EE 435/535: Error Correcting Codes  
Course Syllabus: Fall 2009

COURSE INFORMATION:
Class Schedule: TTh 12:45 - 2 PM; Room 218, Engineering Bldg 69
Course URL: http://www2.nau.edu/~sh295/ECC

INSTRUCTOR INFORMATION:
Instructor: Dr. Sheryl Howard
Office Hours: To be announced
Office: Room 261, Engineering Bldg 69
Phone: 523-3504
Email: sheryl.howard@nau.edu
URL: http://www2.nau.edu/~sh295

COURSE TEXTBOOK:

Under Course Outline, the Lin & Costello chapter corresponding to the material covered is given. Some topics will be covered in greater detail during the lectures than in the book.

Other references on error-correcting codes, which you may find helpful but are not required for the class, include:


CO-CONVENED COURSE:
This course is a co-convened course; undergraduates take this course as EE435, and graduate students take this course as EE535. The course lectures apply to both undergraduate and graduate students. Both undergraduate and graduate students are expected to do homework and project components of this course. However, each homework assignment has extra problems included specifically for the graduate students; undergraduates are not required to do these extra problems. Similarly, each mini-project has a section designated for graduate students only. Undergraduates are not required to do this extra section of each mini-project. If desired, however, undergraduates may work any of the extra graduate homework problems or extra mini-project sections for extra credit.

OFFICE HOURS:
Office hours will be announced in class and posted on the course website. If your schedule conflicts with my office hours, email me at sheryl.howard@nau.edu to make an appointment. If you have questions on the course material, please contact me as soon as you can for assistance.
COURSE GRADING:
This course is project-based, rather than exam-based. There will be two mini-projects and one final project assigned during the semester. Further details on the projects are listed in the Projects section below. The course grade is based on the projects, presentation of the final project, homework and attendance at the graduate seminar.

<table>
<thead>
<tr>
<th>Mini-Project 1</th>
<th>125 points</th>
<th>Due approximately 6th week</th>
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</thead>
<tbody>
<tr>
<td>Mini-Project 2</td>
<td>125 points</td>
<td>Due approximately 10th week</td>
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<tr>
<td>Final Project Report</td>
<td>100 points</td>
<td>Due finals week</td>
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<tr>
<td>Final Project Presentation</td>
<td>100 points</td>
<td>Last week of classes</td>
</tr>
<tr>
<td>Homework</td>
<td>50 points</td>
<td>Approximately every other week</td>
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<tr>
<td>Total</td>
<td>500 points</td>
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</tbody>
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Final grades will be determined by the following percentages:
A=90+%, B=80-89%, C=70-79%, D=60-69%, F=below 60%.
However, at the professor’s discretion, grading cutoffs may be lowered slightly.

LATE WORK:
Assignments are due when specified. Late homework will only be accepted in the following class period and will be penalized by 10% off. Late project reports will only be accepted for one week past the due date, and will be penalized by 20% off. The final project presentation is due when scheduled, as is the final project report. No late final project reports will be accepted.

PROJECTS:
This course is project-based instead of exam-based. Two mini-projects will be assigned, both of which involve programming in C or Matlab. One month is allowed for completion of each mini-project.

Graduate students taking EE 535 will be assigned an extra section on each mini-project to complete. Undergraduates taking EE 435 are not required to do the graduate portion of each mini-project. However, if they wish, undergraduates may do the EE 599 portion for extra credit.

The final project is chosen by each individual student. The instructor will provide a list of possible final project topics. The student may also choose their own topic after consultation with the instructor.

Undergraduates taking EE 435 may do either a literature search on a topic of interest, or a programming project, pending project approval from the course instructor.

Graduates taking EE 535 are required to include both a programming component and a literature review in their final project. The final project topic must be approved by the course instructor.

HOMEWORK:
Homework will be assigned approximately every other week. Late homework is only accepted by the following class period, and will be penalized by 20%.

Graduate students taking EE 535 will be assigned additional homework on each assignment, which the undergraduates taking EE 435 will not be required to complete. The undergraduates may do the EE 535 problem(s) for extra credit if they wish.
COURSE OUTLINE:
The proposed schedule below is a guideline only and is subject to change. Supplementary topics may be included at the instructor’s discretion.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics Covered</th>
<th>Text Reference</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Motivation for Coding, Noise in Communication Systems</td>
<td>Ch. 1</td>
</tr>
<tr>
<td>2</td>
<td>Probabilistic Channels, Block Code Basics</td>
<td>Ch. 1 &amp; 3</td>
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<tr>
<td>3</td>
<td>Error Probability, Modulation, Probabilistic Decoding</td>
<td>Ch. 1</td>
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<tr>
<td>4</td>
<td>Block Codes: Encoding, Minimum Distance, Decoding</td>
<td>Ch. 3</td>
</tr>
<tr>
<td>5</td>
<td>Performance Analysis; Repetition and Hamming Codes</td>
<td>Ch. 3 and 4</td>
</tr>
<tr>
<td>6</td>
<td>Convolutional Codes: Encoding, Catastrophic Codes</td>
<td>Ch. 11</td>
</tr>
<tr>
<td>7</td>
<td>Convolutional Codes: State Diagrams, Trellises</td>
<td>Ch. 11</td>
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<tr>
<td>8</td>
<td>Maximum-Likelihood Decoding, the Viterbi Algorithm</td>
<td>Ch. 12</td>
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<tr>
<td>9</td>
<td>Performance Bounds</td>
<td>Ch. 12</td>
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<tr>
<td>10</td>
<td>Soft-Decision Decoding: Maximum A Posteriori (MAP) Decoding</td>
<td>Ch. 14</td>
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<tr>
<td>11</td>
<td>Iterative Decoding, Use of MAP Decoders in Iterative Decoding</td>
<td>Ch. 14</td>
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<tr>
<td>12</td>
<td>Turbo Codes: Encoding and Decoding</td>
<td>Ch. 15</td>
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<td>13</td>
<td>Low-Density Parity Check (LDPC) codes: Sum-Product Decoding</td>
<td>Ch. 17</td>
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<td>14</td>
<td>LDPC Encoding and Code Design, Min-Sum Decoding</td>
<td>Ch. 17</td>
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<tr>
<td>15</td>
<td>Final Project Presentations</td>
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<tr>
<td>16</td>
<td>Finals Week: Final Project Report Due</td>
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COURSE PREREQUISITES:
EE 110 and EE 348 with a grade of C or better. Good Matlab and C programming skills are expected. Familiarity with the following mathematical skills: complex arithmetic, linear algebra and integration.

COURSE DESCRIPTION:
A first course in coding theory. Linear block codes, decoding and encoding. Hamming distance and error-correcting capabilities. Convolutional codes, maximum-likelihood decoding and the Viterbi algorithm. Iterative decoding and design of state-of-the-art iteratively-decodable codes such as turbo codes and low-density parity-check codes (LDPCs).
COURSE OBJECTIVES:
Understand the principles of error-correcting codes, and their application to communication systems with noise.

CELL PHONE POLICY:
- Cell Phone Use in Class:
  If you have a cell phone or beeper, please turn it to silent mode. You should not make calls during class. You should not speak or text message in the classroom. If you do receive an emergency call, ask to be excused so that you can take it outside the classroom.

UNIVERSITY POLICIES:
Links to the following policies are posted on the course website.
- Academic Integrity
- Accommodation of Religious Observance and Practice
- Classroom Management
- Safe Environment
- Students with Disabilities

ACADEMIC DISHONESTY:
Incidents of cheating or plagiarism are treated seriously. The NAU policy on academic dishonesty in Appendix G of the current Student Handbook (linked on the course website) applies in these situations.