ECE 519

Coding for Reliable Communications – Course Syllabus

Spring 2014

Instructor: Guillermo Atkin

Office: SH – 141, 312-567-6810

Office Hours: T and R: TBA

e-mail: atkin@iit.edu

Class Hours: TBA

Description: Encoders and decoders for reliable transmission of digital data over noisy channels. Linear block codes, cyclic codes, BCH codes, convolutional codes, turbo codes, LDPC Codes, TCM. Maximum likelihood decoding for convolutional codes. Performance of block and convolutional codes in additive white Gaussian channel.

Prerequisites:

- Knowledge of Algebra
- Basic knowledge of digital modulation methods.
- Basic knowledge of block and convolutional codes.
- Undergraduate degree in EE or CS.

Text: Error Control Coding, by Shu Lin and Daniel J. Costello, Jr., Prentice Hall, Second Edition, 2004.

References:

- Theory and Practice of Error Control Codes, by Richard E. Blahut, Addison Wesley Publishing Company, 1983.
- The Theory of Error-Correcting Codes, by F. J. MacWilliams and N. J. A. Sloane. New York: North-Holland, 1977.
- Error-Correction Coding for Digital Communications by G. C. Clark, Jr. and J. B. Cain. Plenum Press, New York, 1981.
- Digital Communications, by John G. Proakis (and Salehi), McGraw-Hill Book Company.

Course Outline:

Coding for Reliable Digital Transmission and Storage

i. Introduction. Types of Codes
ii. Modulation and Demodulation. Maximum Likelihood Decoding
iii. Types of Errors and Error Control Strategies
iv. Turbo Codes

Introduction to Algebra

I. Definitions. Groups. Fields
II. Galois Field GF(2^m). Construction and Properties
III. Vector Spaces. Matrices

Linear Block Codes

i. Introduction
ii. Syndrome and Error Detection

iii. Minimum Distance. Error Correction Capability
iv. Standard Array and Syndrome Decoding
v. Error Probability over BSC
vi. Hamming Codes

Cyclic Codes

i. Description. Generator and Parity-Check Matrices.
ii. Encoding. Syndrome and Error Detection. Decoding
iii. Cyclic Hamming Codes

BCH Codes

I. Description. Encoding/Decoding
II. Nonbinary BCH Codes and Reed Solomon Codes
III. Weight Distribution and Error Detection Capability

Convolutional Codes

i. Encoding
ii. Structural Properties Of Convolutional Codes
iii. Distance Properties of Convolutional Codes

Maximum Likelihood Decoding of Convolutional codes

i. The Viterbi Algorithm
ii. Performance Bounds for Convolutional Codes
iii. Construction. Implementation of Viterbi Algorithm
iv. Sequential Decoding of Convolutional Codes

Introduction to Trellis Coded Modulation

Grading. Coursework will be graded as follows:

1.	Homework	10%	(every week, due Mondays)
2.	Projects	20%	(TBA)
3.	Exams 1	20%	(02/16/2012)
4.	Exams 2	25%	(03/29/2012)
5.	Final exam	25%	(TBA)

HW should be submitted before the beginning of the class on Tuesdays (MC section) using the Digital Dropbox (Blackboard) for other sections, the due date is Thursday before the class. Homework solutions will be posted in the Blackboard on Fridays. No late HW will be accepted without previous instructor consent.

Grade Policy: A (≥ 90%); B (80 - 89%); C(66 - 79%); D(50 - 65%)

Reasonable accommodations will be made for students with documented disabilities. In order to receive accommodations, students must obtain a letter of accommodation from the Center for Disability Resources and make an appointment to speak with me as soon as possible. The Center for Disability Resources is located in the Life Sciences Building, room 218, 312-567-5744 or disabilities@iit.edu.