

ECEN 5692 -- Principles of Digital Communication

Spring 2009, 3 credit hours, 2:00-3:15pm TR, ECEE 265

Instructor: Prof. Youjian Liu, youjian.liu@colorado.edu,
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Office Hour: TR 3:15-4:45pm. If there are seminars or faculty meetings from 3:30-4:30pm, the office hour will be extended to 5:45pm. The office hour starts at the second week.

Homework: Homework is due Every Tuesday. To be fair to those who finish the homework on time, no late homework is accepted except for special circumstances agreed by the instructor *in advance*.

Grading:

- Projects 10% (Final Project Score = Your Score /Highest Score*100.)
- Homework 20% (10 pts per problem, the final HW score = Average of (Your Score of a HW/Highest Score of that HW)*100.)
- In Class Midterm 30% (Final Midterm Score = Your Score /Highest Score*100.)
- In Class Final 40% (Final Final-exam Score = Your Score /Highest Score*100.)
- Final Grade is calculated from the following:
100>=A>=90>=A->=85>=B+>=80>=B->=70>=B->=65>=C+>=60>=C>=50>=C->=45>=D+>=40>=D>=30>=D->=25>=F>=0

Catalog Description: This course focuses on the fundamental principles which can be used to transmit digital data reliably over noise and band-limited waveform channels. It is an application of digital signal processing and detection and estimation theory. The transmitter and receiver algorithmic structures for channel models which are encountered in practice are developed and analyzed. Connections will be made between the course materials and current digital standards, such as 3G/4G cellular systems.

I intend to add as much modern coding theory into the course as the time permits. This class will be taught with the goal to prepare students for research.

Textbook:

- Fundamentals of Communications Systems, by Michael P. Fitz, Publisher: McGraw-Hill Professional, ISBN-10: 0071482806, ISBN-13: 978-071482806, Publish Date: June 27, 2007
- Modern Coding Theory, by Tom Richardson, Ruediger Urbanke, Cambridge University Press, March 17, 2008, available online. ISBN-10: 0521852293, ISBN-13: 978-0521852296
- My notes

References:

- (1) Fundamentals Of Wireless Communication, by David Tse, Pramod Viswanath, ISBN: 0521-84527-0, ISBN 13: 978-0521-84527-4, Publisher: Cambridge Univ Pr, Publish Date: 27 June, 2005

- (2) Wireless Communications, by Andrea Goldsmith, ISBN: 0521-83716-2, ISBN 13: 978-0521-83716-3, Publisher: Cambridge Univ Pr, Publish Date: 08 August, 2005
- (3) Digital Communications, Proakis, McGraw-Hill, 4th edition, 2001. ISBN: 0-07-232111-3. This is an easy-to-access and good handbook.
- (4) Digital Modulation and Coding, S. G. Wilson, Prentice Hall, 1996. It provides more insight to coding related tradeoff.

Goals: Learn to analyze and design digital modulation and demodulation schemes for memoryless channels and channels with memory.

Prerequisites by Topic: Linear Systems, Noise and Random Processes. (DSP and Detection and Estimation Theory is a plus.)

Topics:

Introduction to mathematical techniques of digital communication theory: fundamentals of probability, introduction to random processes, spectral analysis of deterministic and random signals, narrow band signals and bandpass systems, discrete representation of deterministic and random signals, elements of detection theory. Waveform transmission over the additive Gaussian channel: memoryless modulation, optimum receivers for coherent demodulation, error probability performance. Digital modulation schemes: important modulation methods, receivers, error rate performance, comparison between signaling schemes, and practical applications. System design for intersymbol interference channels: optimum design of receivers under the Nyquist criterion, the mean-squared error criterion, and the maximum likelihood sequence receiver.

Computer Usage: A few assignments require use of Matlab on computer.

Administrative Notes:

- (1) If you qualify for accommodations because of a disability, please submit to me a letter from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. (303-492-8671, Willard 322, www.Colorado.EDU/disabilityservices)
- (2) Students should inform the instructor well in advance about religious obligations that conflicts with scheduled exams, assignments or class attendance so that special accommodation could be discussed.
- (3) The development of the Internet has provided students with historically unparalleled opportunities for conducting research swiftly and comprehensively. The availability of these materials does not, however, release the student from appropriately citing sources where appropriate; or applying standard rules associated with avoiding plagiarism. Specifically, the instructor will be expecting to review papers written by students drawing ideas and information from various sources (cited appropriately), presented generally in the student's words after careful analysis, synthesis, and evaluation. An assembly of huge blocks of other individuals' existing material, even when cited, does not constitute an appropriate representation of this expectation. Uncited, plagiarized material shall be treated as academically dishonest, and the paper will be assigned an 'F' as a result. If the student is confused as to what constitutes plagiarism, he/she should review the CU Honor Code on this topic, or see the instructor. Papers submitted by any student, written in part or in whole by someone other than that student, shall be considered to constitute fraud under the University Honor Code, and result in the assignment of an 'F' for the entire course.