COURSE OUTLINE

(1) GENERAL

SCHOOL	Engineering		
DEPARTMENT	Electrical and Computer Engineering		
LEVEL OF STUDY	Undergraduate		
COURSE UNIT CODE	8.019	**SEMESTER OF STUDY**	8th
COURSE TITLE	Wireless networks		

COURSEWORK BREAKDOWN	**TEACHING WEEKLY HOURS**	**ECTS Credits**
Theory (Lectures)	3	3
Tutorial/Project	1	1
Laboratory	1	1
TOTAL	**5**	**5**

COURSE UNIT TYPE	Scientific area course / specialization / skill development
PREREQUISITES	
LANGUAGE OF INSTRUCTION/EXAMS	Greek
COURSE DELIVERED TO ERASMUS STUDENTS	Yes
WEB PAGE (URL)	https://eclass.hmu.gr/courses/ECE122/

(2) LEARNING OUTCOMES

Learning Outcomes
The course is a compulsory course (CC) of the 3rd Direction (Telecommunications and Information Technology) aiming to introduce students the principles of wireless networks, by equipping them with the necessary knowledge and skills to: a) design and plan the implementation of wireless networking infrastructures b) analyze their overall performance as well as that of each individual component, c) supervise and optimize their performance, d) study techniques and technologies that will allow the development of innovative services, and e) develop architectures that will allow convergence and interoperability with other existing and emerging technologies. In this context, the student will become familiar with the principles, the technologies and the architectures that characterize wireless networks, by studying physical layer techniques (modulation, coding, multiplexing and spectrum spreading and exploitation techniques), with multiple access mechanisms, interference avoidance and resource management techniques, and will acquire skills related to the wireless channel characteristics and its exploitation, multi-antenna techniques (SISO, MIMO, etc.) and radio resource management techniques, as well as the design and analysis of transceivers and wireless network systems by utilising the Software Defined Radio (SDR) technology.   Upon successful completion of the course the student will be able to: 1. Understand the operation and organization of wireless networks and their exploitation for transferring information and services through them.   2. Knows, recognise and be aware of the tools used for the implementation and management of wireless networks, the interconnection of heterogeneous networks both to each other and to the Internet, as well as the operation of the most widespread wireless networking protocols and standards.   3. Apply tools for the analysis and the evaluation of the performance of wireless networks, as well as mechanisms and methods for optimal operation, toward robust and secure transfer of information and services.   4. Analyse and calculate the principle communication characteristics of wireless networks, and the way they are connected to each other and to the Internet.   5. Propose solutions for the implementation and maintenance of wireless networks, analysis of information that passes over them and optimal utilization of the available resources based on the required quality of service (QoS).
General Skills
• Search, analysis and synthesis of data and information, using the necessary technologies   • Adaptation to new situations   • Decision making   • Autonomous work   • Teamwork   • Work in an international environment   • Work in an interdisciplinary environment   • Promoting liberal, creative and inductive/deductive thinking

(3) SYLLABUS

Theoretical Lectures
• Introduction and overview of wireless networks: services and performance requirements of wireless networks, typical wireless network constellations, interactivity, multiple access and random access techniques, principles and design of cellular systems.

- Propagation models, shading and logarithmic distribution, coverage area, spectral performance improvement techniques in wireless and cellular networks.
- Fading and propagation issues, types of fading, time dispersion and frequently selective behaviour, Doppler effect, dispersion and spatial variation issues, broadband channel characteristics and impact on systems.
- Baseband transmission and physical layer techniques, modulation, coding, multiplexing, differentiation techniques, Multiple Input Multiple Output systems (MIMO).
- Spectrum spreading, direct sequence and frequency hopping spread spectrum, interference, multi-path RAKE receivers, multiple access with code division (CDMA), transmission of multiple carriers (Orthogonal Frequency Division Multiplexing), cyclic prefix, peak-to-average power ratio, frequency and timing offset.
- Multiple access techniques, Time / Frequency / Code / Space / Division Multiple Access, scheduling and random access.
- Wireless local area networks (WLAN), IEEE 802.11b/g/n/ac/ax, wireless network architectures and technologies GSM, UMTS, LTE, LTE-Advanced, management of wireless resources, communication and mobility, mobility management protocols, IP mobility protocols, TCP extensions in the presence of multiple network interfaces, Multicast TCP.
- Cloud computing and software defined networking (SDN) in next generation wireless networks, system architectures and design for CloudRAN (CRAN), virtualization of wireless Network Functions (NFV), Edge computing/networking in wireless infrastructures.
- Software Defined Radio (SDR), SDR architectures, SDR systems, description of SDR transceiver subsystems, Cognitive Radios and dynamic spectrum access/sharing.

Laboratory
Projects utilising the exploitation of software tools for simulation and analysis of wireless networks characteristics and performance:
- Transmission and reception modules for OFDM signals (MATLAB)
- Multiple access focused on TDMA, FDMA and CDMA techniques (MATLAB)

Projects with hardware modules for the creation of sine wave and square wave aby utilising the SDR technology, and implementation of a transceiver in the UHF band that makes use of the OFDM technique (LimeSDR platform).

(4) TEACHING METHODS - ASSESSMENT

MODE OF DELIVERY	In-Class Face-to-Face
USE OF INFORMATION AND COMMUNICATION TECHNOLOGY	• Use of ICTs in lecturing • Use of ICTs in laboratory-based training • Use of ICTs for the communication with students via the e-class platform • Specialised software tools for experimentation • Actual/real platform that supports technologies for WiFi, WiMAX, LTE, SDR, and Spectrum Analysis. • Support of the educational process via the e-class platform

TEACHING ORGANISATION	Method description / Activity	Semester Workload
	Lectures	39
	Tutorials	13
	Laboratory work	13
	Project-based assignments	20
	Journal/paper reading & theoretical study	15
	Non-guided personal study	50
	Total Contact Hours	**150**

ASSESSMENT METHODS	**Language of Assessment** Greek **Description** Written exams, laboratory evaluation and project evaluation **Student assessment methods** • Written examination with short answer questions (Concluding) • Written exams with multiple choice questions (Concluding) • Written assignment (Formative) • Public presentation (Formative) • Laboratory/project work (Formative) For the successful completion of the course the students must obtain a grade of ≥5.0 in both the final written examination and the laboratory work, as well as in the elaboration and public presentation of the project (theoretical study). The final grade of the course consists of: • Final written examination in the entire course content (65%), • Elaboration of theoretical project (10%) • Public presentation of the project (5%), • Elaboration of laboratory-based projects/work (20%). The assessment criteria are announced to students at the beginning of the semester and are published on the course webpage in the e-Class platform.

(5) RECOMMENDED BIBLIOGRAPHY

- Recommended Bibliography:
- *T. S. Rappaport, "Wireless Communications: Principles & Practice," 2nd Ed., Prentice-Hall:Upper Saddle River, NJ, ISBN-13: 978-0130930033*
- *K. Pahlavan & P. Krishnamurthy, "Principles of Wireless Networks: A Unified Approach", Prentice Hall Communications Engineering and Emerging Technologies Series, ISBN-10: 0130930032*
- *W. Stallings, "Wireless Communications & Networks", Prentice-Hall, Inc. Upper Saddle River, NJ, USA, ISBN-13: 978-0131918351*

- Relevant Scientific Journals:

- *IEEE Communications Magazine*
- *IEEE Wireless Communications*
- *Wireless Networks, Springer*
- *Wireless Personal Communications, Springer*
- *IEEE Communications Magazine, ComSoc*
- *IEEE Wireless Communications,*
- *IEEE Journal of Communications and Networks*
- *Transactions on Emerging Telecommunications Technologies (ETT), Wiley*