ECE 561: Error Control Coding - Fall 2001

Description: An introduction to the theory and application of error control systems. This course provides:

- working knowledge of error control coding in digital communication and storage systems (e.g., how does your stereo read a scratched CD),
- necessary background for understanding the relevant research topics discussed in technical literature (e.g., to study new concatenation schemes for "turbo" coding),
- an overview of the finite field theory (without your taking a two-semester math course).

Prerequisites: Graduate standing or upper-class undergraduate with strong familiarity with linear algebra and digital communication.

Textbook: S. B. Wicker, *Error Control Systems for Digital Communication and Storage*, Prentice Hall, 1995. ISBN 0-13-200809-2.

Instructor: Dr. Ben Liang
office: Rhodes 372/374
email: liang@ece.cornell.edu

Lectures: 10:10 - 11:25 Tuesdays and Thursdays, Upson 205
Office Hours: 12:30 - 2:00 Wednesdays and 11:30 - 1:00 Thursdays

Course Website: http://courses.ece.cornell.edu/ece561
Outgoing information about course operations will be posted to this website.

Grading Policy: There will be bi-weekly homework assignments, three exams, and one computer project. Homework will be graded solely on the basis of effort, not correctness. Solutions to the homework problems will be available when they are due, usually two weeks after they are assigned. The three exams do not significantly overlap. The exam problems will be similar to the homework problems (therefore it would be wise to treat the homework assignments seriously). The project will mainly consist of the Matlab simulation of encoders and decoders in error control systems. Both a working program and a well-written report are expected.

The weights of different grading components:

Homework	20%
Project	20%
Exams (3)	60%

Topical Outline

This course will cover the following topics, roughly in the order as listed here:

- Error Control Coding for Digital Communication Systems (Chapter 1) - introduction, noisy channel coding theorem, coding gain
- Galois Fields (Chapter 2) - groups, fields, vector spaces, finite field construction, finite field properties
- Linear Block Codes (Chapter 4) - Hamming bound, Singleton bound, standard-array, syndrome-table decoding, Hamming codes
- Polynomials over Galois Fields (Chapter 3) - Euclidean domains, primitive polynomials, conjugacy classes, factoring $X^n - 1$, ideals
- Cyclic Codes (Chapter 5) - generator polynomial, shift-registers
- BCH and Reed-Solomon Codes (Chapter 8 and Chapter 9) - BCH bound, BCH codes, Reed-Solomon codes, decoding algorithms, Euclid's algorithm, Galois field Fourier transform
- Convolutional Codes (Chapter 11 and Chapter 12) - linear convolutional encoding, structural properties, Viterbi decoding
- Trellis Coded Modulation (Chapter 14) - set partitioning, Ungerboech encoder
- Turbo Codes - It's unlikely that we will have enough time left to cover this topic, but by the end of this course, you will have learned enough to read and understand technical writing on turbo codes (and much more!) with a reasonable level of confidence.