

ECE 860—Advanced Coding Theory
Meeting time: TTh 3:30pm-4:45pm
Meeting location: 219 Lowry

Instructor: Dan Noneaker
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Office hours: by appointment

Purpose of course: ECE 860 covers the theory of convolutional codes, trellis codes, and turbo codes and their applications.

Outline: (approximate)

- i.) *Binary convolutional codes:* representation; minimal, systematic, feedback, and non-catastrophic realizations; distance properties; maximum-likelihood sequence estimation and the Viterbi algorithm; performance analysis; code puncturing (5.5 weeks)
- ii.) *Trellis-coded modulation:* information-theoretic motivation; representation; distance properties; decoding; analysis; set partitioning and code design (4 weeks)
- iii.) *Multidimensional trellis codes:* lattices and multi-dimensional signal sets; multi-dimensional coding and distance bounds; constellation shaping (2 weeks)
- iv.) *TCM with non-ideal channels:* rotational invariance and phase recovery; intersymbol interference (ISI) channels and precoding (1.5 weeks)
- v.) *Turbocodes:* serial and parallel realizations, distance properties, iterative decoding, performance characteristics (1.5 weeks)
- vi.) *Mid-term Exam:* (0.5 weeks)

Prerequisites: ECE 820 and ECE 857.

Grading: 30% homework, 30% mid-term exam, 40% final exam

Text:

S. Lin and D. Costello, *Error Control Coding: Fundamentals and Applications*, Prentice Hall, 2nd edition, 2004.

Course notes and assigned reading from journal papers.

References:

S.B. Wicker, *Error Control Systems for Digital Communications and Storage*, Prentice Hall, 1995. (This is the required text for the pre-requisite course ECE 857)

R. Johannesson and K. S. Zigangirov, *Fundamentals of Convolutional Coding*, IEEE Press, 1999.

S.G. Wilson, *Digital Modulation and Coding*, Prentice Hall, 1996.

E. Bighlieri, *et al*, *Introduction to Trellis-Coded Modulation with Applications*, Macmillan, 1991.

(the references will be available as needed at the library reserve desk)

Attendance, Class meetings: Regular class attendance is strongly recommended. Every attempt will be made to announce class cancellations in advance. A time for make-up lectures will be determined.

Exam policy: Make-ups for a missed exam will only be allowed for urgent reasons. Make-up exams must be requested and taken before the scheduled exam date, except in extenuating circumstances.

Homework policy: Collaboration with your classmates on homework assignments IS allowed. However, each student must develop and write up each homework solution. No copying of solutions from others is allowed, even if the solutions are obtained as a result of collaboration.