AEEE501 - Advanced Digital Communication Systems

Course Title	Advanced Digital Communication Systems				
Course Code	AEEE501				
Course Type	Compulsory				
Level	MSc				
Year / Semester	1 /1				
Teacher's Name	Dr. Haris Haralambous / Prof M. Komodromos				
ECTS	8	Lectures / week	3	Laboratories/week	None
Course Purpose	The aim of the course is to familiarize students with advanced concepts and principles of Digital Communications, in order to analyse digital communication systems in terms of their transmission characteristics and subsequently to design advanced communication system architectures by selecting basic building blocks with appropriate parameters under specific bandwidth and transmission rate constraints.				
Learning Outcomes	By the end of the course, students must be able to: 1. Define mathematical models for channels and explain their characteristics. Differentiate between types of channels. 2. Manipulate baseband, bandpass deterministic and random signals in the time domain and evaluate their spectra in the frequency domain using Fourier transforms. 3. Describe digital baseband and bandpass modulation schemes. Analyse and evaluate their performance. 4. Analyse waveform and vector channel models in AWGN. 5. Implement and evaluate optimal receivers for AWGN channels. 6. Evaluate and compare PSK, QAM systems and digital signalling methods. 7. Describe spread spectrum communications systems and direct sequence signals. Evaluate their error rate performance. Outline applications of spread spectrum systems.				
Prerequisites	None		Corequisites		None
Course Content	• Basics of Digital Communications, Basic elements of a digital communication system. Communication channels and their characteristics. Mathematical models. • Signal analysis of deterministic and random signals. Fourier transforms. Representation of baseband and bandpass signals. Vector space representations. Orthogonal expansions. Random variables and random processes. • Digital Modulation Schemes, Pulse Amplitude Modulation, Quadrature				

	Amplitude Modulation, Phase Modulation, Continuous phase Frequency Shift Keying Multidimensional signaling, Power spectral density of digitally modulated signals. • Optimum Receivers for AWGN, Waveform and vector channel models, Optimal detection, Implementation of the optimal receiver for AWGN channels. • Demodulation and detection, Error probabilities for PSK and QAM, Noncoherent detection, Comparison of of digital signalling methods, Detection of signalling schemes with memory, Optimum receivers of CPM signals, Effects of Noise and eye patterns, Intersymbol interference. • Performance analysis for wireline and radio communication systems, Regenerate repeaters and link budget analysis. • Spread Spectrum Communication: Model of SS digital communication system, Direct sequence signals, Error rate performance, applications of spread spectrum systems.
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. Auditory exercises, where examples regarding matter represented at the lectures, are solved and further, questions related to particular open-ended topic issues are compiled by the students and answered, during the lecture or assigned as homework. Topic notes are compiled by students, during the lecture which serve to cover the main issues under consideration and can also be downloaded from the e-learning platform or 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	**(a) <u>Textbooks:</u>** • J. Proakis and Masoud Salehi, ***Digital Communications***, 5th edition, McGraw-Hill, 2008. **(b) <u>References:</u>** • Papoulis and S. U. Pillai, ***Probability, Random Variables and Stochastic Processes***, 3rd edition, McGraw-Hill, 2002.
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, oral exam, quizzes, design assignments and design projects. 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 10% • Homework 10% • Mid-Term written exams 40%

	• Quizzes 10% • Group project 30% Students are prepared for final exam, by revision on the material 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 30%, 40% and 30%, 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. The group project is a research activity undertaken by a group of students. It is based on a collective effort to perform an extensive literature review on a particular subject in order to propose, analyse and design a digital communication solution to meet certain system requirements and constraints.
Language	**English**