

Iowa State University

Course Information

EE621: Coding Theory - Spring 2009

Instructor:

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

Lectures:

TR10:45-12:00

Office Hours:

R2:00-3:30

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 network coding.

Prerequisites:

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

References:

- S.Lin and D.J.Costello, Jr., Error-Control Coding: Fundamentals and Applications, Prentice Hall, 2004.
- T.Richardson and R.Urbanke, Modern Coding Theory, Cambridge Univ. Press, 2008.
- L.Hanzo, T.Liew, and B.Yeap, Turbo Coding, Turbo Equalization and Space-Time Coding, IEEE Press and John Wiley, 2002.
- S.B.Wicker, Error Control Systems for Digital Communication and Storage, Prentice Hall, 1995.
- R.E.Blahut, Theory and Practice of Error-Control Codes, Addison-Wesley, Reading, MA, 1983.

Tentative Topics:

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. Recent Topics
 - Turbo Codes
 - LDPC Codes
 - Space-Time Codes
 - Cooperative Coding
 - Network Coding

Grading:

Homeworks/Class Participation:	20%
Midterm Exam :	40%
Project:	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.

Disability Statement:

If you have a documented disability and anticipate needing accommodations in this course, please make arrangements to meet with me soon. Please request that a Disability Resources staff send a SAAR form verifying your disability and specifying the accommodation you will need.