COURSE OUTLINE

(1) GENERAL

SCHOOL	ENGINEERING		
ACADEMIC UNIT	ELECTRICAL AND COMPUTER ENGINEERING DEPT.		
LEVEL OF STUDIES	Undergraduate		
COURSE CODE	**ECE_TEL840**	**SEMESTER**	**8**
COURSE TITLE	Mobile Communications and Networks		

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	1	
Laboratory	0	
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: Digital Communications, 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 is a basic introductory lesson in the concepts of Mobile Communications, Networks and its applications. The course aims to introduce students to the concepts, key features, phenomena, technologies, communication protocols and state-of-art architectures that are prominent in Mobile Communications. It also introduces students to the design and management of a mobile network. Specifically, it introduces students to the architectures of 3G, 4G, 5G network as well as key features of advanced mobile management networks, performance evaluation as well as channel and resources management in general. Finally, the course aims to provide students with an understanding of the critical parameters as well as their description of a mobile communications network and to link the knowledge that students will gain with the demand for skilled staff in the job market.

Key words: PSTN, GSM, handover, location update, cell selection reselection, Σηματοδοσία #7, PCM, MTP protocol, Erlang B/C, communication channel management, QoS, LTE, OFDMA, Τεχνολογία

MIMO, Cell capacity, traffic evaluation and management.

Learning outcomes

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

At the Knowledge level:

1. Understand the key and critical features of mobile communication.
2. Have an understanding of the basic architecture of a mobile network.
3. Understand basic operating procedures MM & RRM (handover, location update, cell selection reselection).
4. Understand the reasons for the performance/signal degradation and respective phenomena in a mobile network.
5. Understand PCM (Pulse-code modulation) theory
6. Understand the key and critical features of a 3G, 4G, 5G network.
7. Understand cellular protocols as well as call signaling technologies and protocols.
8. Have an understanding of the concept of mobile wireless network design.
9. Understand technologies such as MIMO, sectoring, admission control etc.

At the Skill level

1. Theoretical evaluation and calculation of the critical parameters in a mobile communications network.
2. Theoretical calculation of the maximum radio coverage distance in a mobile network.
3. Cellular cell capacity multiparametric calculation.
4. Theoretically calculate the critical cell design parameters in a mobile communications network.
5. To calculate cellular cell capacity in state-of-the-art networks.
6. Theoretically calculate the maximum radio coverage distance in a mobile network.

At the Competence level

1. Acquire knowledge of the tools and techniques for designing and managing a mobile network.
2. Collaborate with their peers to organize and present a team work within the course objectives.
3. Be able to handle appropriate mobile network simulation software and experimental equipment from the Wireless and Mobile Communications Lab.

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.
- Independent/self-organized work effort
- Teamwork
- Working and collaboration at an international environment/level
- Promoting free, creative and inductive thinking

(3) SYLLABUS

Short Presentation

Introduction to Fixed Telephony PSTN and the basic architecture of a telephone network, The GSM network - architecture, module descriptions (BSC, BTS, MSC, HLR, VLR), MM & RRM (handover, location update, cell selection reselection), Basic Cellular Concept, Cell Coverage-Link Budget Calculation, Cell Capacity Planning, Frequency Planning, Signaling # 7 - Introduction to PCM, Introduction to Signaling # 7, MTP Protocol, MTP routing, MTP data link layer functions, SCCP protocol, BSSAP, ISUP, MAP protocols, Call procedures, switching processes, location update processes - Presentation of signaling diagrams, Protocols. The 3G, 4G, 5G Network, Core Network - Core Network Architecture, Network Design, Access Network - Rectangular Codes, Cell Capacity, Capacity and Coverage Planning Approach, Protocols and Signal Management, The LTE Network, Core Network Core Network Architecture, Access Network, Cell Capacity Protocols and Call Management, MIMO Technology

The theory lectures cover the following thematic units:

- **Introduction to PSTN Fixed Telephony, the Basic Architecture of a Telephone Network**
  Introduction to the concept of both fixed and mobile telephony, differences, advantages, challenges, historical overview.
- **The GSM network - architecture, module descriptions, functions and services**
  Complete and thorough study of the basic GSM architecture, key elements, interfaces, basic functions and services based on this architecture.
- **Wireless Environment in Mobile Communications, Cellular Systems and Interference (1)**
  Introduction to noise environments, categories, performance implications, network reliability. Co-channel interpolation, adjacent channel interpolation.
- **Wireless Environment in Mobile Communications, Cellular Systems and Interference (2)**
  Distance between cells, distribution in clusters. Frequency reallocation and distribution. Radio transmission mechanisms. Effect of mobility. LoS vs. Non-LoS effect on performance.
- **Dimensioning of Cellular Systems and Telephone Networks (1)**
  Models for studying and evaluating telecommunications traffic in cellular systems. Erlang B / C. Exercises. Spectral performance of cellular systems.
- **Dimensioning of Cellular Systems and Telephone Networks (1)**
  Models for studying and evaluating telecommunications traffic in cellular systems. Erlang B / C. Exercises. Spectral performance of cellular systems.
- **PCM encoding in voice transmission over telephone network**
  Performance study and features of PCM encoding in cellular voice transmission. Sampling Theorem. Uniform and non-uniform quantization process. Channel grouping. Safety Channels. Exercises.
- **Operational procedures for Mobility and Resource Management**
  MM & RRM (handover, location update, cell selection reselection) operating procedures. Admission Control. Flow charts. Study all possible transition cases. Algorithms, criteria, handover-margin, approaches.
- **Study of 3G, 4G mobile telephony and services**
  Evolution of backbone networks mainly but also access network due to the introduction of 3G 4G technologies advantages, challenges. Proposed trading solutions / protocols. Study on the exploitation of new technologies for the development of new services. Homogenization of technologies.
- **Study of 5G, 6G mobile telephony and services**
  Study of the upcoming evolution of backbone technologies mainly and 5G, 6G access network, advantages, challenges. Proposed trading solutions / protocols. Study on the exploitation of new technologies for the development of new services. Homogenization of technologies.
- **Signaling Protocols for mobile networks (1)**
  Introduction to techniques, protocols and technologies for installing, maintaining, and terminating connections ensuring seamless communication, guaranteed QoS and security. CAS-4bit protocol,

MTP, MTP routing, MTP data link layer functions

- **Signaling Protocols for mobile networks (2)**
  Introduction to techniques, protocols and technologies for installing, maintaining, and terminating connections ensuring seamless communication, guaranteed QoS and security. Protocol # 7, SCCP, BSSAP, MPLS implementation and impact on signaling.
- **Satellite communications**
  Introduction to Mobile Satellite Systems. Categories, advantages-disadvantages. Design and development challenges. GPS. Applications. Study of specific case studies.

(4) TEACHING and LEARNING METHODS - EVALUATION

DELIVERY *Face-to-face, Distance learning, etc.*	Face to face in the classroom. Remote using eclass platform
USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY *Use of ICT in teaching, laboratory education, communication with students*	• 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.
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*	
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.*	A. Theoretical Part Evaluation: Written final examination including: 1. Solving exercises 2. Multiple choice questions 3. Comparative evaluation of theoretical issues B. Αξιολόγηση Ασκήσεων: Written final examination including: 4. Solving exercises 5. Multiple choice questions Notes:

Activity	***Semester workload***
Lectures	39
Exercises – Labs	20
Homework	51
Preparation for the final examinations	15
Course Total	***125 hours (5 ECTS)***

	6. 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. 7. Exams are conducted in Greek language. 8. The assessment process and assessment criteria are published on the course's website in the e-Class.

(5) ATTACHED BIBLIOGRAPHY

- Suggested bibliography:

1. Θεολόγου Μ. Ε., Δίκτυα Κινητών και Προσωπικών Δεδομένων, Εκδόσεις Τζιόλα, 2007
2. Λούβρος Σπυρίδων και Κούγιας Ιωάννης, Το Δίκτυο Κινητής Τηλεφωνίας GSM, Εκδόσεις Νέων Τεχνολογιών, 2010
3. Σταύρος Κοτσώπουλος ,Κινητή τηλεφωνία, Εκδόσεις Παπασωτηρίου.

- Related academic journals: