

Subject card

Subject name and code	Introduction to Stochastic Differential Equations, PG_00155561						
Field of study	Mathematics						
Date of commencement of studies	October 2025		Academic year of realisation of subject		2026/2027		
Education level	Master's studies		Subject group		Obligatory subject group in the field of study Optional subject group		
Mode of study	full-time studies		Mode of delivery		at the university		
Year of study	2		Language of instruction		Polish		
Semester of study	4		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
	[MATMU2_W02] knows and understands well the role and importance of the construction of mathematical reasoning	The student knows the concept of stochastic differential equation and its integral representation.	[SW4] test/exam - oral or written
	[MATMU2_W03] knows and understands in-depth a selected field of theoretical or applied mathematics and is able to understand the formulations of issues in this field that are still at the research stage and knows the connections of issues in this field with other areas of mathematics	The student knows the theorem of existence and uniqueness of solutions to stochastic differential equations.	[SW4] test/exam - oral or written
	[MATMU2_U01] can construct mathematical reasoning: prove theorems and refute hypotheses through construction and selection of counterexamples	The student is able to use the known proof methods and methods of solving tasks, and uses the learned concepts correctly.	[SU4] test/exam - oral or written
	[MATMU2_W01] knows and understands in-depth the theory of selected areas of mathematics	The student knows and understands the elements of stochastic analysis, in particular theorems that are the subject of the lecture along with appropriate definitions, examples and proofs.	[SW4] test/exam - oral or written
	[MATMU2_K05] is ready to independently search for information in literature, also in foreign languages	The student is ready to independently search for information in the literature.	[SK8] observation of student's independent or team work
	[MATMU2_U06] is able to apply methods and examples from a selected field of mathematics in related fields	The student is able to use the known proof methods and methods of solving tasks, and uses the learned concepts correctly.	[SU4] test/exam - oral or written
	[MATMU2_U05] can perform proofs in a selected field and, if necessary, also use tools from other areas of mathematics	The student is able to use the known proof methods and methods of solving tasks, and uses the learned concepts correctly.	[SU4] test/exam - oral or written
	[MATMU2_K02] is ready to precisely formulate questions to deepen his/her understanding of a given topic or find missing elements of reasoning	The student is ready to precisely formulate questions regarding stochastic differential equations.	[SK8] observation of student's independent or team work
	[MATMU2_K01] is willing to acknowledge the limitations of his or her own knowledge and is willing to pursue further education	The student is ready to recognize the limitations of his or her own knowledge and to pursue further education.	[SK8] observation of student's independent or team work
	[MATMU2_U03] can understand mathematical texts of various types from selected fields of mathematics	The student demonstrates an understanding of mathematical reasoning in the field of stochastic differential equations.	[SU4] test/exam - oral or written
	[MATMU2_U07] is able to define his/her interests and develop them; in particular, is able to establish contact with specialists in his/her field, e.g. understand their lectures intended for young mathematicians	The student can establish contacts with specialists in their field, e.g. understand their lectures intended for young mathematicians	[SU8] observation of student's independent or team work
	[MATMU2_K06] is ready to formulate opinions on basic mathematical issues	The student is able to formulate opinions about stochastic differential equations.	[SK8] observation of student's independent or team work
	[MATMU2_K04] is ready to understand and appreciate the importance of intellectual honesty in one's own and other people's actions; ethical conduct	The student understands the importance of intellectual honesty and ethical conduct.	[SK8] observation of student's independent or team work
	[MATMU2_U04] is able, at an advanced level and including modern mathematics, to apply and present, orally and in writing, methods of at least one selected branch of mathematics	The student is able to use the known proof methods and methods of solving tasks, and uses the learned concepts correctly.	[SU4] test/exam - oral or written

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%
	student's activity	51.0%	5.0%
	final exam	51.0%	50.0%
	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.	
	eResources addresses		
Example issues/ example questions/ tasks being completed	Not applicable		
Work placement	Not applicable		

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