EE 460 - Communication Systems II

Designation: EE elective course for electrical engineering majors.

University Bulletin Description: EE 460: (3) Probability fundamentals, digital/analog modulation/demodulation, system noise analysis, Signal-to-Noise ratio and Bit Error Rate calculations, optimal receiver design concepts, introductory information theory.
Prerequisite: EE 360.

Prerequisites by Topics:
1. Understanding and ability to analyze problems using probability, random variables.
2. Understanding of linear systems and ability to analyze signals through linear systems.
3. Knowledge of Fourier series and Fourier transforms and signal representation by orthogonal signal sets, in general.
4. Knowledge of Sampling Theorem and baseband modulation schemes.
5. Knowledge of analog amplitude and angle modulation and demodulation systems.
6. Knowledge of principles of digital data transmission and emerging digital communications technologies.

Textbook/Required Materials:
Modern Digital and Analog Comm. Systems, 3rd ed., B. P. Lathi, Oxford University Press, 1998.

Learning Outcomes:
This course covers basics of probability, random variables and processes. Also, it covers techniques involved in the design of communications systems. The emphasis is on principles and the background necessary to fully understand the communications systems design rules.

Topics:
1. Introduction To Theory of Probability; definitions - random variables - statistical averages - central limit theorem -correlation.
2. Random Processes; definitions - power spectral density - transmission of random signals through linear systems – band-pass random signals.
3. Behavior of Analog Systems in the Presence of Noise; baseband systems, amplitude-modulated systems (AM) – frequency-modulated and angle-modulated systems (FM and PM).
4. Digital Transmission in Presence of Thermal Noise; optimum threshold detection - general analysis: optimum binary receiver - carrier systems: ASK, FSK, PSK and DPSK - M-ary communications.
5. Optimum Signal Detection; Geometric Representation of Signals: signal space - Gaussian random process - optimum receiver - equivalent signal sets - colored channel noise.
6. An Introduction to Information Theory; measure of information - capacity of a continuous channel- practical communications systems in light of Shannon's Theory.

Class/laboratory schedule: Two one hour and 15 minutes lectures per week ~~plus three 3 hours exams in the evenings~~.

Computer usage: MATLAB software is used in signals and systems analyses in homework assignments.
Laboratory Projects/Assignments:

Contribution to Meeting the Requirements of Criterion 5. Curriculum:
This course contributes to both the engineering topics and design components.
This course provides insights into designing transmission systems and shows how to apply appropriate performance measures in order to counter the deleterious effects of transmission impairments. It is a prerequisite to our first year graduate level courses in communications.

Relationship to Program Outcomes:

O.1.1. Graduates will possess mathematics skills necessary for electrical engineering.
O.1.3. Graduates will have attained computer proficiency.
O.2.3. Graduates will understand the basic concepts of linear systems and how they interact with continuous-time signals.
O.2.5. Graduates will have knowledge of digital systems.
O.3.1. Graduates will have in-depth technical knowledge in one or more areas of specialization.
O.3.2. Graduates will have practical understanding of the major electrical engineering concepts and demonstrate application of their theoretical knowledge of the concepts.
O.6. Graduates will appreciate their role as engineers in society.

Prepared by: John Doherty **Date:** May 8, 2008