COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**ECE_TEL841**	**SEMESTER**	**8**
COURSE TITLE	NETWORK SIMULATION		

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*	**WEEKLY TEACHING HOURS**	**CREDITS**
Lectures	3	
Seminars / Practice exercises	0	
Laboratory	1	
Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).	4	5

COURSE TYPE *general background, special background, specialised, general knowledge, skills development*	Specialised
PREREQUISITE COURSES:	No. Students are advised to have already attended the courses: Computer Networks, Wireless Networks
LANGUAGE OF INSTRUCTION and EXAMINATIONS:	Greek
IS THE COURSE OFFERED TO ERASMUS STUDENTS	Yes
COURSE WEBSITE (URL)	https://www.ece.uop.gr/

(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*

The course aims to study computer and network simulation techniques. The basic components of simulation, how to develop a model and the applications of simulation in computer networks are presented.

The course material includes the types of simulation models, the mechanisms of evolution and time control, the basic elements of more complex systems, the flow tables of simulated systems.

In addition, the characteristics of random numbers, random number generators and the production of random samples as well as the evaluation of these generators are analyzed.

The performance metrics of a system and the issue of organization, collection, processing, analysis and presentation of simulation results are analyzed.

In the practical / laboratory part, students will immerse and use dominant and open tools for simulating networks and systems with respect to numerous scenarios.

<u>Keywords</u>: Computer simulation of systems and networks. Performance analysis. Modeling and simulation. NS2 / NS3.

Learning outcomes

Upon successful completion of the course, students will be able to:

<u>In terms of Knowledge:</u>

1. Understand the main aspects of Simulation and Emulation and the different between them.
2. To distinguish the areas where the simulation finds application as well as its benefits.
3. Distinguish between structural elements, models and ways of studying systems.
4. Distinguish between simulating discrete events and continuous time simulation.
5. To know the mechanisms of evolution and control of simulation time.
6. Distinguish the basic elements of system study.
7. Choose a random number generator control method.
8. Analyze the production of random samples.
9. Calculate the appropriate performance metrics of a system.

<u>At the skill level:</u>

1. Be able to identify the events and the evolution of the flow of time in basic engine fault scenarios.
2. To know the types of simulation models.
3. To know the components of a distinct time simulation model.
4. Calculate the simulation flow tables for a simulated local network.
5. Perform data collection of a simulation.
6. Analyze the simulation results.
7. Perform statistical analysis of results.

<u>At the Competence level:</u>

1. Have knowledge of network design tools and techniques.
2. Collaborate with their classmates to organize and present a group project as part of the course objectives.
3. Be able to handle appropriate network simulation software as well as experimental equipment from the Wireless and Mobile Communications laboratory.

General Competences

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	*……*
Production of new research ideas	*Others…*
	…….

- Search, analyze and synthesize data and information using the necessary technologies.
- Autonomous work
- Teamwork
- Work in an international environment
- Promoting free, creative and inductive thinking

(3) SYLLABUS

Short Presentation

Why simulation is important in the study, design, development and evaluation of a network and system in general. What are the difficulties / challenges / limitations in designing and implementing a reliable and highly accurate simulation model. Understanding all the key aspects of designing / developing / operating / maintaining a simulation model. Simulation techniques. Classification of approaches and categories of simulation and related techniques. How does the design of a simulation model affect the study of a network, protocol, or system? What is the correct methodology depending on the case and what are the main mistakes.

Lectures will cover the following thematic areas:

- **Introduction to simulation.**

  Defining simulation, advantages, disadvantages, errors, problems, system, status variables, system activities, model, model design.
- **Basic principles of design, study of a simulation model**

  Types of simulation models, time evolution mechanism, methodologies. Next event mechanism, fixed space mechanism, examples.
- **Modeling of continuous systems**

  Introduction, Web Models, Systems Sensitivity Analysis, Construction of Detailed Models.
- **Random numbers, random number generators, categories, properties.**

  Properties of random numbers. Why random numbers are important in simulation. Medium Square Generators, Linear Equilibrium Other Generators, Generators, Tausworthe, Fibonacci. Examples.
- **Statistical Checks of Random Number Generators (1)**

  Desirable features. Basic mistakes. Frequency control. Serial control.
- **Statistical Checks of Random Number Generators (2)**

  Self-correlation test. Running test. Check x2. Kolmogorov-Smirnov control.
- **Production of Random Samples of Specific Distribution**

  Why we need different distributions depending on the scenario. Reverse transformation. Acceptance-rejection. Experimental method
- **Analysis of simulation results (1)**

  Assessment, recognition of performance metrics. Data collection process. Basic mistakes.
- **Analysis of simulation results (2)**

  Categorization depending on how the data is analyzed. Confidence intervals. Measurement categories.
- **Complete Examples of Design, Study, and Performance Evaluation of Simulation Models** Identification of entities, events, parameters and metrics. Flow diagram of individual functions and the model as a whole. Time / event evolution chart. Extracting metric performance and analyzing results. Model "Damaged Machines and a Repairman"
- **Complete Examples of Design, Study, and Performance Evaluation of Simulation Models** Identification of entities, events, parameters and metrics. Flow diagram of individual functions and the model as a whole. Time / event evolution chart. Extracting metric performance and analyzing results. Model of "Node Coupon Network" and "FIFO Tail Server" scenarios.
- **Complete Examples of Design, Study, and Performance Evaluation of Simulation Models** Identification of entities, events, parameters and metrics. Flow diagram of individual functions and the model as a whole. Time / event evolution chart. Extracting metric performance and analyzing results. Model of "Two Servants in a row" scenario.
- **Use of tail theory to simulate telecommunication systems**

  Definitions and symbolisms. Queue M / M / 1. Queue M / G / 1. Queue M / D / 1. Queue D / D / 1. Examples

(4) TEACHING and LEARNING METHODS - EVALUATION

<table>
<tr>
<td>DELIVERY
Face-to-face, Distance learning, etc.</td>
<td>Face to face in the classroom.
Remote using eclass platform</td>
</tr>
<tr>
<td>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY
Use of ICT in teaching, laboratory education, communication with students</td>
<td>
Slides (ppt) for teaching the theoretical part, which have been posted since the beginning of the semester in the e-Class.
Practical part guides (one for each exercise), posted since the beginning of the semester in the e-Class.
Exercise Solutions (given to students after each exercise).
Support for learning process through the e-Class platform.
Course-specific software and materials.</td>
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<td>TEACHING METHODS

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 ECTS</td>
<td><table>
<tr><th>Activity</th><th>Semester workload</th></tr>
<tr><td>Lectures</td><td>39</td></tr>
<tr><td>Exercises – Labs</td><td>20</td></tr>
<tr><td>Homework</td><td>51</td></tr>
<tr><td>Preparation for the final examinations</td><td>15</td></tr>
<tr><td>Course Total</td><td>125 hours (5 ECTS)</td></tr>
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<td>STUDENT PERFORMANCE EVALUATION

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.</td>
<td><u>A. Theoretical Part Evaluation:</u>

Written final examination including:
Solving exercises
Multiple choice questions
Comparative evaluation of theoretical issues
<u>B. Αξιολόγηση Ασκήσεων:</u>

Written final examination including:
Solving exercises
Multiple choice questions
<u>Notes:</u>
The final grade is derived from the weighting of the theoretical grades and the work with coefficients specified at the beginning of the semester and communicated to the students via eClass.
Exams are conducted in Greek language.
The assessment process and assessment criteria are published on the course's website in the e-Class.
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</tr>
</table>

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Τεχνικές Προσομοίωσης «Θεωρία & Εφαρμογές», Μάνος Ρουμελιώτης, Σταύρος Σουραβλάς, Εκ. Τζιόλα, 2015 .
2. Προσομοίωση και Εφαρμογές, Μιχάλης Σφακιανάκης, Εκ. Πατάκη 2004
3. Computer Simulation Techniques: The definitive introduction, Harry Perros, http://www.csc.ncsu.edu/faculty/perros/simulation.pdf , 2009.
4. Μοντελοποίηση και Προσομοίωση, Μάνος Ρουμελιώτης, Ελληνικό Ανοικτό πανεπιστήμιο, Πάτρα 2001.

- Related academic journals: