropriate methods and toolsn	Student identifies, classifies and describes basic types of random processes, analyses their properties, calculates parameters and characteristics of random processes.	[SU1] Assessment of task fulfilment [SU4] Assessment of ability to use methods and tools

<table>
<tr><td>Subject contents</td><td>1. Random vectors (RV). Complex RV- mathematical description. Statistical moments for one RV. Autocorrelation matrix and auto-covariance matrix and their properties. 2. Cross-correlation and cross-covariance matrices and their properties. Conditional moments. Histograms. 3. Estimation of RV function moments. Estimation of the autocorrelation matrix and the autocovariance matrix of RV. Data matrix definition and properties. 4. Gaussian RV. Linear transformation of RV. Unitary transformation. Probability density function (PDF) of linear transformed RV. 5. Diagonalization of the autocorrelation matrix and the autocovariance matrix of RV- unitary transformation method.Data matrix Singular Value Decomposition (SVD) and its use for unitary diagonalization of autocorrelation matrix. 6. Diagonalization of the autocorrelation matrix with the aid of triangular matrix decomposition- Cholesky L-U decomposition and QR matrix decomposition. 7. Random process (RP) definition and examples of RP. RP description as a set of realizations. Method of averaging on the set of RP realizations. PDF and distribution function of RP. 8. Statistical moments of RP. Stationarity and ergodicity of RP. Properties of stationary RP. Other definitions of RP stationarity. 9. Examples of RP- Bernoulli RP, binomial RP, random walking RP, discrete Wiener RP, Markov RP. 10. Markov chains (MC) – homogenity and stationarity of MC, state classification, Kolmogorov-Chapman equation, random walking RP as MC. 11. Hidden Markov chain model. Periodity and cyclostationarity of RP. Gaussian RP. Correlation analysis of complex RP. Autocorrelation matrix and autocovariance matrix of RP. 12. Description of RP in frequency domain- power spectral density (PSD) function and its properties, physical interpretation. Sampling theorem for RP. White noise, pass-band white noise, discrete white noise. 13. Maximum likelihood estimation method. Properties of estimators. Cramer-Rao inequality. Estimation of mean value and autocorrelation function of stationary RP- biased and non-biased estimator. 14. PSD estimation- periodogram and its properties. 15. Passing RP through linear and non-linear systems. Derivative and integral of RP.</td></tr>
<tr><td>Prerequisites and co-requisites</td><td>No requirements</td></tr>
<tr><td>Assessment methods and criteria</td><td>
<table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Midterm colloquium</td><td>50.0%</td><td>100.0%</td></tr>
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<tr><td>Recommended reading</td><td>
<table>
<tr><td>Basic literature</td><td>A. Papoulis, Probability, Random Variables, and Stochastic Processes, McGraw-Hill, 1991 Therrien, C. W. Discrete Random Signals and Statistical Signal Processing. Prentice-Hall, 1992. Hwei P. Hsu, Theory and Problems of Probability, Random Variables and Random Processes, McGraw-Hill, 1997.</td></tr>
<tr><td>Supplementary literature</td><td>No requirements</td></tr>
<tr><td>eResources addresses</td><td>Adresy na platformie eNauczanie:</td></tr>
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<tr><td>Example issues/ example questions/ tasks being completed</td><td></td></tr>
<tr><td>Work placement</td><td>Not applicable</td></tr>
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