

**EE 225**  
**Coding Theory**

<b>Units</b>	4 units. Seminars 4hrs/w.
<b>Prerequisite</b>	EE 215, EE 224
<b>Grading</b>	Letter grade only

**Catalog Description**

An overview of basic combinatorial concepts widely used in error-correcting codes.

**Grading:** Every week all students are assigned a chapter to read. Also, each student is assigned a short topic for presentation. Letter grade is based on presentations (60%) and midterm exam (40%).

**Textbooks:**

R. E. Blahut, "Algebraic Codes for Data Transmission" Acambridge University Press, Cambridge Inc., 2003, (ISBN: 0 521 55374).

F.J. MacWilliams and N.J.A. Sloane, "The Theory of Error-correcting codes", North-Holland Pub. Co., Amsterdam, New York, Oxford, 1998 (ISBN 0 444 85193 3).

**References:**

1. W.W. Peterson and E.J. Weldon. "Error-correcting codes." The MIT Press, Cambridge, 1972 (ISBN 0262160390).
2. "The Handbook of Coding Theory", Editors: V. Pless and W.C. Huffman, Elsevier, New York, 1998 (ISBN: 044450088X).
3. R. Gallager, "Information Theory and Reliable Communication"; Wiley & Sons, 1968 (ISBN: 0471290483).
4. R. E. Blahut, "Theory and Practice of Error Control Codes", Addison Wesley., 1983 (ISBN: 0201101025).
5. J. H. Van Lint, "Introduction to Coding Theory", Springer-Verlag, New York, 1998 (ISBN: 3540641335).

**Introduction.** Communication channels. Error detection and correction. Block codes. Hamming distance. Code parameters. Shannon channel capacity. Linear and dual codes, generator/ parity-check matrices; standard arrays (Sect. 1.1-1.5)

**Error-correction capabilities of block codes.** The Hamming (S 1.5) and Singleton (S. 1.10) upper bounds. The Plotkin (S. 2.2) bound. The Gilbert-Varshamov lower bound ( S. 1.10). The Johnson (S. 17.3) and Elias bounds (S. 17.7). The Greismer bound (S. 17.5).

**Special matrices and codes.** Hadamard matrices and codes (S. 2.3), t-schemes (s. 2.5) and Steiner systems (S. 2.7); Hamming codes (S. 1.7).

**Reed-Muller codes.** Boolean functions. Code constructions and parameters. Majority-logic decoding (S. 13.2, 13.3, 13.6).

**Random Codes.** Weight spectra of random linear codes (Ref. 2, Ch. 6).

**Extra topics:**

**Algebraic Concepts.** Ideals, residue classes, Groups, rings, factor groups and ideals. Galois fields. Vector subspaces. Discrete vector spaces and linear codes. (S. 4.1-4.6).

**Cyclic codes.** Matrix and polynomial description. Generator and parity check polynomials. Code zeros. Hamming codes. Encoding.

**Complexity issues in Coding Theory.** Minimum distance and maximum-likelihood decoding. Decoding algorithms with exponential and polynomial complexities.