Course description

Course title	Course code
Stochastic analysis	

Lecturer	Department where the course is delivered
Dr. Antanas Lenkšas	Department of Mathematical Analysis Faculty of Mathematics and Informatics Naugarduko St. 24, LT-03225 Vilnius, Lithuania

Cycle		Type of course
Second		Compulsory

Mode of delivery	Semester or period when the course is delivered	Language of instruction
Face-to-face or distance learning	1st semester (Fall)	English, Lithuanian

Prerequisites and corequisites	
Prerequisites: Probability theory course (min 6 ECTS credits), calculus (one and several variables, min 16 ECTS credits)	**Corequisites (if any):** Minimal knowledge of elements of functional analysis is preferred

Number of ECTS credits	Student's workload	Contact hours	Individual work hours
5	125	48	77

Course objectives: programme competences to be developed		
The course gives the main principles of stochastic differential equations with driving Brownian motion, their applications, and modeling.		
Learning objectives	**Learning objectives**	**Learning objectives**
Operating with the main concepts of the theory of stochastic integration and stochastic differential equations.	Operating with the main concepts of the theory of stochastic integration and stochastic differential equations. Skills in constructing, analyzing, and simulating stochastic models.	Operating with the main concepts of the theory of stochastic integration and stochastic differential equations. Skills in constructing, analyzing, and simulating stochastic models.
Skills in constructing, analyzing, and simulating stochastic models.		
A critical evaluation of current problems and research issues in the fields of probability and stochastic processes, stochastic analysis		

Course content: breakdown of the course	Individual work hours and assignments				
	Lectures	Recitation hours	**Total contact hours**	**Individual work hours**	**Assignments**
1. 1. Brownian motion (BM). Quadratic variation of a BM. Discrete- and continuous-time models and stochastic differential equations (SDEs). [1], Chs. 2-3.	4	2	**6**	**8**	Solving the problems from [1]; individual study of recommended readings [3], Chapters 2-3; [4], Chapter 3.
2. Stochastic integral (SI) with respect to a BM. [1], Ch. 4.	4	2	**6**	**8**	
3. Itô's formula for a BM. [1], Ch. 5.	4	2	**6**	**8**	
4. SDEs. The existence and uniqueness of a solution. [1], Ch. 6.	2		**2**	**4**	
5. Itô processes and SIs with respect to them. Itô's formula for an Itô process. [1], Ch. 7.	5	3	**8**	**8**	
6. Stratonovich integral and equations. [1], Ch. 8.	4	2	**6**	**8**	
7. Linear SDEs. The expectation and variance of a solution of a linear SDE. [1], Ch. 9.	4	2	**6**	**8**	
8. Solutions of SDEs as Markov processes. Kolmogorov equations. Stationary density. Application examples. [1], Chs. 10-11.	5	3	**8**	**8**	
Preparation for exam and examination.				**17**	
Total	**32**	**16**	**48**	**77**	

Assessment strategy	**Weight**	**Time of assessment**	**Criteria**
Common evaluation scheme. The final mark (not exceeding 10) equals the sum of points (rounded to the nearest integer) obtained in written exam and practical training plus one.			
Written exam	80-100%	2.5 h	The final examination includes 1-2 theoretical questions (6 points) and 4 problems (4x1 points).
Problem solving	0-20%	Practical training	Additional points for test results and activity at the lectures and practical training (up to 2 points).

Author	**Publ. year**	**Title**	**Volume**	**Publisher**
Required reading				
1. V. Mackevičius	2011	Introduction to Stochastic Analysis: Integrals and Differential Equations		London, ISTE/Wiley
2. V. Mackevičius	2005	Stochastic Analysis (in Lithuanian)		Vilnius: Vilnius University Press
Recommended reading				
3. T. Mikosch	1998	An Elementary Introduction to Stochastic Calculus with a View Toward Finance		World Scientific, Singapore
4. D. Lamberton and B. Lapeyer	2000	Introduction to Stochastic Analysis applied to Finance		Chapman & Hall, London.