Elective Course: ECE 544: Introduction to Digital Communications
Spring Semester 2004

Course Description: Credit 3.
Prerequisite: ECE301, ECE302, ECE 440. Introduction to digital communication systems and spread spectrum communications. Signal space representation of digital signals, binary and M-ary signaling methods, detection of binary and M-ary signals, comparison of digital communication systems in terms of signal energy and signal bandwidth requirements, signal design for bandlimited channels, modulation codes for spectral shaping. The principal types of spread-spectrum systems are analyzed and compared. Application of spread spectrum to multiple-access systems and to secure communication systems is discussed.

Prerequisite: ECE301, ECE302, and ECE 440.

Prerequisites by topic: Fourier Series and Transforms, Probability, Random Variables, Random Processes, Autocorrelation Functions, Power Spectral Density Functions.

Textbook: John G. Proakis, Digital Communications, 4th Edition, McGraw Hill, 2000. ISBN 0-07-232111-3

Coordinator: Paul Salama, Associate Professor of Electrical and Computer Engineering

Goals: To introduce digital communication systems, signaling methods, detectors, signal space representations, signal design, and spread spectrum communications.

Outcomes: Upon successful completion of the course, students should be able to

1. Determine the frequency content of any signal, that is, the student should be capable of obtaining the signal's Fourier Series and/or its Fourier Transform. [a]
2. Determine the lowpass equivalent or a given narrowband bandpass signal. [a]
3. Determine whether a mathematical representation of a signal is a PAM, a PPM signal, a PFM, a QAM, a simplex FM signal, or a multidimensional signal. [a]
4. Determine the signal space representation of a PAM, a PPM signal, a PFM, a QAM, a simplex FM signal, and a multidimensional signal. [a]

5. Determine whether a visual representation of the signal space representation is that of a PAM, a PPM signal, a PFM, a QAM, a simplex FM signal, or a multidimensional signal. [b2]
6. Determine the appropriate matched filter after determining the nature of the signal to be demodulated. [a, c]
7. Given the mathematical representation of a modulated signal, determine the power spectrum. [a]
8. Given the visual representation of a modulated signal and/or of its signal space representation, determine its power spectrum after determining the nature of a modulated signal. [b2, e]
9. Determine the probability of error committed by a decoder given the probability distribution of the corrupting noise and the a priori probabilities of the signal for a given ASK, PSK, or FSK signal. [a]
10. Determine the Signal-to-Noise ratio of the output of the demodulator when the modulated signal has been corrupted by additive noise. [a]
11. Design signal pulses for bandlimited channels. [a, c]
12. Choosing modulation codes for spectrum shaping. [a, c]

Topics:

1. Overview Elements of a Digital Communication System
2. Representation of Bandpass Signals and Systems
3. Signal Space Representation
4. Representation of Digitally Modulated Signals
5. Power Spectra of Digitally Modulated Signals
6. Optimum Receivers for Signals Corrupted by AWGN
7. Performance of Optimum Receivers for Memoryless **Modulation**
8. Noncoherent Demodulation
9. Signal Design for Communication Through Bandlimited Channels
10. Introduction to Spread Spectrum Communications

ABET category: Engineering science 3 credits or 100 %

Prepared by: Paul Salama Date: September 2, 2005