Objective: It is difficult to overstate the degree to which digital communications has impacted society. What most people do not understand is the technology behind 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 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. Applications to modern wireless communication system standards will be discussed throughout and then considered in detail at the end of the course.

Course Format: Three 50-minute lectures (MWF 11:15 in Marston 211).

Instructor: Prof. Dennis Goeckel
Contact: Office: Marcus Hall 215L, Phone: 545-3514, e-mail: goeckel@ecs.umass.edu
Office Hours: Wednesday, 2:00pm-3:30pm (or by e-mail appointment)

Prerequisites: ECE 563 or graduate standing.


Grading: Homework - 15 %
Midterm Exam 1 (Date: March 7, 2018, Time: 7:00pm-9:00pm, Place: TBD) - 25 %
Midterm Exam 2 (Date: April 11, 2018, Time: 7:00pm-9:00pm, Place: TBD) - 25 %
Final Exam (Date: May 3, 2018, Time: 10:30am-12:30pm, Place: Marston 211) - 35 %

All exams will be closed-book closed-notes, and calculators will not be allowed; however, a single handwritten 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 Communication Standards