

## COURSE OUTLINE

### (1) GENERAL

<b>SCHOOL</b>	ENGINEERING		
<b>ACADEMIC UNIT</b>	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
<b>LEVEL OF STUDIES</b>	Undergraduate		
<b>COURSE CODE</b>	<b>ECE_TEL951</b>	<b>SEMESTER</b>	<b>9</b>
<b>COURSE TITLE</b>	Computer Network Performance		
<b>INDEPENDENT TEACHING ACTIVITIES</b> <i>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</i>		<b>WEEKLY TEACHING HOURS</b>	<b>CREDITS</b>
Lectures		3	
Seminars / Practice exercises		1	
Laboratory			
<i>Add rows if necessary. The organisation of teaching and the teaching methods used are described in detail at (4).</i>		4	5
<b>COURSE TYPE</b> <i>general background, special background, specialised, general knowledge, skills development</i>	Specialized (Signals, Telecommunications and Networks)		
<b>PREREQUISITE COURSES:</b>	None. Students are advised to have knowledge of probability theory and statistics, and basic knowledge of computer network services and computer systems.		
<b>LANGUAGE OF INSTRUCTION and EXAMINATIONS:</b>	Greek		
<b>IS THE COURSE OFFERED TO ERASMUS STUDENTS</b>	Yes		
<b>COURSE WEBSITE (URL)</b>	<a href="https://www.ece.uop.gr/">https://www.ece.uop.gr/</a>		

### (2) LEARNING OUTCOMES

<p><b>Learning outcomes</b></p> <p><i>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.</i></p> <p><i>Consult Appendix A</i></p> <ul style="list-style-type: none"> <li>• <i>Description of the level of learning outcomes for each qualifications cycle, according to the Qualifications Framework of the European Higher Education Area</i></li> <li>• <i>Descriptors for Levels 6, 7 &amp; 8 of the European Qualifications Framework for Lifelong Learning and Appendix B</i></li> <li>• <i>Guidelines for writing Learning Outcomes</i></li> </ul>
<p>Upon successful completion of the course, students will be able to:</p> <p><u>At the Knowledge level:</u></p> <ul style="list-style-type: none"> <li>- Understand and be able to handle stochastic processes and queuing models that are essential for modeling and studying the performance of communication networks.</li> <li>- Study network protocols Networks and how they can assist in the analysis of network performance and their implementation.</li> <li>- Understand the basic concepts of network performance analysis</li> <li>- Be able to understand basic concepts of telecommunications</li> </ul> <p><u>At skill level:</u></p> <ul style="list-style-type: none"> <li>- To evaluate the performance of communication protocols that he/she will come across in different stages of his/her career</li> </ul>

- Understand the concepts of network performance.

At the level of abilities:

- To design new communication protocols.
- To communicate effectively with experts and non-experts.
- to configure communication protocols.
- To utilize software tools for network analysis and data interpretation.

**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?*

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

- Search, analyze and synthesize data and information using the necessary technologies.
- Develop ability to work in independently
- Teamwork
- Work in an international environment
- Producing free, creative and inductive thinking

**(3) SYLLABUS**

**Theory Lectures:**

Lecture 1: Computer Networks and Probability Theory, Random Variables and Stochastic Processes - Distribution Function - Independent Random Variables, Expected Values, Conditional Probability and Independence

Lecture 2: Dispersion of the random variable X- Conditional, Bernoulli Stochastic Processes, Poisson Stochastic Processes, Arrival Times

Lecture 3: Superposition of a Poisson Processes - Analysis of a Poisson Process, Random incidence paradox Sums of Independent Random Variables, strong law of large numbers, weak law of large numbers, Central Limit Theory

Lecture 4: Markov Chains, Status Category - Markovian Chain Analysis, Birth-death Markov chains, Delay Estimation Models, Little's Law

Lecture 5: Queues M / M / 1, Distribution competence Upon Arrival - Distribution competence at Departure, Queuing systems M/M/m, M/M/m/m, M/G/

Lecture 6: Networks of Queues, Jackson's Theorem, Applications

Lecture 7: Kleinrock Independence Approximation

Lecture 8: P-K formula

Lecture 9: Συστήματα χρονοθυρίδων για πολλαπλή πρόσβαση -Σύστημα ALOHA

Lecture 10: Telecommunication Traffic theory

Lecture 11: Modeling networks as graphs. Network Flow Models,

Lecture 12: Network Flow Algorithm

Lecture 13: The Max-Flow problem.

During seminars, tutoring exercises will be implemented in parallel with the theoretical part that focuses on solving examples/exercises and facing case studies.

#### (4) TEACHING and LEARNING METHODS - EVALUATION

<p style="text-align: center;"><b>DELIVERY</b></p> <p style="text-align: center;"><i>Face-to-face, Distance learning, etc.</i></p>	<p><i>Face-to-face</i></p>																					
<p style="text-align: center;"><b>USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY</b></p> <p style="text-align: center;"><i>Use of ICT in teaching, laboratory education, communication with students</i></p>	<ul style="list-style-type: none"> <li>- Tutorial slides (ppt) that assist the theoretical part, are being posted at the e-class platform for the students during the semester .</li> <li>- Communication is also supported by e-Class platform (distribution of slides, supplementary material, announcements, links and bibliography, etc.).</li> </ul>																					
<p style="text-align: center;"><b>TEACHING METHODS</b></p> <p><i>The manner and methods of teaching are described in detail.</i></p> <p><i>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.</i></p> <p><i>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</i></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: center;"><b>Activity</b></th> <th style="text-align: center;"><b>Semester workload</b></th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">Lectures</td> <td style="text-align: center;">39</td> </tr> <tr> <td style="text-align: center;">tutoring exercises</td> <td style="text-align: center;">13</td> </tr> <tr> <td style="text-align: center;">Study and analysis of bibliography</td> <td style="text-align: center;">43</td> </tr> <tr> <td style="text-align: center;">Project assignment</td> <td style="text-align: center;">30</td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td> </td> <td> </td> </tr> <tr> <td style="text-align: center;"><b>Course Total</b></td> <td style="text-align: center;"><b>125 hours (5 ECTS)</b></td> </tr> </tbody> </table>		<b>Activity</b>	<b>Semester workload</b>	Lectures	39	tutoring exercises	13	Study and analysis of bibliography	43	Project assignment	30									<b>Course Total</b>	<b>125 hours (5 ECTS)</b>
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<p style="text-align: center;"><b>STUDENT PERFORMANCE EVALUATION</b></p> <p><i>Description of the evaluation procedure</i></p> <p><i>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</i></p> <p><i>Specifically-defined evaluation criteria are given, and if and where they are accessible to students.</i></p>	<ul style="list-style-type: none"> <li>I. Final exam (70%) which includes:               <ul style="list-style-type: none"> <li>a. Solving exercises</li> <li>b. Comparative evaluation of theory</li> </ul> </li> <li>II. Project (30%) prepared by student groups.</li> </ul>																					

#### (5) ATTACHED BIBLIOGRAPHY

<p>- Suggested bibliography:</p> <ol style="list-style-type: none"> <li>1. <i>Θεωρία Τηλεπικοινωνιακής Κινήσεως και Εφαρμογές, Μιχαήλ Δ. Λογοθέτη, 3<sup>η</sup> έκδοση Κλειδάριθμος</i></li> <li>2. <i>Data Networks, Dimitri Bertsekas and Robert Gallager, Second Edition, Prentice Hall 1992.</i></li> <li>3. <i>Multiple Access Protocols: Performance and Analysis, R. Rom and M. Sidi, Springer-Verlag 1990.</i></li> <li>4. <i>Stochastic Modeling and the Theory of Queues, Ronald W. Wolff, Prentice Hall 1989.</i></li> <li>5. <i>Queueing Theory for Telecommunications, John N. Daigle, Addison - Welsey 1992.</i></li> <li>6. <i>Analysis and Synthesis of Computer Systems, E. Gelenbe and I. Mitrani, Academic Press 1980.</i></li> </ol>
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7. *The Art of Computer Systems Performance Analysis, Techniques for Experimental Design, Measurement, Simulation and Modeling*, Raj Jain, John Wiley and Sons Inc. 1991.
8. *Performance analysis of Computer Networks*, Matthew Sadiku, Sarhan Mus., Springer, 2013

-Συναφή επιστημονικά περιοδικά:

1. IEEE Network Magazine
2. IEEE/ACM transactions on Networking