COURSE PROFILE

Course Number : EE 370	**Course Title : Introduction to Communication Systems**
Required / Elective : Required	**Pre-requisite :** EE353, MATH230
Catalog Description: Review of Fourier transforms, linear systems. Bandpass processes and systems, Hilbert transform. Linear and angular modulation, modulator and demodulators. Frequency translation and FDM. Review of probability and introduction to random processes. Noise analysis of communication systems. Sampling and quantization. Pulse modulation, PCM and TDM. Matched filters, intersymbol interference.	**Textbook / Required Material :** Haykin and Moher. *Introduction to Analog & Digital Communications, 2nd Ed*. New Jersey: Wiley, 2007.
Course Structure / Schedule : (3+0+1) 3 / 6 ECTS	
Extended Description: Introduction to Communication Systems is a senior level treatment of communication systems, with an emphasis on analog communications, as well as some introductory material on digital communications. The goals of this course are – To introduce mathematical tools and concepts, such as Hilbert transform, and ways to obtain more manageable representations of pass-band signals and systems, – To develop an understanding of the fundamental stages of a communication system, such as modulators and demodulators, and how they work, – To convey the principals of several modulation (analog and digital) techniques, their practical usage areas and their performances under several channel models, – To introduce the concept of random processes, they key properties, and their relevance to communication system analysis, especially modelling of noise, – To investigate the challenges of the communication channel such as noise, bandwidth limitation, interference, and to present methods to overcome these challenges. – To provide the students with some hands on experience on how to design, construct and test simple communications hardware, and how to simulate such systems using computer tools.	
Design content : Team project, focusing on design of simple modulator and demodulator circuits.	**Computer usage:** Project, focusing on simulation of modulation and demodulation techniques, and SNR calculations using MATLAB.
Course Outcomes: a. Ability to use transform domain analysis to understand the concept of modulation, the need for modulation, and its effect on spectra of signals. [2,3,6] Relevant Content: Usage of Fourier and Hilbert transforms, to obtain baseband equivalent representation of pass-band signals and systems, application of Fourier	

transform to analyze the effect of modulation on the signal spectra,

b. Ability to describe and identify random processes, and to compute their statistical properties relevant for communication. [2,6]

   Relevant Content: extension of knowledge on random variables to random processes, usage of random processes to model noise, compute its energy, and its effect on the performance of modulation systems.

c. Ability to model the communication channel using time and frequency domain analysis and random processes, and quantify the effect of noise in communication systems [2,6]

   Relevant Content: Modeling of communication systems and the effects of noise and dispersion on these systems, characterization of transmitted and received signal spectra, computation of signal to noise ratios.

d. Ability to appreciate the need for effective use of scarce resources such as power and bandwidth, and the trade-offs in system design [Outcome 3,6,7]

   Relevant Content: Basic understanding of the widespread and vastly varied use of communications, the need for effective use of scarce resources such as power and bandwidth, and ways to provide that effective use, and trade-offs involved while choosing/designing modulation techniques.

e. Ability to analyze and evaluate the performance of basic communication techniques, and to design communication system components to satisfy given requirements. [6,7]

   Relevant Content: Evaluation of performance of modulation and demodulation techniques, design and implementation of modulators and demodulators with given specifications.

f. Ability to design and implement basic modulator and demodulator circuits, simulate modulation and demodulation techniques, and their performance in noise. [7,8]

   Relevant Content: Class project, conducted in teams, involving hardware, and software (MATLAB) components that encourage project management and parallel independent work.

g. Ability to effectively explain the basic principles of communication systems and results of related designs and simulations, via oral and visual tools. [9],

   Relevant Content: Class project presentations and report, midterm examination conducted in the form of an oral-exam.

h. Ability to perform an introductory level analysis in advanced graduate topics [10]

   Relevant Content: Some references to advanced topics at graduate level, as related to course material; introduction to topics in random processes, serving as stepping stones to graduate programs, and projects which motivate self learning.

i. Ability to use basic analog circuit design tools, and MATLAB, for modeling, simulation, and design of communication systems [7,11]

Relevant Content: One or more of: design and performance analysis of modulators and demodulators, modeling communication channels, and simulation of several communication architectures using MATLAB.

The contribution of this course to the program outcomes can be rated as follows:

Outcomes 2,6,7,11 : SIGNIFICANT

Outcomes 8,9 : MODERATE

Outcomes 3,10: SOME

Recommended reading:

Proakis and Salehi. *Fundamentals of Communication Systems*. New Jersey: Pearson Prentice Hall, 2005.

Teaching Methods:

Pre-readings, lecture and problem/discussion sessions, individual exercises and projects, group projects.

Assessment Methods:

- Exams (written and oral) [Course outcomes a,b,c,d,e,g].
- Portfolios (programming and design projects, presentations) [d, e, f, h, i].
- Class surveys, exit surveys [d,g,h].

Student Workload:

Preparatory reading	28 hrs
Lectures,workshop, discussions	56 hrs
Homeworks	18 hrs
Presentations	3 hrs
Projects	40 hrs
Midterm Exam	2 hrs
Final Exam	3 hrs
TOTAL ……	**150 hrs to match 25 x 6 ECTS**

Prepared by : Onur Kaya	Revision Date : 03/02/2010