Department of Electrical Engineering
University of Southern California

EE 564 — COMMUNICATION THEORY **Fall 2008**

Instructor: Professor Urbashi Mitra, Professor
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TA: Mr. Srinivas Yerramalli, EEB 522, yerramal@usc.edu
office hours: TBD

Course Web Page: via Blackboard/DEN
`http://den.usc.edu`
Contains homework, solutions, and relevant handouts. Course announcements, homework hints and modifications will be posted on this page – please check it regularly.

Lectures: MW 9:30am-10:50am, OHE 100C

Course Objectives: To understand, in detail, basic detection theory, methods of performance analysis, digital modulation and detection techniques for the additive white Gaussian noise channel include channels with and without memory.

Prerequisites: Random Processes (EE526a) as well as its prerequisites (*i.e* Probability Theory (EE464), Transform Theory (EE401) and Linear Algebra (EE441)).

Other Requirements: Basic computer skills (*i.e.* programming and plotting).

Text:
1. J. Proakis, *Digital Communications*, 4th edition, McGraw Hill, New York 2001.

A detection text (see references) is also quite useful:

1. C. L. Weber, *Elements of Detection and Signal Design*, Springer-Verlag, New York 1968 (key portions posted on course web-site).

Grading: 20% Homework (lowest homework score will be thrown out)
35% Midterm (1.3 hours)
45% Final (2.0 hours)
Final grades will be assigned by a combination of student score distribution (curve) and the discretion of the instructor.

Exams: **Midterm** Wednesday, October 8 or 15 (more likely), 2008, 9:00am-10:50am
Final Monday, December 15, 11:00am-1:00pm

Office Hours: Mondays 11:00am -12:00pm; Tuesdays 1:00pm - 2:30pm, and by appointment.
Use of email is encouraged: ubli@usc.edu.

Late Policy: No late homework will be accepted. A late assignment results in a zero grade.

Make-up Exams: No make-up exams will be given. If you cannot make the exam dates due to a class conflict, you must notify me by the last day to add/drop a course. If I cannot accommodate your schedule, you must drop the class. In the case of a required business trip or a medical emergency, a signed letter from your manager or doctor is required. This letter must include the telephone number of your doctor or supervisor.

Grade Adjustment: If you dispute any scoring of a problem on an exam or homework set, you have **one week** from the date that the graded paper is returned to request a change in the grade. After this time, no further alterations will be considered. All requests for a change in grade must be submitted in writing to me.

Changes/Information: The student is responsible for all assignments, changes of assignments, announcements, lecture notes *etc.* All such changes should be posted on the course web-site.

Other: As per university guidelines published in SCampus, the academic integrity policy will be upheld.

References: Starred references are especially useful.
Detection References –

1. C. Helstrom, *Elements of Signal Detection and Estimation*, Prentice Hall, 1995.
2. E. L. Lehmann, *Testing Statistical Hypotheses*, Wiley, 1986.
3. B. Porat, *Digital Processing of Random Signals: Theory and Methods*, Prentice Hall, 1994.
4. * H. V. Poor, *Signal Detection and Estimation, 2nd edition*, Springer-Verlag, 1994.
5. * L. Scharf, *Statistical Signal Processing, Detection and Estimation Theory*, Addison-Wesley, 1990.
6. H. Van Trees, *Detection, Estimation, and Modulation Theory*, Wiley, 1971.

Communication & Coding References –

1. J. R. Barry, E. A. Lee, and D. G. Messerschmitt, *Digital Communication, 3rd edition*, Kluwer Academic Press, 2004.
2. * S. Benedetto & E. Biglieri, *Principles of Digital Transmission - With Wireless Applications* , Kluwer Academic Publishers, Amsterdam 1999.
3. M. K. Simon, S. M. Hinedi, and W. C. Lindsey, *Digital Communication Techniques – Signal Detection and Design*, Prentice-Hall 1995.
4. S. G. Wilson, *Digital Modulation and Coding*, Prentice-Hall, 1996.
5. * J. M. Wozencraft and I. M. Jacobs, *Principles of Communications Engineering*, Waveland Press, 1990 (reprint of a 1965 Wiley & Sons text).

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Outline:

1. Overview of digital communication theory and systems
2. Binary Detection Theory
3. Signal Space/Random Processes Preliminaries
4. Complex Low Pass Representations
5. M-ary Detection Theory
6. Union Bound/Performance Analysis
7. Digital Modulation methods
8. Nyquist criterion
9. Matched Filter
10. Memoryless modulation/channels
11. Channels with memory
12. Equalization
13. Synchronization

Suggestions:

1. Remember the big picture.
2. Read the book and supplementary sources.
3. Prepare your own summaries from texts and notes.
4. Work in groups for study (explain main concepts to each other).
5. Write up your homework on your own.