EE5120 Error Control Coding

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Instructor: Pradeep Sarvepalli
Office: ESB 336B
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Class: Slot B, ESB 207B (Maybe be shifted)
Textbook: Error control coding (2nd Ed.) by Shu Lin, D. J. Cosetello Jr.
References: Error correction coding by T. K. Moon
Error control systems for digital communication and storage, by S. B. Wicker.
Office Hours: Mon 2-3pm.
Teaching Assistants:
Arun Aloshious ESB 326
Sourav Chatterjee ESB 210B
Mahesh Dubey ESB 215C

Outline: This is an introductory course on coding theory with an emphasis on algebraic codes. I assume that you have a basic knowledge of linear algebra, and probability. I will be covering a selection of topics from Chapters 1-7, 11-12, 17 in textbook (2-6, 9, 12 and 15 in the book by Moon). Some homework assignments will require you to code in matlab. There will be two course projects. You are assumed to have familiarity with matlab or some other programming language. 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: The tentative grading policy is as follows.
Homework—20% (about 5–7)
Miniquizzes—20% (once in a week)
Projects (two)—35% (The first one will be slightly smaller in scope than the second)
Final—25%