KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
ELECTRICAL ENGINEERING DEPARTMENT

EE 571 Digital Communications I

First Semester (111), Ver. 2.0

Prerequisites : EE370, EE315 or equivalent courses.

Instructor : Dr. Ali H. Muqaibel, Office: 59-1088, Phone: 1595 E-mail: muqaibel@kfupm.edu.sa
Web Site: http://faculty.kfupm.edu.sa/ee/muqaibel or WebCT

Course Objectives:

- Understand basic components of digital communication systems.
- Design optimum receivers for digital modulation techniques.
- Analyze the error performance of digital modulation techniques.
- Design digital communication systems under given power, spectral and error performance constrains.

Course Description: Time and frequency representation of signals. Spectral density and autocorrelation. A/D and D/A conversion. PAM and PCM systems. Detection of binary and M-ary signals in Gaussian noise. Matched filter and correlator receivers. Pulse shaping. Band pass modulation and demodulation techniques. Error performance for binary and M-ary systems. Spectral Analysis of digital signals. Communication link analysis.

Course Outline:

Review: Sampling theorem, analog-to-digital conversion and PCM, random variables and stochastic processes.

Detection Theory: Vector channels, detection of signals in noise, decision rules such as MAP and maximum likelihood rules, waveform channels, error probability of baseband signals.

Modulation Techniques: Bandpass signal representation, noise characterization in bandpass systems, orthogonal expansion of signals [4.2.3], phase and frequency shift keying, quadrature modulation, differential and M-ary modulation schemes, coherent and noncoherent receivers, correlator, matched filter and envelop detector. [5.1]

Performance of Modulation Techniques: Computation of the error probability for different modulation techniques and water-fall error curves. [5.2]

Spectral Characterization: [4.4]

Spectral characterization of modulation techniques, bandwidth definitions, pulse shaping, spectrally-efficient modulation schemes such as OQPSK, $\frac{\pi}{4}$-QPSK, MSK, GMSK and CPM.

Comparison of Modulation techniques:

Channel capacity theorem [7.1], maximum information rate in a communication system, power and spectral efficiency of modulation techniques, link budget [5.5].

Textbook:

- J. Proakis, Digital Communications, McGraw-Hill Prentice-Hall, 4th edition, 2001. (Ch1,2,4,5,6,7)
- Lecture notes.

References:

- Papoulis, Probability, Random Variables, and Stochastic Processes, McGraw-Hill, 1965.
- J. Wozencraft and I. Jacobs, Principles of Communication Engineering, John Wiley & Sons, 1965.
- H. Van Trees, Detection, Estimation and Modulation Theory, John Wiley & Sons, 2001.

- Sklar, Digital Communications Fundamental and Applications, Prentice-Hall, 1988.
- S. Wilson, Digital Modulation and Coding, Prentice-Hall, 1995.

Homework Assignments:

Homework will be issued about once every two weeks. Collaborative work is encouraged between students. However, solutions are to be worked out and submitted individually.

Grading Policy:

Homework problems	12%	
Exam I	20%	Saturday of Week 7 (Oct. 22, 2011, Class time)
Exam II	20%	Saturday of Week 12 (Dec. 3, 2011, Class time)
Quizzes	8%	
Final Exam	30%	
Term Paper	10%	

Coverage Outline: *(Time and emphasis may be adjusted as needed)*

No.	Topic	Lectures	Reading
1	**Review** • Introduction to the course • Basic Elements of Digital Communication Systems, Sampling theorem, analog-to-digital conversion and PCM. • Communication Channels • Random variables and stochastic processes.	**5**	Ch1 Ch2
2	**Characterization of Communication Signals and Systems** • Representation of Band-Pass Signals and Systems • Signal Space Representations • Representation of Digitally Modulated Signals • Spectral Characteristics of Digitally Modulated Signals	**10**	Ch4
3	**Optimum Receivers for the Additive White Gaussian Noise Channel** • Optimum Receiver for Signals Corrupted by Additive White Gaussian Noise • Performance of the Optimum Receiver for Memoryless Modulation • Optimum Receiver for CPM Signals • Optimum Receiver for Signals with Random Phase in AWGN Channel • Performance Analysis for Wireline and Radio Communication Systems	**10**	Ch 5
4	**New Developments in Digital Communication**	**1**	
5	**Projects' Presentations**	**2**	
6	**In Class Major Exams**	**2**	