Iowa State University

Course Information

EE621: Coding Theory - Spring 2007

Instructor:.

Sang W. Kim; 3112 Coover Hall, 294-2726, swkim@iastate.edu

Lectures:

Tu,Tr 2:10-3:30, 1324 Howe

Office Hours:

To be announced

Course Website:

WebCT: EE621

Course Description:.

Coding theory is a foundation to modern digital communications, having broad applications in virtually all types of digital communications and digital data storage. This course is a graduate course, covering linear block codes, theory of finite fields, cyclic codes, BCH and Reed-Solomon codes, convolutional codes, trellis coded modulation, turbo codes, low density parity check codes, space-time coding, and adaptive coding.

Prerequisites:

EE521 will be useful but not required. An undergraduate probability course is assumed.

Text:

S.B.Wicker, Error Control Systems for Digital Communication and Storage, Prentice Hall, 1995.

References:

1. S.Lin and D.J.Costello, Jr., Error-Control Coding: Fundamentals and Applications, Prentice Hall, 2004.

2. R.E.Blahut, Theory and Practice of Error-Control Codes, Addison-Wesley, Reading, MA, 1983.

3. L.Hanzo, T.Liew, and B.Yeap, Turbo Coding, Turbo Equalization and Space-Time Coding, IEEE Press and John Wiley, 2002

Tentative Course Outline:

1. Overview
    - Shannon's Channel Coding Theorem
    - Encoding and Decoding
    - Coding Gain
2. Introduction to Algebra
    - Euclid's Division Theorem
    - Group, Ring, Field
    - Vector Space
3. Linear Block Codes
    - Definitions
    - Generator Matrix, Parity Check Matrix
    - Bounds
    - Maximum Likelihood Decoding, Syndrome Decoding, Bounded Distance Decoding
    - Code Modifications
    - Coding Diversity
4. Cyclic Codes
    - Polynomials
    - Construction of Fields
    - Primitive Polynomial
    - General Theory of Cyclic Codes
    - Shift Register Encoder and Decoder
5. BCH and Reed-Solomon Codes
    - BCH Codes
    - Code Design
    - Reed-Solomon Codes
    - Decoding Algorithms
6. Convolutional Codes
    - Encoder
    - State Diagram, Trellis diagram
    - Viterbi Algorithm
    - Hard and Soft Decision Decoding
    - Performance Analysis
    - Puncturing
7. Coded Modulation
    - Code and Modulation
    - Ungerboeck's Design Rule
    - Performance Analysis
8. Special Topics
    - Turbo Codes
    - LDPC Codes
    - Space-Time Codes
    - Adaptive Coding

Grading:

Exam I: 30%
Exam II: 30%
Homeworks/Project/Class Participation: 40%

Project:

Projects can be done individually or in groups of two on a topic related to this course. It can be a further exploration of a topic covered in class via a set of research papers, a small research problem, simulation studies of algorithms, etc. More details will be announced later in the semester. Please let me know if you have any questions or suggestions regarding projects. Final report (five-page maximum) on the project is required.