Lecture: Tuesday and Thursday, 12:25-1:45 P.M. at MEB 1208
Prerequisite: ECE 5510, *Random Processes* (also ECE 3500, *Fundamentals of Signals and Systems*)
Credit: 3 hours
Instructor: Neal Patwari
Office: MEB 2256
Office Hours: Wednesday 10am-noon, Thursday 1:45-3:45pm, and by appointment
Email: npatwari@ece.utah.edu
Phone: (801) 581-5917
Grader: Yuehua Liu, Yuehual@eng.utah.edu
Matlab: Matlab is a required part of the homework assignments.
Textbook: J.G. Proakis and M. Salehi, *Communication Systems Engineering*, 2nd edition, Prentice Hall. You may be able to find it for $60 or less on half.com or Amazon used & new. It is a good reference, but we’ll be using only four chapters. One copy will be held on reserve at the library.
On Reserve: The two texts above and:
Description: From the ECE Catalog: “Modern communications; probabilistic viewpoint; vector representation of signal; signal spaces; vector channels; additive white Gaussian noise; optimum receivers; maximum-likelihood detection; error probabilities; memoryless modulation methods: PAM, BPSK, M-PSK, FSK, QAM; message sequences; intersymbol interference (ISI); Nyquist signaling; complex baseband models; noncoherent detection.” Also: synchronization, source coding.
Grading

Course grading will be calculated based on:

Homework: 20% (lowest homework score is dropped)
Project: 25%
Exam 1: 15%
Exam 2: 20%
Final Exam: 20%

Grades are copied onto WebCT’s grade book, so that you can verify that your grade has been recorded properly, and so that you can compare it with the class statistics.

Homework:

Homework will generally be assigned each Thursday in class (or on the web) and be due the following Thursday at 6pm in the homework locker. The homework locker is located in the hallway on the 3rd floor of the MEB, near the southeast stairwell. One will be labeled, ‘ECE5520’. No late homework can be accepted. However, to allow for extenuating circumstances, the lowest homework score will be dropped when calculating the final grade.

Collaboration Policy:

You are encouraged to work together on homework assignments whenever possible. Discussing things is a great way to learn. After making a genuine attempt to solve the homework problems, you are encouraged to discuss the answers with other students currently enrolled in ECE 5520 to check the answers and compare solution approaches. However, after such a discussion, you must complete your answers on your own, without referring to the solutions of other students or to solutions from previous terms. When working on Matlab problems, you may not use or copy code written by another student.

Exams:

All exams must be taken during the scheduled times:
Exam 1: Tuesday, Feb 13, in-class
Exam 2: Thursday, Mar 29, in-class
Final: Tuesday, May 1, 2007, 10:30 am - 12:30 pm

Grading Scale

Tests, project, and homework are designed so that you can demonstrate your mastery of each of the topics within digital communications. Your grade percentage will reflect the percentage of the course topics which you have demonstrated proficiency. Competition is not necessary, since every student can get an ‘A’ grade. The letter grade is encoded as follows:

A: \[ \geq 92 \]  
A-: \[ \geq 90 \text{ and } < 92 \]
B+: \[ \geq 88 \text{ and } < 90 \]  
B: \[ \geq 82 \text{ and } < 88 \]  
B-: \[ \geq 80 \text{ and } < 82 \]
C+: \[ \geq 78 \text{ and } < 80 \]  
C: \[ \geq 72 \text{ and } < 78 \]  
C-: \[ \geq 70 \text{ and } < 72 \]
D+: \[ \geq 68 \text{ and } < 70 \]  
D: \[ \geq 62 \text{ and } < 68 \]  
D-: \[ \geq 60 \text{ and } < 62 \]

Tips:

1. Find another student or students to help you (or to help them) when you (they) have trouble with homework problems. Do that now, from the start!
2. Read the corresponding section in the book before lecture.
3. Come to office hours.
4. Do additional problems, beyond the homework.
**Disability Accommodations**

The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

**Course Topics**

1. Introduction to Digital Communications Systems: P&S 1.1-1.4, MIT Lec. 1
2. Fourier Transform, Power, Energy: P&S 2.1-2.4
3. Sampling, Bandwidth: P&S 2.5
4. Bandpass Signals, Complex Baseband Representation: Fitz Ch. 4
5. Orthogonality, Gram-Schmidt Orthogonalization: P&S 7.1
7. Optimal receivers: Matched Filter, Correlation: P&S 7.5.1, 7.5.2
8. Detection Theory: P&S 7.5.3
9. Inter-symbol Interference (ISI), Nyquist Filtering, Eye-Diagrams: Bateman 3.1-3.4, P&S 8.3, 8.3.1
11. Phase Shift Keying (PSK): P&S 7.3.2, Bateman 5.4, 6.4
12. Differential encoding, decoding
13. Frequency-Shift Keying (FSK): P&S 7.4.1, Bateman 5.3, 6.3
15. Probability of Error, Union Bound: P&S 7.6, Bateman 6.6
16. Comparison of Modulation Techniques: 7.6.10, Bateman 5.5
17. Carrier Synchronization: P&S 7.5.4, 7.5.5
18. Symbol Synchronization: P&S 7.8
19. Source Entropy, Conditional Entropy, Entropy Rate: P&S 6.1
20. Huffman Coding: P&S 6.3.1
21. Lempel-Ziv Source Coding: P&S 6.3.2