

Subject card

Subject name and code	Introduction to Stochastic Differential Equations, PG_00170283						
Field of study	Mathematical Modeling and Data Analysis						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2025/2026		
Education level	Master's studies		Subject group				
Mode of study	full-time studies		Mode of delivery		at the university		
Year of study	1		Language of instruction		Polish		
Semester of study	2		ECTS credits		6.0		
Learning profile	academic		Assessment form		exam		
Conducting unit	Institute of Mathematics -> Faculty of Mathematics, Physics and Informatics -> Rector						
Name and surname of lecturer (lecturers)	Subject supervisor		dr Monika Wrzosek				
	Teachers						
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	30.0	30.0	0.0	0.0	0.0	60
	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	60		10.0		80.0	150
Subject objectives	The aim of the course is to familiarize students with the theory of stochastic differential equations and selected properties of solutions to stochastic differential equations.						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[MMiADMU2_U06] is able to apply methods and examples from a selected field of mathematics in related fields	Is able to apply methods or examples from the theory of stochastic differential equations in related fields.	[SU4] test/exam - oral or written
	[MMiADMU2_K02] is ready to precisely formulate questions to deepen his own understanding of a given topic or to find missing elements of reasoning	The student is ready to precisely formulate questions concerning stochastic differential equations.	[SK8] observation of student's independent or team work
	[MMiADMU2_K01] is ready to recognize the limitations of his own knowledge and is ready to continue his education	is willing to acknowledge the limitations of his/her own knowledge and is willing to pursue further education	[SK8] observation of student's independent or team work
	[MMiADMU2_U04] can, at an advanced level and including modern mathematics, apply and present in speech and in writing the methods of at least one selected branch of mathematics	is able to apply methods learned in the stochastic differential equations course	[SU4] test/exam - oral or written
	[MMiADMU2_U03] can understand mathematical texts from selected areas of mathematics	can understand texts on the theory of stochastic differential equations	[SU8] observation of student's independent or team work
	[MMiADMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in the actions of himself and others; is ready to act ethically	is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; ethical conduct	[SK8] observation of student's independent or team work
	[MMiADMU2_U07] is able to define his interests and develop them; in particular, is able to establish contact with specialists in their field, e.g. understand their lectures intended for young mathematicians	is able to independently supplement knowledge of the theory of stochastic differential equations	[SU8] observation of student's independent or team work
	[MMiADMU2_K06] is ready to form an opinion on basic mathematical issues	The student is able to formulate opinions on stochastic differential equations.	[SK8] observation of student's independent or team work
	[MMiADMU2_U01] can construct mathematical reasoning: prove theorems and disprove hypotheses by constructions and selecting counterexamples	Is able to prove theorems from the theory of stochastic differential equations	[SU4] test/exam - oral or written
	[MMiADMU2_W01] knows and understands in-depth the theory of selected areas of mathematics	The student knows the theorem on the existence and uniqueness of solutions to stochastic differential equations.	[SW4] test/exam - oral or written
	[MMiADMU2_W02] knows and understands well the role and importance of the construction of mathematical reasoning	knows selected proofs from the theory of stochastic differential equations	[SW4] test/exam - oral or written
	[MMiADMU2_K05] is ready to independently search for information in literature, also in foreign languages	is ready to search for additional information in the literature on the theory of stochastic differential equations	[SK8] observation of student's independent or team work
Subject contents	1. The Ito process and Ito's lemmas. 2. Solution of a linear stochastic differential equation. 3. Theorem on the existence and uniqueness of a strong solution to the stochastic differential equation in the space of Ito processes. 4. The concept of a weak solution of a stochastic differential equation. 5. Properties of solutions of stochastic differential equations. 6. Diffusion generator, Dynkin formula, Feynman-Kac formula.		
Prerequisites and co-requisites	Basics of the theory of stochastic processes.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	observation of the student's attitude	51.0%	0.0%
	final exam	51.0%	50.0%
	student's activity	51.0%	5.0%
	tests	51.0%	45.0%
Recommended reading	Basic literature	1. F. C. Klebaner, Introduction to Stochastic Calculus with Applications, ICP 2005. 2. B. Øksendal, "Stochastic Differential Equations: An Introduction with Applications." Springer, 2003.	

	Supplementary literature	1. Z. Brzeźniak, T. Zastawniak, "Basic Stochastic Processes", Springer, 1999. 2. J. Cyganowski, P. Kloeden, J. Ombach, "From Elementary Probability to Stochastic Differential Equations with Maple", Springer, 2002. 3. W. Feller, "Wstęp do rachunku prawdopodobieństwa", t. I i II, PWN, Warszawa 1977. 4. A.D. Wentzell, "Wykłady z teorii procesów stochastycznych", PWN, Warszawa 1980.
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Example issues/ example questions/ tasks being completed	Not included	
Work placement	Not applicable	

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