COURSE OUTLINE

(1) GENERAL

SCHOOL:	Engineering		
DEPARTMENT:	Electrical and Computer Engineering		
LEVEL OF STUDY:	Undergraduate		
COURSE UNIT CODE:	7.019	**SEMESTER OF STUDY**	7th
COURSE TITLE:	Mobile and Satellite Communications		

COURSEWORK BREAKDOWN	**TEACHING WEEKLY HOURS**	**ECTS Credits**
Theory (Lectures)	3	2
Tutorial/Project	1	1
Laboratory	1	2
	5	**5**

COURSE UNIT TYPE:	Special background
PREREQUISITES:	
LANGUAGE OF INSTRUCTION/EXAMS:	Greek
COURSE DELIVERED TO ERASMUS STUDENTS	No
MODULE WEB PAGE (URL)	https://eclass.hmu.gr/courses/ECE188/

(2) LEARNING OUTCOMES

Learning Outcomes

The course offers in-depth introduction to mobile and satellite communication networks. Specifically, the operating principles, architectures and specific features of mobile communications systems (GSM, GPRS / EDGE, 3G / UMTS, 4G / LTE, LTE-A) are discussed in detail, while an introduction is made to future fifth generation (5G) and sixth generation (6G) networks. At the same time, the understanding of the methods of analysis and design of satellite communication systems is sought. The aim of the course is students to understand concepts related to both the physical layer of mobile and satellite systems (radio coverage, cellular system design, wireless resource management, etc.), as well as the end-to-end data traffic and service provision (Flow Management data, mobility management, graded quality of service, etc.) in advanced mobile and satellite communications systems.

Upon successful completion of the course the student will be able to:

1. Know in depth the architecture, subsystems and protocols of Mobile and Satellite Communication systems.
2. Simulate and interpret basic physical level processes in mobile and satellite communication systems, such as: channel equalization, digital modulation, channel encoding.
3. Design different satellite orbits.
4. Analyze and design mobile and satellite links of specific telecommunication requirements.
5. Evaluate the final performance of mobile and satellite communication systems.
6. Study a topic of interest and write a relevant report (after first conducting thorough research in reputable sources of the international literature).

General Skills

- Search, analysis and synthesis of data and information, using the necessary technologies
- Adaptation to new situations
- Autonomous work
- Teamwork
- Work in an interdisciplinary environment
- Production of new research ideas

(3) COURSE CONTENT

Theoretical Lecture Units

- Evolution of mobile communication systems.
- Basic principles of cellular systems' design.
- Radio coverage models, installation of base stations.
- Types of interruptions, interferences and channel characterization.
- Mobility management and handover processes.
- Techniques for effective management and delegation of wireless resources.
- Modulation techniques for satellite and mobile communications:
  - Analog modulation methods. FM modulation.
  - Digital modulation techniques (BPSK, QPSK, OQPSK, FSK, DPSK).
  - Spectrum modulation techniques.
  - Decoding of digital signals.
  - Group encoding (MPSK, MFSK).
  - Digital channel rendering.
- Single and multiple access networks
  - Multiple frequency division access (FDMA / OFDMA),

- Time Division (TDMA)
- Code Division (CDMA)

- Space Diversity techniques. MIMO systems. Smart antennas.
- Channel encoding methods for error checking.
- GSM, GPRS / EDGE, UMTS, LTE and LTE-A architectures and protocols.
- Introduction to the technological features of 5G and 6G systems.
- Satellite links, geosynchronous and geostatic satellites, orbits and orbital mechanics.
- Satellite channels, analysis of the satellite links in terms of transmitted and received power, signal-noise relations and the effect of random factors.
- Use of adaptive filtering and calculation of the error probability in digital telecommunication systems.
- Satellite signal processing on the transponder and the effect of non-linearity of satellite amplifiers.
- Satellite Digital TV. Technical and functional characteristics, requirements and examples of applications.
- TCP / IP over satellite links.
- Mobile Satellite Communications
- VSAT Networks (Very Small Aperture Terminals)

Laboratory Exercises

The proposed laboratory exercises are intended to cover the theoretical part of the course. There will be laboratory exercises related to:

- Base station installation features,
- Radio coverage studies,
- Frequency assignment studies,
- Interference studies,
- Simulation of mobile communication networks through software tools
  - o Incoming call management (Call Admission Control),
  - o Wireless channel quality control (links with or without line of sight)
  - o Transmission rate management with Adaptive Modulation and Coding (AMC).
- Study of signal transmission and detection in the presence of noise.
- Study of satellite parabolic mirror antenna.
- Study of signal-noise relationship (thermal noise, intermodulation noise, non-linear distortion, group delay) in satellite links.
- Study of effects of propagation medium (multi-propagation, interruption mechanisms) on the quality of a satellite link.
- Computer simulation of satellite links' operation
- Study of links and explanation of additional interferences in practice (eg the Doppler effect).

(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
TEACHING ORGANISATION	

Method description / Activity	Semester Workload
Lectures	52
Laboratory work	13
Non-guided personal study	32
Project-based assignments	40
Homework	13
Course Total	**150**

ASSESSMENT METHODS

Language of Assessment
Greek

Student assessment methods

1. Written final examination (40%)
   - with exercises
   - with multiple choice questions
2. teamwork assignment for the theoretical part of the course (with written report and oral assessment) (20%).
3. teamwork assignment for the laboratory part of the course (with written report and oral assessment) (30%).
4. Homeworks (10%).

The course evaluation criteria are announced to the students at the beginning of the semester and are posted on the course website in eClass.

(5) RECOMMENDED BIBLIOGRAPHY

-Recommended Bibliography:

1. Α. Κανάτας, Φ. Κωνσταντίνου, Γ. Πάντος «Συστήματα Κινητών Επικοινωνιών», Παπασωτηρίου, 2013.
2. Μ.Ε. Θεολόγου, «Δίκτυα Κινητών και Προσωπικών Επικοινωνιών», 2η έκδοση, Εκδόσεις Τζιόλα, 2010.
3. Λούβρος Σπυρίδων, «Το Δίκτυο LTE», Εκδόσεις Νέων Τεχνολογιών, 2014.
4. S. R. Saunders, A. Aragon-Zavala, "Κεραίες και διάδοση για ασύρματα συστήματα επικοινωνιών", ΕΚΔΟΣΕΙΣ ΠΕΔΙΟ Α.Ε., 2016
5. Cell Planning for Wireless Communications, Manuel F. Catedra, et al, Artech House Mobile Communications Library
6. Cellular Communications: Worldwide Market Development (Artech House), Garry A. Garrard, Garry Gerrard, Artech House
7. GSM and Personal Communications Handbook, Siegmund Redl, Artech House Mobile Communications Library
8. The Mobile Communications Handbook, Jerry D. Gibson, R.C. Dorf, Electrical Engineering Handbook Series
9. Third Generation Mobile Communications Systems, Ramjee Prasad, Warner Mohr, Artech

House
10. Δ. Βουγιούκας, "Δορυφορικές Επικοινωνίες- Τεχνολογίες, Συστήματα και Εφαρμογές", ΣΕΑΒ, Κάλλιπος, Αθήνα, 2016.
11. G. Maral, M. Bousquet, "Δορυφορικές Επικοινωνίες : Συστήματα, Τεχνικές και Τεχνολογία", 5η Έκδοση, Εκδόσεις Τζιόλα, Θεσσαλονίκη 2012.
12. T. Pratt, C. W. Bostian, and J. E. Allnutt, Δορυφορικές Επικοινωνίες, John Wiley and Sons, 2nd ed., 2003 (μετάφραση: Α. Κανάτας).

Relevant Scientific Journals:

- IEEE Communications Surveys and Tutorials
- IEEE Communications Magazine
- IEEE Journal on Selected Areas in Communications
- IEEE Access
- IEEE Wireless Communications
- Wireless Networks, Springer
- Wireless Personal Communications, Springer
- Transactions on Emerging Telecommunications Technologies (ETT), Wiley