Course unit title:	Communications Systems I		
Course unit code:	AEEE321		
Type of course unit:	Compulsory		
Level of course unit:	Bachelor (1st Cycle)		
Year of study:	2		
Semester when the unit is delivered:	5 (Fall)		
Number of ECTS credits allocated :	6		
Name of lecturer(s):	Dr. Symeon Nikolaou		
Learning outcomes of the course unit:	1. Analyze continues systems and signals in time and frequency domain and determine the concepts of instantaneous and time-averaged values 2. Construct AM communication systems and combine system units to assembly DSB-AM, SSB-AM and DSB-SC-AM modulation, transceivers. 3. Determine the structural units of angle modulation systems and modify proposed communication systems to accommodate the need for PM, FM and NBFM modulation considering the frequency domain limitations. 4. Compare and argue the performance of AM and PM communication systems and assess the effect of noise in the transceiver's complexity and modulation's effectiveness. 5. Experiment with the taught communication units using the available simulation packages at the laboratory and justify the selection of a communication system upon the application.		
Mode of delivery:	Face-to-face		
Prerequisites:	AEEE223	Co-requisites:	None
Recommended optional program components:	None		
Course contents:	• **Amplitude Modulation** Study and analyze Amplitude Modulation (AM) systems, DSB-AM, Modulation index and efficiency, carrier frequency, side-frequencies, spectrum and spectrum plots. Single tone and multi-tone modulation. Over-modulation and distortion. Spectrum. Other forms of AM, DSB-SC-AM, SSB-AM and Vestigial Sideband. Spectra. AM transmitters. Demodulation schemes of AM signals. Study the super-heterodyne receiver and the Costas Loop. Operation of the mixer, the envelope detector and the product detector. Costas Loop. SSB-AM demodulation. Phasing and filtering method. • **Angle Modulation** Phase Modulation, PM. Phase function and complex envelope. Phase deviation, modulation index, spectrum and bandwidth. Tone modulation. Carson's rule. Plots. Frequency Modulation, FM. Instantaneous frequency and frequency deviation. Sensitivity and modulation index. Bandwidth and Carson's rule. Spectrum of single		

	tone modulation using Bessel functions. Narrowband and wideband FM. Generation and demodulation. Pre-emphasis and de-emphasis systems. Frequency Division Multiplexing transmitter, receiver and spectra. • **Noise in Communication Systems** Noise. Signal-to-Noise ratio. Noise figure. Cascaded devices. Friis' theorem. Link budget evaluation. • **Laboratory Experiments** <u>Introduction to Communications</u> Information, information sources, analog and digital. Deterministic and random signals. Channels. Communication systems. Frequency allocation. Instantaneous power and average power, rms value, Decibel. Signal to Noise ratio. Spectrum. Overview of Fourier series, Fourier Transform and spectrum of signals. <u>*Amplitude Modulation (AM)*</u> General form of bandpass signals. Complex envelope. Amplitude Modulation. DSB-AM, SSB-AM and DSB-SC-AM. Modulation index and efficiency, carrier frequency, side-frequencies, spectrum and spectrum plots. Over-modulation and distortion. Average power and peak envelope power. Envelope detector. Multi-tone modulation. Power of AM signals. Generation and demodulation of AM. Costas Loop. Super-heterodyne receiver. <u>*Angle Modulation*</u> Phase Modulation, PM. Phase function and complex envelope. Phase deviation, modulation index, spectrum and bandwidth. Tone modulation. Carson's rule. Frequency Modulation, FM. Instantaneous frequency and frequency deviation. Sensitivity and modulation index.. Bandwidth and Carson's rule. Spectrum of single tone modulation using Bessel functions. Narrowband and Wideband FM. Generation and demodulation. Pre-emphasis and de-emphasis. Frequency division multiplexing. <u>Noise in Communication Systems</u> Noise. Signal-to-Noise ratio. Noise factor and noise figure. Cascaded devices. Friis' theorem. Link budget evaluation.
Recommended and/or required reading:	
Textbooks:	Leon W. Couch II, ***Digital and Analog Communication Systems***, 7th ed. Prentice Hall 2007
References:	1. B. P. Lathi, *Modern Digital and Analog Communication Systems*, 3rd edition, Oxford University Press, 1998. 2. John Proakis and Masoud Salehi, *Communication Systems Engineering,* Second edition, Prentice Hall, 2002. 3. S. Haykin, *Communication Systems,* 4th edition, John Wiley and Sons, 2001.

Planned learning activities and teaching methods:	The taught part of course is delivered to the students by means of lectures, conducted with the help of computer presentations. Lecture notes and presentations are available through the web for students to use in combination with the textbooks. Lectures are supplemented with laboratory work carried out at the communications laboratory. During laboratory sessions, students develop the systems and perform simulations of the time and frequency domain response using a computer based emulator.
Assessment methods and criteria:	• Assignments 5% • Tests: 20% • Laboratory Work: 15% • Final Exam 50%
Language of instruction:	English
Work placement(s):	No