COURSE OUTLINE

1. GENERAL INFORMATION

SCHOOL	MARITIME AND INDUSTRIAL STUDIES		
DEPARTMENT	INDUSTRIAL MANAGEMENT AND TECHNOLOGY		
LEVEL OF STUDY	UNDERGRADUATE		
COURSE UNIT CODE	ΤΕΣΤΑ31	**SEMESTER OF STUDY**	6th
COURSE TITLE	QUEUEING THEORY AND SYSTEMS SIMULATION		

INDEPENDENT TEACHING ACTIVITIES *in case in which credits are awarded for separate components/parts of the course, e.g. in lectures, laboratory exercises, etc. If credits are awarded for the whole of the course, give the weekly teaching hours and the total credits*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	4	5.5
Add rows if necessary. The organization of teaching and the teaching methods used are described in detail at section 4.		

COURSE TYPE *general background, special background, specialized general knowledge, skills development*	Special background
PREREQUISITE COURSES:	None
LANGUAGE OF INSTRUCTION and EXAMINATION/ASSESSMENT:	Greek
THE COURSE IS OFFERED TO ERASMUS STUDENTS	No
COURSE WEBSITE (URL)	https://eclass.unipi.gr/courses/BDT131/

2. LEARNING OUTCOMES

LEARNING OUTCOMES

The course learning outcomes, specific knowledge, skills and competences of an appropriate (certain) level, which students will acquire upon successful completion of the course, are described in detail. It is necessary to consult:

APPENDIX A

- *Description of the level of learning outcomes for each qualifications' cycle, according to the European Higher Education Area's Qualification Framework.*
- *Descriptors for Levels 6, 7 & 8 of the European Qualifications Framework for Lifelong Learning and APPENDIX B*
- *Guidelines for writing Learning Outcomes*

The subject of the course is the introduction to Classical Queueing Theory and Simulation Methods. In Queuing Theory, the basic concepts are presented, with emphasis on the structural characteristics of the systems, the evaluation of their effectiveness and their practical applications. The course presents Poisson processes and systems with one or more service stations, infinite or finite population and infinite or finite waiting positions. For presenting the analytical relationships, emphasis is given on the way these arise from Markov's general equilibrium relations and Little's Law.

Simulation introduces the basic concepts, definitions and the central concept of discrete events simulation methods through many examples. The course presents the methods of generating random numbers and the "dimensions" of the simulation (based on a fixed time step, events, entities, etc.). The course includes the demonstration of software use, with the main aim of recognizing the basic concepts and definitions that have been discussed theoretically and in exemplary tables.

Within the course, through many examples and its successful completion, the student becomes familiar with the theory and the basic concepts, so that he/she can:

- Identify in practice the problems that can be addressed by either Queueing Theory methods or Simulation methods, analyze their structure and characteristics, and identify the requirements in data and parameters
- Easily learn any Queueing and Simulation Analysis software, having understood the theoretical and conceptual framework.
- Proceed to deepening stochastic processes in industrial processes

General Competences

Taking into consideration the general competences that students/graduates must acquire (as those are described in the Diploma Supplement and are mentioned below), at which of the following does the course attendance aims

Search for, analysis and synthesis of data and information, by the use of technologies that are necessary according the case
Adapting to new situations
Decision-making
Independent work
Team work
Working in an international environment
Working in an interdisciplinary environment
Introduction of innovative research
Project planning and management
Respect for difference and multiculturalism
Environmental awareness
Social, professional and ethical responsibility and sensitivity to gender issues
Critical consciousness, criticism and self-criticism
Development of free, creative and inductive thinking

- Search for, analysis and synthesis of data and information, by the use of technologies that are necessary according the case
- Adapting to new situations
- Decision-making
- Independent work
- Social, professional and ethical responsibility and sensitivity to gender issues
- Critical consciousness, criticism and self-criticism
- Development of free, creative and inductive thinking

2. COURSE CONTENT

The course covers the following topics:

Week	Topic
1	**Introduction to queueing systems** - Applications, definitions, assumptions and symbols. Basic structure and system features, performance measures. Poisson processes: Poisson distribution and negative exponential distribution, their relationship and their use in modeling queuing systems
2	**Queueing Systems -** Little's Law and mean times in system and queue. Markov's birth-death and equilibrium equations for M/M/1. In-depth system study, feature changes and their impact on performance measures, cost issues, etc.
3	**M/M/1 system** – In depth study of the simplest queueing system based on stability relations. Cost optimization issues.
4	**Generalization of stability relations and M / M / S system** - Comparison with M/M/1 system and cost optimization issues.
5	**Systems with finite population - source of arrivals -** M/M/1/∞/N and M/M/S/∞/N
6	**Systems with limited capacity -** M/M/1/K και M/M/S/K
7	**Other systems:** Examination of how our approach to queueing systems can be generalized to systems with other characteristics.
8	**Introduction to Simulation** - General concepts, objectives, advantages - disadvantages, applications, classification of simulation models
9	**Simulation of discrete systems -** General logic, stochastic phenomena, pseudo-random numbers and their generation methods. Simulation based on entities,

	fixed time, event-based, and so on. Special computational techniques in simulation
10	**Simulation as a method of analyzing complex queuing systems** - Simulation of business problems: order policies, stocks etc
11	**Modelling systems for Discrete Event Simulation** – Entities, life cycle, flow charts, entity characteristics, events and activities, use of queues, Activity Cycle Diagram
12	**Simulation software** - Using MS Excel to solve simple simulation problems, applications of complex business simulations using specialized software.
13	**Review exercises**

Case studies from the following bibliography are presented:

- Hillier, F.S., and Lieberman, G.J. (2009). Introduction to Operations Research, McGraw-Hill, New York.
- Taha, H.A. (2010). Operations Research: An Introduction. Prentice-Hall, India.

In addition, articles, audiovisual lecture material, web addresses, useful information, exercises and/or software are posted at eclass.

3. TEACHING METHODS - ASSESSMENT

TEACHING MODE *Face-to-face, in-class lecturing, on distance teaching and distance learning etc.*	In-class lecturing
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY *Use of ICT in Teaching, Laboratory Education, Communication with students*	**Teaching:** Lectures with audiovisual media, support of the learning process through the eclass platform **Communication with students:** face-to-face at office hours, email, eclass
COURSE DESIGN *Description of teaching techniques, practices and methods:* *Lectures, seminars, laboratory practice, fieldwork, study and analysis of bibliography, tutorials, clinical practice, Art Workshop, Interactive teaching, Educational visits, project, Essay writing, Artistic creativity, etc.* *The study hours for each learning activity as well as the hours of non- directed study are given according to the principles of the ECTS*	

Activity / Method	***Semester Workload***
Lectures	52
Case studies/exercises	26
Self-study of lecture material and exercises	57
Counselling	0.5
Exams (written)	2
Course Total	***137.5***

STUDENT PERFORMANCE EVALUATION/ASSESSMENT METHODS *Detailed description of the evaluation procedures:* *Language of evaluation, assessment methods, formative or summative (conclusive), multiple choice questionnaires, short- answer questions, open-ended questions, problem solving, written work, Essay/report, oral exam, public presentation, laboratory work, art interpretation, other……etc* *Evaluation criteria are specifically defined and given as well as if and where they are reported and accessible to students.*	**Language of exams:** Greek **Assessment Methods:** After the last lecture, the exam material is posted at eclass. The final course grade is formed by the written exams (100%) taken in the examination period of the spring semester and, in case of failure, in the September resits. The written examination includes problem solving/exercises and short-answer questions. It is conducted with closed books. Students may use a 2-page note with the mathematical expressions they think necessary. The evaluation of students with special learning difficulties in writing and reading (as certified and qualified by a competent

	institution) is performed according to the relevant procedure decided by the Department Assembly. **Notification of the Assessment Criteria:** The evaluation criteria are made known during the first lecture and are clearly stated on the course website and e-class. The answers to the exam questions are posted at eclass after the exam date. Students have the opportunity to discuss their exam paper with the course instructor (at the posted office hours) after the announcement of the course grades.

4. SUGGESTED BIBLIOGRAPHY

-Suggested Bibliography :

- Book [21919]: Simulation and Applications [in Greek], Sfakianakis M.
- Book [59393781]: Special Topics in Operations Research [in Greek], Karkazis I.
- Book [12518838]: Quantitative Analysis and Administrative Decision Making Vol. A΄ [in Greek], Economou G., Georgiou A.

-Scientific Journals: not applicable

-Lecture Notes