University of Massachusetts
Department of Electrical and Computer Engineering

ECE 697U - Error Control Coding
Spring, 2008

http://www-unix.ecs.umass.edu/∼goeckel/ece697u.html

Objective: The purpose of this course is to study the theory and application of both classical and modern error control coding.

Course Format: Two 75-minute lectures (MW 10:10-11:25am)

Instructors: Dennis Goeckel, 215H Marcus Hall, e-mail: goeckel@ecs.umass.edu
Office Hours: M: 9am-10am, MW: 11:30am-12:15pm (or by e-mail appointment)

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Office Hours: TBD

Prerequisite: ECE 603 or consent of instructor

Main Textbook: (Available at the Jeffrey Amherst College Book Store)
Error Control Coding: Second Edition, by S. Lin and D. Costello, 2004, Prentice-Hall, ISBN: 0130426725

Grading: Homework (three to four long-term) - 30 %
Midterm - 35 %
Course Project - 35 %

Course Outline (Subject to Modification)

I. Motivation and Overview
Application examples. Statement of the Channel Coding Theorem, long history of trying to achieve it.

II. Introduction to Channel Coding Practice
Channel models, hard and soft-decision decoding. Hamming distance, generator and parity check matrices. Distance properties of codes and bounds on such.

III. Classical (Block) Channel Coding Theory
Constructions of finite fields, minimal polynomials. Cyclic codes, including BCH, Reed-Solomon codes.

IV. Trellis Codes
Definition, state space and trellis representation. The Viterbi algorithm. Distance properties, transfer function bounds. Trellis-coded modulation.

V. Modern Error Control Coding
LDPC Codes - Structure, Encoding, LDPC Decoding and Analysis Over Erasure Channels.
Decoding for memoryless channels. Asymptotic analysis and design of LDPC codes.
Construction of finite length LDPC codes. Special classes of LDPC codes.
Survey of hardware architectures. An overview of Turbo codes.

VI. Contemporary Applications
Wireless (fading) communication channels, space-time coding, multiple-input multiple-output (MIMO) systems. Magnetic recording.