MASTER 'S PROGRAMME
APPLIED MATHEMATICS - IN ENGLISH
2ND YEAR OF STUDY, 2ND SEMESTER

COURSE TITLE	**FINANCIAL MARKET MODELLING. MARTINGALE METHODS**
COURSE CODE	**MA4MPF**
COURSE TYPE	full attendance/tutorial
COURSE LEVEL	2nd cycle (master's degree)
YEAR OF STUDY, SEMESTER	2nd year of study, 2nd semester
NUMBER OF ECTS CREDITS	**7**
NUMBER OF HOURS PER WEEK	4 (2 lecture hours + 2 seminar hours)
NAME OF LECTURE HOLDER	Dr. Rotenstein Eduard-Paul
NAME OF SEMINAR HOLDER	Dr. Rotenstein Eduard-Paul
PREREQUISITES	Curriculum: Analysis, Optimization theory, Probability theory, Differential Equations Competencies: the use of basic notions of nonlinear analysis and differential equations Language: advanced level of English

A GENERAL AND COURSE-SPECIFIC COMPETENCES

General competences:

- ✓ The use of informatics resources, the efficient use of carrier development; the making of a rigorous and clear mathematical project on a given theme
- ✓ The development of an efficient team work

Course-specific competences:

- ✓ The efficient use of notions, methods and mathematical models for economic framework applications
- ✓ The analysis of data provided by economic and informatics models
- ✓ The modelling, analysis and optimization of some phenomenon and economical processes
- ✓ Mathematical modelling and simulation of of finance and banking problems

B LEARNING OUTCOMES

- ✓ To build, to approximate and simulate real models which describe real financial processes using basic and advanced tools of mathematical analysis, combinatorics, probability theory and stochastic analysis
- ✓ After successfully completing this course, the students will be able to:
  - ✧ Identify and select adequate methods for solving linear and nonlinear optimization problems, which model processes from financial markets and banking issues
  - ✧ Know and use basic mathematical notions and tools used for the optimization of studied economical processes, in conformity to a minimal list related to the course content
  - ✧ Build, approximate and simulate models which describe financial processes using basic and advanced tools studied at this course

C LECTURE CONTENT

1. Basic notions of probability and stochastic analysis
2. Ito's formula, linear stochastic differential equations
3. Basics on the language and notions used in financial markets
4. Cox-Ross-Rubinstein binomial model and its asymptotic behavior
5. Black-Scholes model and its sensitivity indexes; the martingale approach
6. Fixed income markets. Classical models with compound interest rate
7. Merton model, Vasicek model, Cox-Ingersoll-Ross model
8. Hull-White model, Heath-Jarrow-Morton model
9. Forward risk neutral martingale measures
10. Swaps contracts

	11. Inter-currency financial markets: general concepts and real models 12. Risk analysis and default; hedging for credit financial derivatives 13. Elements of risk theory. Markov processes, Kolmogorov equations 14. Operational time and insurance models
D	**RECOMMENDED READING FOR LECTURES**
	1. Bremaud, P., *An Introduction to Probabilistic Modeling*, Springer-Verlag, 1988 2. Hull, J. C., *Options, Futures and Other Derivatives*, 4th ed., Prentice Hall, 1999 3. Karatzas, I.; Shreve, S.E., *Brownian motion and Stochastic Calculus*, Springer-Verlag, N.Y,.1998 4. Musiela, M; Rutkowsi, M., *Martingale Methods in Financial Modelling*, second edition, Springer-Verlag Berlin Heidelberg, 2005
E	**SEMINAR CONTENT**
	1. Basic notions of probability and stochastic analysis 2. Ito's formula, linear stochastic differential equations 3. Basics on the language and notions used in financial markets 4. Cox-Ross-Rubinstein binomial model and its asymptotic behavior 5. Black-Scholes model and its sensitivity indexes; the martingale approach 6. Fixed income markets. Classical models with compound interest rate 7. Merton model, Vasicek model, Cox-Ingersoll-Ross model 8. Hull-White model, Heath-Jarrow-Morton model 9. Forward risk neutral martingale measures 10. Swaps contracts 11. Inter-currency financial markets: general concepts and real models 12. Risk analysis and default; hedging for credit financial derivatives 13. Elements of risk theory. Markov processes, Kolmogorov equations 14. Operational time and insurance models
F	**RECOMMENDED READING FOR SEMINARS**
	1. Karatzas, I.; Shreve, S.E., *Brownian motion and Stochastic Calculus*, Springer-Verlag, N.Y,.1998 2. Musiela, M; Rutkowsi, M., *Martingale Methods in Financial Modelling*, second edition, Springer-Verlag Berlin Heidelberg, 2005
G	**EDUCATION STYLE**
LEARNING AND TEACHING METHODS	Lectures: conversation, proof and problematization Seminars: exercises, conversations
ASSESSMENT METHODS	Course: weight in the final grade 50% (written exam, oral examination) Class activity/homework: weight in the final grade 50% (written exam, presentation of a home project) Minimal requirements: 1. To identify and select correct models for solving easy exercises 2. To know and correctly use basic notions and mathematical tools studied at this course, in order to obtain optimal solutions for different types of financial markets models 3. To create and present a project on a given theme 4. Minimum grade 5
LANGUAGE OF INSTRUCTION	English