

University of Massachusetts
Department of Electrical and Computer Engineering
ECE 564/645 - Communication Systems/Digital Communications
Spring, 2014

<http://www.ecs.umass.edu/~goeckel/commsystems.html>

Objective: It is difficult to overstate the degree to which digital communications has impacted society. What most people do not understand is the sophisticated models and deep mathematics which has made such an impact possible - solving the *very* difficult wireless communications problem. The objective of this course is to provide an introduction to the field of digital communications at a high mathematical level appropriate for senior undergraduates or graduate students. The course will consider, in depth, all three parts of a modern digital communication system: (1) source coding; (2) error control coding; and (3) modulation. An introduction to information theory, which considers the fundamentals underlying all aspects, will also be provided. This course is intended to serve both as a foundation for further work in the areas of signal processing and communications and as a terminal course for those outside of the area who desire a rigorous understanding of the field.

Course Format: Three 50-minute lectures (MWF 11:15 in Marston 220).

Instructor: Prof. Dennis Goeckel

Contact: Office: Marcus Hall 215L, Phone: 545-3514, e-mail: goeckel@ecs.umass.edu

Office Hours: Monday, 10:00-11:00am; Wednesday, 12:30-1:30 pm
(or by e-mail appointment)

“Where Everybody Knows Your Name”: I will try to learn everybody’s name, although you may have to remind me two or three times before we get it. Please come by my office hours during the first two weeks of the semester so that I can meet you.

Prerequisites: ECE 563 or graduate standing.

Textbook: None required. However, a recent good text is: U. Madhow, *Fundamentals of Digital Communication*, Cambridge 2008.

Grading: Homework - 15 %

Midterm Exam 1 (Date: March 5, 2014, Time: 7:00pm-9:00pm, Place: TBD) - 25 %

Midterm Exam 2 (Date: April 26, 2014, Time: 7:00pm-9:00pm, Place: TBD) - 25 %

Final Exam - 35 %

All exams will be closed-book closed-notes, and calculators will **not** be allowed; however, a single **hand-written** formula sheet will be allowed. The final exam will be cumulative. Homeworks will be collected at the beginning of the **lecture** on the date that they are due. Late homeworks will not be accepted.

Ground Rules: You are allowed to work together on homeworks; however, each student must submit his/her own solutions. Also recall that homeworks are really only preparation for the exams, so do not rely too heavily on other students for help. **Academic dishonesty** (either taking or giving answers on an exam, use of extra crib sheets, theft of another’s work, etc.) will be dealt with harshly; you will receive an “F” for the course, and there may be further disciplinary action.

Course Overview

I. Overview and Mathematical Preliminaries

Components of a digital communication system; review of probability and random processes.

II. Source Coding and Information Theory

Sampling and quantization; lossless source coding; definition of entropy; channel capacity.

III. Modulation and Demodulation for the AWGN Channel

Signal spaces; MAP reception; sample constellations and their error probabilities; bounds on error probability; sample modulation formats.

IV. Error Control Coding

Minimum distance and error correction capability; linear block codes - generator and parity check matrices, hard-decision (syndrome) decoding; convolutional codes - encoding and Viterbi decoding.

V. Signaling over Bandwidth-Limited Channels

Signal design for no intersymbol interference (ISI); optimum receiver in the presence of ISI; suboptimal equalization methods.

VI. Wireless Communications and Standards