WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

FACULTY OF FACULTY OF PURE AND APPLIED MATHEMATICS

SUBJECT CARD

Course name in Polish **Całka Stochastyczna i Teoria Martyngałów**

Course name in English **Stochastic Integrals and Theory of Martingales**

Course language **English**

University-wide general course type:
1) basic course (mathematics, physics, chemistry, other)
2) humanity course
3) managerial skills
4) English language
5) other modern language

Departmental course developing professional skills:
1) **specialized course**
2) interdisciplinary course
3) seminar (interdisciplinary, specialized, departmental)

Type of course (obligatory, optional)

Educational effects according to ZW 26/2017 regulations: P8S_WG, P8S_UW, P8S_KK, P8S_KR

Subject code **MAT1309**

*delete as applicable

	Lecture
Number of hours of organized classes in University (ZZU)	30
Number of hours of total student workload (CNPS)	90
Form of crediting	Exam
Number of ECTS points	3
including number of ECTS points for practical (P) classes	
including number of ECTS points for direct teacher-student contact (BK) classes	2

PREREQUISITES RELATING TO KNOWLEDGE, SKILLS AND OTHER COMPETENCES

1. Knowledge of probability theory and basic stochastic processes
2. Competences in reaching complementary areas of knowledge and skills

SUBJECT OBJECTIVES	
C1	The student will get acquainted with selected concepts and results in the theory of stochastic integration and martingale theory.
C2	The student will acquire the ability to use the stochastic integral and martingales in stochastic analysis.

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SUBJECT EDUCATIONAL EFFECTS

Relating to knowledge:

PEK_W01 – Has knowledge of martingales and stochastic integrals.

PEK_W02 – Has knowledge about the use of martingales and stochastic integrals in stochastic analysis.

Relating to skills:

PEK_U01 – Has skills related to the methodology and methodology of scientific research.

PEK_U02 – Is able to create and conduct scientific research independently.

Relating to social competences:

PEK_K01– Is aware of the role of cooperation, including international cooperation.

PEK_K02– Is aware of the importance of conducting the original scientific activity.

PROGRAM CONTENTS		
Form of classes – lecture		Number of hours
Lec 1	Filtration, conditional expectation, martingale	2
Lec 2	Convergence of martingales	2
Lec 3	Burkholder-Gundy inequality	2
Lec 4	Random Poisson measures	2
Lec 5	Mecke-Palm formula	2
Lec 6	Martingales defined by integrals against Poisson measures	2
Lec 7	The Lévy-Itô construction of Lévy's processes	2
Lec 8	Lévy system for Markov processes	2
Lec 9	Elements of Malliavin calculus for jump processes	2
Lec10	Brownian motion	2
Lec11	White noise and Hermite polynomials	2
Lec12	Orthogonal random measures	2
Lec13	Stochastic integration against orthogonal random measures	2
Lec14	Elements of Malliavin calculus for the Brownian motion	2
Lec15	Stochastic differential equations and Wagner-Platen expansions	2
	Total hours	**30**

TEACHING TOOLS USED	
N1	Lecture
N2	Office hours
N3	Written work: solving exercises and problems

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EVALUATION OF ACHIEVED SUBJECT EDUCATIONAL EFFECTS		
Evaluation: F – forming (partial) C – concluding	Educational effect number	Way of evaluating achievement of educational effects
F1	PEK_U01, PEK_U02, PEK_W01, PEK_W02	Participation in lectures
F2	PEK_W01, PEK_W02, PEK_U01, PEK_U02, PEK_K01, PEK_K02	Solving exercises and problems
C=0.5*F1+0.5*F2		

PRIMARY AND SECONDARY LITERATURE

PRIMARY LITERATURE:

[1] Revuz, Daniel; Yor, Marc. Continuous martingales and Brownian motion. Grundlehren der Mathematischen Wissenschaften, 293. Springer-Verlag, Berlin, 1999.

[2] Schilling, René. Measures, Integrals and Martingales. Cambridge University Press, Cambridge, 2010.

[3] Schilling, René L. An introduction to Lévy and Feller processes. From Lévy-type processes to parabolic SPDEs, 1–126. Adv. Courses Math. CRM Barcelona, Birkhäuser/Springer, Cham, 2016.

SECONDARY LITERATURE:

[4] Bogdan, Krzysztof; Byczkowski, Tomasz; Kulczycki, Tadeusz; Ryznar, Michal; Song, Renming; Vondraček, Zoran. Potential analysis of stable processes and its extensions. Lecture Notes in Mathematics, 1980. Springer, 2009.

[5] Kallenberg, Olav. Foundations of Modern Probability, Springer, 2002.

[6] Kingman, J.F.H.. Procesy Poissona. Wydawnictwo Naukowe PWN, 2002.

[7] Ikeda, Nobuyuki; Watanabe, Shinzo. Stochastic Differential Equations and Diffusion Processes, North-Holland, 1981.

[8] Nualart, David. The Malliavin Calculus and Related Topics, Springer, 2006.

[9] Platen, Eckhard, Bruti-Liberati, Nicola. Numerical Solution of Stochastic Differential Equations with Jumps in Finance, Springer, 2010 (187-231).

[10] Privault, Nicolas. Stochastic analysis in discrete and continuous settings with normal martingales. Lecture Notes in Mathematics, 1982. Springer, 2009.

[11] Sato, Ken-iti. Lévy processes and infinitely divisible distributions. Cambridge Studies in Advanced Mathematics, 68. Cambridge University Press, 2013.

SUBJECT SUPERVISOR
(NAME AND SURNAME, E-MAIL ADDRESS)

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WROCŁAW UNIVERSITY OF TECHNOLOGY – PHD STUDIES

MATRIX OF CORRELATION BETWEEN EDUCATIONAL EFFECTS FOR SUBJECT

STOCHASTIC INTEGRALS AND THEORY OF MARTINGALES

AND EDUCATIONAL EFFECTS FOR MAIN FIELD OF STUDY

Doctoral studies at Faculty of Pure and Applied Mathematics

Subject educational effect	Correlation between subject educational effect and educational effects defined for main field of study and specialization (if applicable)**	Subject objectives***	Programme content***	Teaching tool umer***
(knowledge) PEK_W01	**P8S_WG**	C1	Lec1-Lec15	N1, N2, N3
PEK_W02	**P8S_WG**	C2	Lec1-Lec15	N1, N2, N3
(skills) PEK_U01	**P8S_UW**	C2	Lec1-Lec15	N2, N3
PEK_U02	**P8S_UW**	C2	Lec1-Lec15	N2, N3
(competences) PEK_K01	**P8S_KK**	C2	Lec1-Lec15	N2, N3
PEK_K02	**P8S_KR**	C2	Lec1-Lec15	N2, N3

** - enter symbols for main-field-of-study/specialization educational effects

*** - from table above