COURSE OUTLINE

1. GENERAL

SCHOOL	NATURAL SCIENCES		
DEPARTMENT	MATHEMATICS		
LEVEL OF COURSE	UNDERGRADUATE		
COURSE CODE	MAT_ST468	**SEMESTER OF STUDIES**	8th
COURSE TITLE	STOCHASTIC MODELS IN OPERATIONS RESEARCH		

INDEPENDENT TEACHING ACTIVITIES *if credits are awarded for separate components of the course, e.g. lectures, laboratory exercises, etc. If the credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**TEACHING HOURS PER WEEK**	**ECTS CREDITS**
Lectures and Tutorials	4	6
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (d).		

COURSE TYPE *general background, special background, specialised general knowledge, skills development*	Elective course
PREREQUISITE COURSES:	Recommended prerequisite knowledge: PROBABILITY I and II, STOCHASTIC PROCESSESS
TEACHING AND ASSESSMENT LANGUAGE:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBPAGE (URL)	https://eclass.upatras.gr/courses/MATH952/

2. LEARNING OUTCOMES

Learning outcomes

The course learning outcomes, specific knowledge, skills and competences of an appropriate level, which the students will acquire with the successful completion of the course are described.

Consult Appendix A

- *Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning*

and Appendix B

- *Guidelines for writing Learning Outcomes*

- Developing insight in several fundamental properties of queueing systems and the impact of various stochastic characteristics.
- Gaining familiarity with basic approaches for analyzing queueing models (using probability generating functions and Laplace-Stieltjes transforms).
- Acquiring a sense how methods and results from queueing theory can be applied for improving the efficiency or evaluating the performance of real-life service facilities in society, industry and technology.
- Gaining familiarity with the basic concepts of ruin probability, an active research branch of actuarial mathematics.
- Learning the basics on MDPs, a tool to be used in a class of problems that involve repeated decision making in stochastic environments. MDPs allow to alter the evolution of stochastic systems by exercising control to achieve a certain objective.
- Acquiring knowledge on how to use stochastic systems in modelling problems in biology and epidimiology.
- Learning basic models in inventory management.

General Abilities

Taking into consideration the general competences that the degree-holder must acquire (as these appear in the Diploma Supplement and appear below), at which of the following does the course aim?

Search for, analysis and synthesis of data and information, with the use of the necessary technology	*Project planning and management*
Adapting to new situations	*Respect for difference and multiculturalism*
Decision-making	*Respect for the natural environment*
Working independently	*Showing social, professional and ethical responsibility and sensitivity to gender issues*
Team work	*Criticism and self-criticism*
Working in an international environment	*Production of free, creative and inductive thinking*
Working in an interdisciplinary environment	*Others…*
Production of new research ideas	

- Decision making.
- Ability to work in an interdisciplinary environment.
- Autonomous work.
- Team work.
- Ability to promote free, productive and inductive thinking.

3. COURSE CONTENT

Queueing Systems: Queueing models use basic probability concepts and stochastic processes (Poisson processes, Markov chains, birth-death processes, random walks) to describe and analyze congestion effects in terms of queue lengths and waiting times. In this course, we introduce the most common models in queueing theory, such as M/M/1, M/M/C, M/G/1 and G/M/1, discuss their fundamental properties, and explain how these models arise in various scenarios of interest. The focus is on mathematical techniques for deriving the stationary queue length distribution and waiting-time distribution, and calculating several specific performance measures. We also discuss how these methods and results can be applied for improving the efficiency or evaluating the performance of real-life service facilities.

Markov decision processes (MDPs): Refers to class of problems that involve repeated decision making in stochastic environments. MDPs allow us to alter the evolution of stochastic systems by exercising control to achieve a certain objective. Finite Horizon MDPs, Infinite Horizon Discounted MDPs, Infinite Horizon Total and Average Cost MDPs.

Inventory control: Components of Inventory Models, Deterministic Continuous-Review Models, A Deterministic Periodic-Review Model, A Stochastic Continuous-Review Model, A Stochastic Single-Period Model for Perishable Products.

Stochastic models in biology and social sciences: Volterra and Lanchester models, basic epidemic processes.

Ruin theory: Basic elements of renewal theory, Cramer-Lundberg and Gerber-Shiu models.

4. TEACHING AND LEARNING METHODS - ASSESSMENT

TEACHING METHOD *Face-to-face, Distance learning, etc.*	Lectures (face to face)
USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES *Use of ICT in teaching, laboratory education, communication with students*	Support of the course via the online platform *eClass* of University of Patras
TEACHING ORGANIZATION *The manner and methods of teaching are described in detail.* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, placements, clinical practice, art workshop, interactive teaching, educational visits, project, essay writing, artistic creativity, etc.* *The student's study hours for each learning activity are given as well as the hours of non-directed study according to the principles of the ECTSards του ECTS*	
STUDENT ASSESSEMNT *Description of the evaluation procedure* *Language of evaluation, methods of evaluation, summative or conclusive, multiple choice questionnaires, short-answer questions, open-ended questions, problem solving, written work, essay/report, oral examination, public presentation, laboratory work, clinical examination of patient, art interpretation, other* *Specifically-defined evaluation criteria are given, and if and where they are accessible to students*	**Assessment Language:** Greek **Assessment Language for Erasmus students:** English **Assessment methods:** Final exams (100%) including Theory and Exercises. Minimum passing grade: 5 Μαximum passing grade: 10

Activity	*Semester workload*
Lectures	39
Tutorials	26
Solving homework problems	45
Personal study	37
Final examination	3
Total number of hours for the Course (25 hours of work-load per ECTS credit)	***150***

5. RECOMMENDED LITERATURE

(*in Greek*)

- Φακίνος Δημήτρης. *Στοχαστικά Μοντέλα στην Επιχειρησιακή Έρευνα, Θεωρία και ασκήσεις*. 2η Έκδοση, Εκδόσεις Συμμετρία, 2007
- Βασιλείου Παναγιώτης - Χρήστος. *Στοχαστικές Μέθοδοι στις Επιχειρησιακές Έρευνες*. Εκδόσεις Ζήτη, 2000.
- Πολίτης Κωνσταντίνος. *Εισαγωγή στη Θεωρία Συλλογικού Κινδύνου.* Εκδόσεις Σταμούλη, 2012.
- Hillier Frederick S. and Lieberman Gerald J. *Εισαγωγή στην Επιχειρησιακή Έρευνα.* (μετάφραση της 10ης Αμερικάνικης Έκδοσης). Εκδόσεις Τζιόλα, 2017.

(*in English*)

- Kleinrock Leonard. *Queueing Systems. Vol. I*. Wiley, 1975.
- Medhi Jyotiprasad. *Stochastic Models in Queueing Theory.* Academic Press, 2003.
- Hillier Frederick S. and Lieberman Gerald J. *Introduction to Operations Research*. 10th Edition, McGrawHill, 2015.
- Asmussen S. and Albrecher H. *Ruin probabilities*. 2nd edition, World Scientific, Singapore, 2010.