Massachusetts Institute of Technology
Department of Electrical Engineering and Computer Science

6.450 Principles of Digital Communication

Information Sheet
Fall, 2007

Lecturers

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TA

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Wed. 4:00-6:00pm

Course Secretary

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Welcome to 6.450 !!!

This course is a graduate level introduction to the basic principles of digital communication systems. A digital communication system is one that transmits a source (voice, video, data, etc.) from one point to another, by first converting it into a stream of bits, and then into symbols that can be transmitted over channels (cable, wireless, storage, etc.). The use of the digital bit-stream as the interface between the source and the channel is universal regardless of what kind of source and channel are involved. Digital communication principle, with "bit" as the most important concept of the information age, and applications in computer science, Internet, wireless, etc, is one of the most successful stories of applying mathematics in engineering designs.

The course gives an overview of the designs of digital communication systems. We explain the mathematical foundation of decomposing the systems into separately designed source codes and channel codes. We introduce the principles and some commonly used algorithms in each component, to convert continuous time waveforms into bits, and vice versa. We give a comprehensive introduction to the basics of information theory, a rather thorough treatment of Fourier transforms and the sampling theorem, and an overview of the use of vector spaces in signal processing.

The course would be beneficial particularly to students who are interested in doing research in the fields related to communications, networks, and signal processing. The general principle and philosophy of the engineering designs discussed in this course are inspiring to all engineering majors. As a TQE course, we also try to offer some rigorous mathematical training. The materials of this course are the baselines of further studies in 6.451 (digital communication II), 6.452 (wireless communications), and 6.441 (information theory).

Time and Place: Monday and Wednesday, 9:30am-11:00am, Room 36-153.
Recitation: Friday, 10:00am, Room 36-156

Credits: This is a twelve credit H-level subject, (3-0-9).

Prerequisites:

6.011. Students are expected to have a good undergraduate background in probability and linear systems. Some maturity and patience in looking carefully at fundamental issues is also needed.

Text: The course notes is available in copy center in 11-004, at a price of $20.00. The latest version is also available through the class web site. It is however not encouraged to print out the entire notes from Athena.

Web Page and Mailing List: The course web page is

http://web.mit.edu/6.450/www/

A course mailing list 6.450mit.edu has been setup for announcements. Please contact the TA to make sure you are on the mailing list.

Course Handouts: Handouts and graded problem sets not picked up during lecture can be found on the file cabinet in front of Michael Lewy's office.

Problem Sets:

There will be weekly problem sets, though the final problem set will not be collected. Problem sets will be shorter in weeks involving either quizzes or holidays. You are expected to do all the assigned problems, and we will assume that in making up the quizzes and final. We encourage you to cooperate with each other in doing the problem sets. The problem sets are vehicles for learning, and whatever maximizes learning for you is desirable. This usually includes discussion, teaching of others, and learning from others. You are not competing for grades with your classmates.

Problem sets must be handed in by the end of the class in which they are due. Problem set solutions will usually be available at the end of the due date lecture.

The grades assigned to problems sets will be 0, 1, or 2. Usually only one or two of the problems on a set will be graded, and you are responsible for asking about points of confusion. You are also welcome to flag confusing topics in the problem sets; this will not lower your grade. It will usually be more efficient, however, for you to ask one of us directly about such issues.

Exams:

There will be two quizzes during the semester. The quizzes will be closed book, but you may bring three double sided 8.5" by 11" pages of notes to each of the quizzes. Most people find that the preparing of such notes helps them much more than their use.

The quizzes will be scheduled as shown on the following schedule. The final exam will be scheduled by the registrar for 3 hours. We will attempt to make each quiz and the final a test of understanding rather than of speed-writing.

Course Grade:

The final grade in the course is based upon our best assessment of your understanding

of the material. The final grade is given roughly according to the following rule:

each quiz:	40%
problem sets:	20%

Reference Texts: The class notes cover all the material in the course, but the following references can provide enrichment and additional examples.

1. J.G. Proakis, *Digital Communications*, 4th ed., McGraw-Hill, 2000. This larger variety of systems than the class notes, but in less depth.

2. J.G. Proakis and M. Salehi, *Communication Systems Engineering*, Prentice Hall 1994. This is an undergraduate version of the above text.

3. J.M. Wozencraft and I.M. Jacobs, *Principles of Communication Engineering*, Weily, 1965. Classic text that first developed the signal space view of communication.

4. S.G. Wilson, *Digital Modulation and Coding*, Prentice-Hall, 1996. Another text covering mostly the material of the last two thirds of the course.

5. R.G. Gallager, *Information Theory and Reliable Communication*, Wiley, 1968. Treats most of the topics here in a more advanced information theoretic treatment.

6. T.M. Cover and J.A. Thomas, *Elements of Information Theory*, Wiley, 1991. An excellent text on information theory.

7. D. Tse and P. Viswanath, *Fundamentals of Wireless Communication*,Cambridge 2005. Excellent Coverage of many topics in the last third of the course.

8. A. Goldsmith, *Wireless Communications*, Cambridge 2005. An up-to-date of wireless channels.

9. G. Strang, *Introduction to Linear Algebra*, 3rd ed., Wellesley-Cambridge Press, 1998. Gives clear explanations of many standard linear algebra results.

Calendar:

Date	Day	Lecture #	Notes
Sep. 5	Wed	1	
Sep. 10	Mon	2	
Sep. 12	Wed	3	
Sep. 17	Mon	4	
Sep. 19	Wed	5	
Sep. 24	Mon		Student Holiday
Sep. 26	Wed	6	Possibly Skipping Lecture
Oct. 1	Mon	7	
Oct. 3	Wed	8	Add Date Oct. 5
Oct. 8	Mon		Columbus Day
Oct. 10	Wed	9	
Oct. 15	Mon	10	
Oct. 17	Wed	11	
Oct. 22	Mon	12	
Oct. 24	Wed		Quiz 1
Oct. 29	Mon	13	
Oct. 31	Wed	14	
Nov. 5	Mon	15	
Nov. 7	Wed	16	
Nov. 12	Mon		Veteran's day
Nov. 14	Wed	17	
Nov. 19	Mon	18	
Nov. 21	Wed	19	Drop Date, Thanksgiving
Nov. 26	Mon	20	
Nov. 28	Wed	21	
Dec. 3	Mon	22	
Dec. 5	Wed	23	No more HW due after Dec. 7
Dec. 10	Mon	24	
Dec. 12	Wed		Quiz 2