Department of Electrical and Computer Engineering
University of Massachusetts - Amherst
ECE 564/645 - Digital Communications
Spring 2017 Syllabus

INSTRUCTOR

Prof. Marco F. Duarte, Marcus 215I, mduarte@ecs.umass.edu
Office Hours: Wednesday 1:30-2:30pm, Thursday 2:00-3:00pm, or by appointment.

LECTURES

220 Marston Hall 11:15am – 12:05pm Monday, Wednesday and Friday

DESCRIPTION

It is difficult to overstate the degree to which digital communications has impacted society - you need to look no farther than your smartphone. What most people do not understand is the sophisticated models and deep mathematics which has made such an impact possible: solving the very difficult wireless communications problem. The objective of this course is to provide an introduction to the field of digital communications at a high mathematical level appropriate for senior undergraduates or graduate students. The course will consider, in depth, all three parts of a modern digital communication system: (1) source coding; (2) error control coding; and (3) modulation. An introduction to information theory, which considers the fundamentals underlying all aspects, will also be provided. This course is intended to serve both as a foundation for further work in the areas of signal processing and communications and as a terminal course for those outside of the area who desire a rigorous understanding of the field.

PREREQUISITES

For ECE 564: ECE 563 Introduction to Communications and Signal Processing.
For ECE 645: Graduate Standing.

TEXTBOOKS

The recommended textbook (not required) is John Proakis, Masoud Salehi, "Fundamentals of Communication Systems," Prentice Hall, 2013 ($210 from Amazon). Older editions should suffice, and one copy is available as a reserve in the Science Library.

Additional resources include:

- John Proakis, "Digital Communications," 5th ed., McGraw-Hill, 2007. (4th edition available in the Science Library)
- Upamanyu Madhow, "Fundamentals of Digital Communication," Cambridge 2008..

Notes from the Spring 2015 edition of the course by Prof. Patrick Kelly will be posted online on Moodle.

HOMEWORK ASSIGNMENTS

There will be five to six homework assignments (one every two weeks) that will be posted in the Moodle course website. Assignments must be turned in at the beginning of the class period on the due date (Friday). One late homework (due at the beginning of the class period on the following Monday) is allowed for each student, and no further late submissions are accepted. It is encouraged to discuss the problem sets with others, but each student must turn in a unique personal write-up or code implementation. *Homework assignments are preparation for exams*, so do not rely too heavily on other students for help. Students registered for ECE 645 will receive an additional higher-level problem in each homework.

EXAMS AND FINAL PROJECT

All students will take two non-cumulative midterm exams. Students registering for ECE 645 will take a cumulative final exam. The weight of these exams on the course grade will be different for ECE 564 and ECE 645 students, as detailed below.

Students registering for ECE 564 will complete a course project consisting of a four-page, IEEE conference-style report on a commercially predominant digital communications standard to be approved by the instructor; more detailed information will be given later in the semester.

GRADING

Item	ECE 564	ECE 645
Homework Assignments	20%	20%
Exam 1 (7pm-9pm, Tentative Date Monday March 20, Location TBA)	30%	25%
Exam 2 (7pm-9pm, Tentative Date Thursday April 20, Location TBA)	30%	25%
Final Project Report (Electronic submission due Tuesday May 9, 10:30am)	20%	
Final Exam (10:30am-12:30pm, Tuesday May 9, Location TBA)		30%

PIAZZA

This term we will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates and the instruction team. Rather than emailing questions to the instructor, the instruction team encourage you to post your questions on Piazza. If you have any problems or feedback for the developers, email team@piazza.com.
Find our class page at: http://piazza.com/umass/spring2017/ece564645/

ACADEMIC HONESTY POLICY

It is expected that all students will abide by the Academic Honesty Policy (available at the Academic Honesty Board/Ombud's Office). Acts of academic dishonesty will result in a grade of F in the course, and possibly additional sanctions including loss of funding for graduate students, being placed on probation or suspension for a period of time, or being dismissed from the University. All students have the right of appeal through the Academic Honesty Board.

ACCOMMODATION POLICY

UMass Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological or learning disability on file with Disability Services (DS), Learning Disability Support Services (LDSS) or Psychological Disabilities Services (PDS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements.

INCLUSIVITY STATEMENT

We are all members of an academic community with a shared responsibility to cultivate a climate where all students/individuals are valued and where both they and their ideas are treated with respect. The diversity of the participants in this course is a valuable source of ideas, problem solving strategies, and engineering creativity. If you feel that your contribution is not being valued for any reason, please speak with me privately. If you wish to communicate anonymously, you may do so in writing or speak with Dr. Paula Rees, Director of Engineering Diversity Programs (rees@umass.edu, 413.545.6324, Marston 128).

TENTATIVE LECTURE SCHEDULE

Week	Topic	Proakis Ch.
1-2	Overview and Mathematical Preliminaries: Components of a digital communication system. Review of Probability and Random Processes	1, 5
3-4	Source Coding and Information Theory: Sampling and quantization. Lossless source coding. Definition of Entropy. Channel Capacity	12
5-7	Modulation and Demodulation for the AWGN Channel: Signal spaces. MAP reception. Sample constellations and their error probabilities. Bounds on error probability. Sample modulation formats.	8
8-10	Multidimensional Digital Modulation and Demodulation M-ary orthogonal signaling. Biorthogonal signaling. Frequency-shift keying.	9
11-12	Error Control Coding: Minimum distance and error correction capability. Linear block codes: generator and parity check matrices, hard decision (syndrome) decoding. Convolutional codes: encoding and Viterbi decoding.	13
13	Signaling over Bandwidth-Limited Channels: Signal design for no inter-symbol interference (ISI). Suboptimal equalization methods.	10-11