GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Stochastic processes, PG_00021038		
Field of study	Mathematics		
Date of commencement of studies	October 2022	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	6.0
Learning profile	general academic profile	Assessment form	exam
Conducting unit	Department of Probability Theory and Biomathematics -> Faculty of Applied Physics and Mathematics		
Name and surname of lecturer (lecturers)	Subject supervisor	prof. dr hab. inż. Tomasz Szarek	
	Teachers	prof. dr hab. inż. Tomasz Szarek	

Lesson types and methods of instruction	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	45.0	0.0	0.0	0.0	30.0	75
	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	75	5.0	70.0	150

Subject objectives	Introduction to basic notions and theorems of the theory of stochastic processes. Equipping a student in the knowledge supporting modelling of the dynamics of random phenomenon.

Learning outcomes

Course outcome	Subject outcome	Method of verification
K7_W04	Extends real stochastic processes to general random elements.	[SW1] Assessment of factual knowledge
K7_U05	Evaluates characteristics of stochastic processes using methods of measure theory and Lebesgue integral.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject
K7_U11	Constructs risk models of selected problems in non-life and life insurance.	[SU2] Assessment of ability to analyse information
K7_W05	Finds analytical formulae for transition probabilities after elapsed time t.	[SW1] Assessment of factual knowledge
K7_U08	Describes families of finite dimensional distributions using classical probability measures.	[SU3] Assessment of ability to use knowledge gained from the subject

Subject contents

LECTURES Revision of selected parts of probability theory and introduction of notion. Moment generating function and its properties. Stochastic processes - definition and examples. Finite dimensional distributions of a stochastic process. Homogeneous Poisson process. Non - homogeneous Poisson process. Markov chains. Branching processes. Martingales. Doob Theorem. Renewal processes. Classical Brownian motion process. Gaussian processes. Trajectories of a classical Brownian motion and their properties. Diffusion processes. Kolmogorov Theorem.

SEMINARS Revision of methods of probability theory. Sequences of random variables (exponential, Bernoulli, geometrical) and their asymptotic properties. Moment generating function. Random walks. Markov chains. Poisson processes. Renewal processes. Stochastic matrices. Ergodic theory of Markov operators. Reversible chains. Markov semigroups and their generators. Martingales. Stationary processes. Gaussian processes.

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="2">Courses completed: Probability Theory (MAT1013)</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="2">

Subject passing criteria	Passing threshold	Percentage of the final grade
Tests	51.0%	50.0%
Exam	51.0%	30.0%
Research project	51.0%	20.0%

</td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>S.Ross, Stochastic Processes, John Wiley and Sons, New York, 1996.

I.I.Gichman, A.W.Skorochod, Wstęp do teorii procesów stochastycznych, PWN, Warszawa, 1968.

G.Grimmett, D.Stirzaker, Probability and Random Processes, Oxford University Press, 2006.</td></tr>
<tr><td>Supplementary literature</td><td>J.Jakubowski, R.Sztencel, Wstęp do teorii prawdopodobieństwa, Wydawnictwo SCRIPT, Warszawa, 2012.

W.Feller, Wstęp do rachunku prawdopodobieństwa, t.I i II, PWN, Warszawa, 2014.

J.R.Norris, Markov Chains, Cambridge University Press, Cambridge, 2007.

S.R.S.Varadhan, Stochastic Processes, AMS, Rhode Island, 2007.</td></tr>
<tr><td>eResources addresses</td><td>Podstawowe
https://enauczanie.pg.edu.pl/moodle/course/view.php?id=26946 -
Adresy na platformie eNauczanie:</td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">At the beginning of the term the student is provided with the list of problems and exercises to be solved. The student presents his/her solutions on the seminar accordingly to a fixed schedule. Tests problems are selected from mentioned lists and the exam on topics from lectures.

Evaluate the extinction/ruin probability. Find stationary distribution. Find one-parameter semigroup from its generator. Classify states. Verify whether a given process is a martingale. Verify the strong Markov property.</td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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