EE5120 Error Control Coding

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Class: Slot B, ESB 128
Textbook: Error control coding (2nd Ed.) by Shu Lin, D. J. Cosetello Jr.
References: Error control systems for digital communication and storage, by S. B. Wicker.
Error correction coding by T. K. Moon

Outline: This is an introductory course on coding theory with an emphasis on algebraic codes. There are no formal prerequisites but I do assume a basic knowledge of probability. The textbook contains more material than can be covered in a single semester. I will be covering a selection of topics from Chapters 1-8, 11-12, and 17. Course details are given below:

1. Introduction to coding
2. Basic algebra
   — Groups, rings, fields, vector spaces, linear algebra
3. Basics of linear codes
   — Block codes, generator and parity check matrices, dual code, code parameters.
4. Decoding linear codes
   — MAP decoder, ML decoder, standard array and syndrome decoding, bounded distance decoder.
5. Finite fields
   — Constructing finite fields, polynomial rings, minimal polynomials.
6. More on linear codes
   — Non binary linear codes, code constructions, some well known linear codes, Hamming codes, Reed-Muller codes, weight enumerator and MacWilliams identity.
7. Bounds on codes
   — Hamming, Gilbert Varshamov, Singleton, Plotkin bounds.
8. Cyclic codes
   — Construction, encoding and decoding.
9. BCH and Reed-Solomon codes
   — Constructing primitive, narrow sense and non narrow sense BCH/RS codes. Decoding BCH/RS codes.
10. Performance of block codes
11. Convolutional codes
    — Encoding, polynomial description, structural properties of convolutional codes
12. Decoding convolutional codes
    — Viterbi decoder, Soft decision decoding of convolutional codes.
13. LDPC codes and other advanced topics (time permitting)
    — Tanner graphs, bit flipping decoding, sum product algorithm.

Grading:
Homework—20%
Quiz I—20%
Quiz II—20%
Final—-40%