AEEE444 - Wireless Communications

Course Title	Wireless Communications				
Course Code	AEEE444				
Course Type	Technical Elective				
Level	BSc (1st Cycle)				
Year / Semester	4th / Spring				
Teacher's Name	Associate Prof Symeon Nikolaou				
ECTS	6	Lectures / week	3	Laboratories/week	0
Course Purpose	The aim of the course is to familiarize the students with the concepts and principles of wireless and cellular communications. Students should be in position to analyze the radio coverage area using the Friis' equation and the empirical models that dictate the propagation environment under investigation. They should be able to distinguish between slow and fast channels and between frequency selective and flat fading channels. Students should be able to analyze the basic characteristics of cellular mobile phone systems and distinguish between competing multiple access schemes, such as TDMA, FDMA, and the modern widespread schemes of OFDMA and WCDMA. They should also be in position to use the basics of queuing theory and the Erlang models to define the call rejection probability for a given re-use factor and for given total bandwidth.				
Learning Outcomes	By the end of the course, students must be able to: 1. Argue for the conditions under which a transmitter should operate to provide adequate coverage for a given sensitivity receiver. 2. Determine the conditions for frequency selective and flat fading wireless channel. 3. Determine the conditions for a slow or fast fading wireless channel. 4. Compare the available digital communication schemes considering the bandwidth limitations, and the regulations applied to wireless communications. 5. Break down the wireless coverage area into cells for a given re-use factor 6. Appraise the current 4G system and compare it with the previous 3G and the upcoming 5G cellular communication system. 7. Apply the main principles of wireless communications to analyse wireless sensor networks and IoT/IoE networks considering the 5G Key Enabling Technologies of beam forming and wireless powered communications.				
Prerequisites	AEEE321	Corequisites	None		

Course Content	**Introduction to wireless communications**: Review of fundamental concepts of wireless communication systems. Definition of the wave propagation and noise for wireless communications systems. **Wireless Channel** Large scale propagation fading. Free space model, Okumoura model, Hata model Small scale fading. Power delay profile. Flat and frequency selective fading. Slow and fast fading. **Wireless techniques:** Examination of modulation and frequency concepts in wireless communication systems. Examination of coding and time-division multiple access techniques. Evaluation of digital and adaptive modulation techniques. Analysis of diversity, capacity and space-division multiple access. **Wireless Networks** Estimation of the entropy and capacity of wireless channels. Evaluation of spread spectrum, CDMA and multi-user wireless systems. **Propagation and Noise.** Effect of noise for multiple access schemes: Modulation and Frequency-Division Multiple Access. Coding and Time-Division Multiple Access. Spread Spectrum and Code-Division Multiple Access.
Teaching Methodology	Students are taught the course through lectures (3 hours per week) in classrooms or lectures theatres, by means of traditional tools or using computer demonstration. Topic notes are compiled by students, during the lecture can also be downloaded from the lecturer's webpage. Students are also advised to use the subject's textbook or reference books for further reading and practice in solving related exercises. Tutorial problems are also submitted as homework and these are solved during lectures or privately during lecturer's office hours
Bibliography	**(t) Textbooks:** • T. Rappaport, "Wireless Communications: Principles and Practice", 2nd ed. Pearson, 2002 **(u) References:** • Simon Haykin, Michael Moher, ''Modern Wireless Communications'' , Prentice Hall, 2005. • Andreas F. Molisch, Wireless Communications, 2nd, Wiley-IEEE, 2010. • Wireless Communications", A. Goldsmith, Cambridge University Press, 2005.

Assessment	The Students are assessed via continuous assessment throughout the duration of the Semester, which forms the Coursework grade and the final written exam. The coursework and the final exam grades are weighted 40% and 60% respectively, and compose the final grade of the course. Various approaches are used for the continuous assessment of the students, such as mid-term written exam, quizzes. The assessment weight, date and time of each type of continuous assessment is being set at the beginning of the semester via the course outline. An indicative weighted continuous assessment of the course is shown below: • Assignments/Quizzes 20% • Mid-Term written exams 80% Students are prepared for final exam, by revision on the matter taught, problem solving and concept testing and are also trained to be able to deal with time constrains and revision timetable. The criteria considered for the assessment of each type of the continuous assessment and the final exam of the course are: (i) the comprehension of the fundamental concepts and theory of each topic, (ii) the application of the theory in solving related problems and (iii) the ability to apply the above knowledge in more complex design problems. The above criteria are weighted 20%, 60% and 20%, respectively. The final assessment of the students is formative and summative and is assured to comply with the subject's expected learning outcomes and the quality of the course.
Language	**English**