Instructor: Alexandra Duel-Hallen  
EBII 2096  
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Instructor office hours for on-campus students: after class or by appointment.  
EOL students: Please contact the instructor or the TA by email to schedule a phone call.  
TA information and office hours will be announced shortly.

Prerequisites: Probability and Stochastic Processes (ECE 514 or equivalent); Digital Signal Processing; Linear Algebra.


Course Objectives: To develop fundamental design and analysis techniques necessary for understanding and working with modern digital communication systems.

Course Description: This course is first graduate-level course in digital communications. Functions and interdependence of various components of digital communication systems will be discussed. Statistical channel modeling, modulation and demodulation techniques, optimal receiver design, performance analysis techniques, source coding, quantization, and fundamentals of information theory will be covered in this course.

Grading:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
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<tr>
<td>Peer Grading</td>
<td>3%</td>
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<tr>
<td>Midterm</td>
<td>30%</td>
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<tr>
<td>Final exam</td>
<td>37%</td>
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<tr>
<td>Project</td>
<td>20%</td>
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+/- grading policy will be used. The course cannot be taken for S/U grading, but can be audited (see below).

Homework: Homework assignments will be posted on the course website. These assignments consist of problems that strengthen understanding and retention of course material. Students will grade their peers’ homework using Moodle Workshop feature. Solutions and grading instructions will be posted. Students should carefully examine grading guidelines and feedback and contact the TA if they have questions on grading. Moreover, students should compare solutions and grading guidelines with their own work and determine the areas where additional practice or review is required. Regular homework completion and grading will qualify you for extra credit. Extra credit is useful if your final course score is on the borderline between two letter grade levels.

Project: Project should be performed in groups (groups are required for on-campus students). Project will be assigned after the midterm and will be due on the last day of class. It will consist of two parts:  
Part 1: Report on a selected topic (a list of possible topics will be provided). Presentation might be included. This will be announced when projects are assigned. Part 1 is required for all students working in groups.  
Part 2: Simulation assignment - the same for all students and not related to the report in Part 1. Part 2 is required for all students.  
Extra credit opportunities related to the projects will be detailed when projects are assigned.

Depth of presentation in class will vary. The homework assignments and project will complement the material presented in class.

Audit Requirements: Audit students will receive AU grade if they turn in and receive a passing score on at least half of the homework assignments, or pass one exam, or pass one part of the project.

Computer Software: MATLAB or C++ (or another high-level language); word processing software.
Exams will contain problems and multiple choice questions. Exams will be closed-book. Three pages of handwritten notes and a conventional calculator will be permitted. Final will be comprehensive. Exams will be based on homework problems, textbook material, and class notes.

Late homework assignments will not be accepted. The lowest score will be dropped (including zero score for one missed assignment). Please note that peer grading for each assignment will be available only to students who turned in that assignment. If you do not submit an assignment, but still would like to grade (and receive peer grading credit) for that assignment, please contact the instructor.

Project deadline extension may be granted by the instructor in rare cases. Please email prior to the deadline.

Exam policy. If a student misses an exam and wishes to receive credit for that exam, or if a student requires extra time, the instructor should not be contacted directly. Please contact the Division of Academic and Student Affairs (DASA) (300 Park Shops, 919-515-3037) for assistance.

Students with Disabilities Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 515-7653.

Academic Integrity All the provisions of the code of academic integrity apply to this course. In addition, it is my understanding and expectation that your signature on any test or assignment means that you neither gave nor received unauthorized aid.

Supplementary References and Useful Web Sites:
http://www.cyclismo.org/tutorial/matlab/

Syllabus
Chapter references to the 5th edition of the textbook are provided. (References to the 4th edition are provided in parentheses if chapter numbers are not the same.)

I. Introduction.
Proakis, Chapter 1. Basic elements of digital communication systems; communication channels; mathematical models; brief history; performance measures.
Objective: You will learn to identify the functions of different components of a digital communication system.

Proakis, Chapter 2.
Objective: You will recall some mathematical concepts necessary for the remainder of the course.

III. Characterization of Signals and Systems.
Proakis, Chapters. 2 and 3 (Ch. 4). Bandpass Signals and Systems; Signal Space Representations; Digital Modulation Methods; Spectral Characteristics of Digitally Modulated Signals.
Objective: You will convert a digital bandpass signal to an equivalent complex lowpass signal; represent transmitted signals for several modulation methods; draw signal space diagrams; compute spectra of modulated signals.

IV. Optimum Receivers for the Additive Gaussian Noise Channel.
Proakis, Chapter 4 (Ch. 5). Correlation and Matched Filter Receivers; Performance of the Optimal Receiver;
Objective: You will design correlation and matched filter receivers; compute the probability of error for several demodulators; compare modulation methods based on the error rate and spectral efficiency.

V. Introduction to Information Theory - Source Coding and Channel Capacity and Coding.
Proakis, Chapter 6 (Ch. 3 and 7). Entropy; Source Models; Source Coding; Quantization; Average Mutual Information; Channel Models and Channel Capacity.
Objective: You will learn about theoretical bounds on the rates of digital communication systems. Principles of source coding and quantization will be introduced.