Computer Science and Engineering
Ferguson Hall – 0115
472-2402

Course Specification

CSCE-463/863
Algorithms

Catalogue Description:
463/863. Introduction to Coding Theory (3 cr) Prereq: CSCE 310, Math 314/814, Math 380 or equivalent. An introduction to the theory of Error Correcting Codes. The topics to be covered include the binary symmetric channel, probability of error, finite fields, linear codes, dual codes, parity check and generator matrices, standard array, maximum likelihood decoding, sphere packing bound, Plotkin and other bounds, Hamming codes, Perfect Codes, Cyclic codes, BCH codes, Reed-Solomon codes, Reed-Muller codes.

Textbook(s) and/or Other Required Materials:
Hoffman, Leonard, Lindner, Phelps, Rodger aand Wall, *Coding Theory, The Essentials*, supplemented as necessary with handouts

Prerequisites by Topic:

- **Mastery** of finite dimenional vector spaces over arbitrary fields, linear transformations, change of bases, eigenvalues, eigenvectors. Elementary probability theory and statistics including some of the basic theoretical distributions.
- **Familiarity** with discrete mathematics topics including induction and recursion, set theory, elementary combinatorics.
- **Exposure** to finite groups, rings and fields.

Course Objectives:

- **Mastery** of linear binary codes, generator and parity check matrices, standard array, syndromes, maximum likelihood decoding. Dual codes, Haming codes, perfect codes, cyclic codes, t-error corecting BCH codes, Golay codes. Non-linear codes, Hadamard codes, bounds. Reed-Solomon, Reed-Muller codes.
- **Familiarity** with convolutional codes, burst error-correcting codes, Preparata Codes. Viterbi decoding. Appication to CD-encoding.
- **Exposure** to weight enumerators, Krawtchouk polynomials, McWilliams theorem.

March 22, 1999

Topics Covered:

1. The binary symmetric channel, linear binary codes, Hamming bound, cosets, standard array, syndromes, coset leaders. Probability of decoder error. Shannon's theorem without proof.
2. Dual codes, Constructing codes from other codes, Hamming codes, perfect codes, the Singleton bound, the Gilbert-Varshamov bound.
3. Two-error correcting BCH codes, finite fields, minimal polynomials.
4. Weight enumerators, Krawtchouk polynomials, McWilliams theorem.
5. Reed-Muller Codes, fast decoding of RM(1,m).
6. Cyclic Codes, the check polynomial, t-error correcting BCH codes.
7. Reed-Solomon Codes, decoding RS codes, Fourier transform in RS-codes, Berlekamp-Massey Algorithm.
8. Burst Error-Correcting Codes, interleaving, applications to compact discs.
9. Convolutional Codes, Shift registers and polynomials, encoding and decoding convolutional codes.
10. Truncated Viterbi decoding.
11. Reed-Muller and Preparata codes

Relationship of Course to Program Objectives:

Contribution of Course to Meeting the Professional Component:

Class/Laboratory Schedule:
Lecture: 45 hours

Prepared by:
Spyros Magliveras, Professor