Course description

Department/Unit /	KMA / SP			**Academic Year**	2023/2024
Title	Stochastic Processes			**Type of completion**	Exam
Accredited/Credits	Yes, 5 Cred.			**Type of completion**	Combined
Number of hours	Lecture 2 [Hours/Week] Tutorial 2 [Hours/Week]				
Occ/max	Status A	Status B	Status C	**Course credit prior to**	YES
Summer semester	0 / -	0 / -	0 / -	**Counted into average**	YES
Winter semester	0 / -	0 / -	0 / -	**Min. (B+C) students**	1
Timetable	Yes			**Repeated registration**	NO
Language of instruction	Czech			**Semester taught**	Summer semester
Optional course	Yes			**Internship duration**	0
Evaluation scale	1|2|3|4			**Ev. sc. – cred.**	S|N
No. of hours of on-premise					
Auto acc. of credit	No				
Periodicity	K				
Substituted course	None				
Preclusive courses	KMA/SP-A				
Prerequisite courses	N/A				
Informally recommended courses	N/A				
Courses depending on this Course	KMA/SZMZ				

Course objectives:

The aim of this course is to introduce basic stochastic processes with continuous time and a general state space (in particular, Markov processes) emplozing the methods of stochastic analysis.

Requirements on student

Students have to write an assignment on given topic (cca 4-8 pages long) or elaborate corresponding number (cca 6) of homeworks and present the results (15 minutes talk) in the last week of the term. Assesment of the written assignment and its oral presentation will create 40% of the final mark.
Final examination consists of written test (30%) and oral examination (30%).

Knowledge and abilities assessed: All assessment tasks will assess the learning outcomes, especically, the ability to provide logical and coherent proofs of results and specific problems related to stochastic processes.

Assessment criteria: The main criteria for marking will be clear and logical formulation of solution methods and correctness of obtained results.

Content

1. Basic notions of probability theory-recollection, the concept of conditional expectation and stochastic (random) process.
2.-3. Some frequently used processes-Brownian motion and fractional Brownian motion, processes with jumps, Levy process.
4. Martingales, definition, some properties and applicability of the martingale theory.
5.-6. Continuous-time Markov processes with a general state space, definition and basic properties. Transition densities, examples-SDE
7.-8. Diffusion processes and models, relation to partial differential equations, Kolmogorov and Fokker-Planck equation. Feynman-Kac formula-killing.
9. Random stopping times and the strong Markov property, the Feller property-continuous dependence on initial data
10.-11. Stationary (equilibrium) states ? invariant measures, recurrence and transience, sufficient conditions for solutions to SDE
12-13. Convergence to the stationary state, nondegenerating SDE

Fields of study

Guarantors and lecturers

- **Guarantors:** Doc. Ing. Jan Pospíšil, Ph.D. (100%)

Literature

- **Basic:** Mandl, Petr. *Pravděpodobnostní dynamické modely : celost. vysokošk. učebnice pro stud. matematicko-fyz. fakult stud. oboru pravděpodobnost a matem. statistika*. Praha : Academia, 1985.
- **Basic:** Maslowski, Bohdan. *Stochastic Equations and Stochastic Methods in PDE's*. Plzeň, 2006.
- **Basic:** Štěpán, Josef. *Teorie pravděpodobnosti : Matematické základy : Vysokošk. učebnice pro stud. matematicko-fyz. fakult*. Praha : Academia, 1987.
- **Basic:** Prášková, Zuzana; Lachout, Petr. *Základy náhodných procesů*. Praha : Karolinum, 1998. ISBN 80-7184-688-0.

Time requirements

All forms of study

Activities	Time requirements for activity [h]
Contact hours	52
Individual project (40)	40
Preparation for an examination (30-60)	40
Total:	**132**

assessment methods

Knowledge - knowledge achieved by taking this course are verified by the following means:

Oral exam

Written exam

Seminar work

Individual presentation at a seminar

prerequisite

Knowledge - students are expected to possess the following knowledge before the course commences to finish it successfully:

Students should have a basic knowledge of probability theory (KMA/PSA), fundamentals of random processes (KMA/ZNP) and of introduction to stochastic analysis (KMA/USA).

teaching methods

Knowledge - the following training methods are used to achieve the required knowledge:

Lecture supplemented with a discussion

Interactive lecture

Students' portfolio

learning outcomes

Knowledge - knowledge resulting from the course:

Students taking this course will be able to understand the mathematical background of stochastic processes and namely
- recognize which stochastic processes are appropriate and needed for modelling randomness in a given research problem

- apply stochastic processes to practical problems
- analyze the usefulness of stochastic processes in professional area
- provide logical and coherent proofs of theoretic results
- solve problems via abstract methods
- apply correctly formal and rigorous competency in mathematical presentation, both in written and verbal form.

Course is included in study programmes: