ECE 515 "Digital Communications"

Spring 2009

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EBII 2096
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TA information and office hours will be announced by email asap.

Prerequisites:
Probability and Stochastic Processes (ECE 514 or equivalent); Signals and Linear Systems; Linear Algebra.

Textbook:
Proakis, G., *Digital Communications*, McGraw-Hill, Fourth Edition. ISBN: 0-07-232111-3 or Fifth Edition (co-authored by Salehi, M., ISBN 9780072957167)

Course Objectives:
To develop fundamental design and analysis techniques necessary for understanding and working with modern digital communication systems.

Course Description:
This course is first graduate-level course in digital communications. Functions and interdependence of various components of digital communication systems will be discussed. Statistical channel modeling, modulation and demodulation techniques, optimal receiver design, performance analysis techniques, source coding, quantization, and fundamentals of information theory will be covered in this course.

Course Requirements:

Homework	10%
Midterm	30%
Final exam	35%
Project	25%

+/- grading policy will used. The course cannot be taken for S/U grading.

Audit Requirements:
Audit students will receive AU grade if they receive a passing score on at least half of the homework assignments, or pass one exam, or pass one part of the project.

Homework consists of problems. Homework solutions will be handed out.

Project will be performed in groups by on-campus students. Distance education students can work in groups or individually. Project will be assigned after the midterm. It will consist of two parts:
Part 1: Report on a selected topic (a list of possible topics will be provided). For on-campus students, presentation might be included. This will be announced when projects are assigned.
Part 2: Simulation assignment - the same for all groups and not related to the report in Part 1.
Students that work individually can choose to turn in only Part 2 to receive full credit.

Engineering online (EOL) students are required to turn in homework and projects to the EOL office. The deadlines for receiving work will be specified for each assignment. Assignments sent to the instructor or the TA will not be accepted.

Computer Software: MATLAB or C++ (or another high-level language); word processing software.

Exams will contain problems and multiple choice questions. Exams will be closed book. 3 pages of notes and a conventional calculator will be permitted. Final will be comprehensive. Exams will be based on homework problems, textbook material, and class notes.

Depth of presentation in class will vary. Homework assignments and projects will complement the material presented in class.

Late homework assignments and projects will not be accepted. Extensions (at most one per person during the semester) may be granted by the instructor in rare cases. If second extension is needed, please follow the exam policy below.

Exam policy. If a student misses an exam and wishes to receive credit for that exam, or if a student requires extra time, the instructor or the TA should not be contacted directly. The University counselor's office should be contacted first. The counselor will examine relevant documentation, and will contact the instructor as appropriate.

Students with Disabilities Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 515-7653.

Academic Integrity All the provisions of the code of academic integrity apply to this course. In addition, it is my understanding and expectation that your signature on any test or assignment means that you neither gave nor received unauthorized aid.

Supplementary References and Useful Web Sites:

E. A. Lee, D. G. Messerschmitt, "Digital Communication," Kluwer, 2004.

R. E. Ziemer, R. L. Peterson, "Introduction to Digital Communication," Prentice Hall, 2001.

J. G. Proakis, M. Salehi, "Contemporary Communication Systems Using MATLAB and Simulink," Thomson Brooks/Cole, Second Edition, 2004.

http://www.cyclismo.org/tutorial/matlab/

Syllabus

Chapter references to the 4th edition of the textbook are provided. (References to the 5th edition are provided in parentheses if chapter numbers are not the same.)

I. Introduction.

Proakis, Chapter 1. Basic elements of digital communication systems; communication channels; mathematical models; brief history; performance measures.

Objective: You will learn to identify the functions of different components of a digital communication system.

II. Review: Probability and Stochastic Processes.

Proakis, Chapter 2.

Objective: You will recall some mathematical concepts necessary for the remainder of the course.

III. Characterization of Signals and Systems.

Proakis, Chapter 4 (Ch. 2 and 3). Bandpass Signals and Systems; Signal Space Representations; Digital Modulation Methods; Spectral Characteristics of Digitally Modulated Signals.

Objective: You will convert a digital bandpass signal to an equivalent complex lowpass signal; represent transmsitted signals for several modulation methods; draw signal space diagrams; compute spectra of modulated signals.

IV. Optimum Receivers for the Additive Gaussian Noise Channel.

Proakis, Chapter 5 (Ch. 4). Correlation and Matched Filter Receivers; Performance of the Optimal Receiver;

Objective: You will design correlation and matched filter receivers; compute the probability of error for several demodulators; compare modulation methods based on the error rate and spectral efficiency.

V. Introduction to Information Theory - Source Coding and Channel Capacity and Coding.

Proakis, Chapters 3 and 7 (Ch. 6). Entropy; Source Models; Source Coding; Quantization; Average Mutual Information; Channel Models and Channel Capacity.

Objective: You will learn about theoretical bounds on the rates of digital communication systems. Principles of source coding and quantization will be introduced.

Other topics and applications will be addressed in the projects.