**EE381K-2 Digital Communications**

Instructor: Prof. Jeff Andrews  
Lecture Hours: MW 5:00–6:15 PM, ENS 306  
Office Hours: Tuesday 1-3pm  
Office: ENS 434, phone 471-0536  
E-Mail: jandrews@ece.utexas.edu  
Web: http://www.ece.utexas.edu/~jandrews  
Unique Course Number: 16760

**Prerequisites**  
The following prerequisites are strongly suggested. If you don’t have these prereqs but think you can handle the course, please see me to discuss it.

1. Graduate Level Probability (EE 381J or equivalent)  
2. An undergraduate course in communications  
3. Some experience with digital signal processing, e.g. discrete Fourier transform.

**Topical Outline**  
This course is meant to provide a strong foundation for graduate study and research in the area of communications. The main objective of the course is to teach the students the engineering principles and analytical techniques required to design and understand digital communication systems. In particular, the focus of this class is the reliable transmission and reception of finite-alphabet (i.e. digital) symbols over noisy channels with memory.

The class is definitely focused on uncoded systems, but we will cover the fundamentals of convolutional codes and trellis codes at the end of the class.

**Topics for the course:**

- Digital Modulation  
- MAP and ML Detection  
- Bandpass and Complex Baseband Signal Representation  
- Intersymbol Interference Channels  
- Equalization: linear (ZF and MMSE) and decision feedback  
- Multicarrier Modulation: Channel partitioning, vector coding, orthogonal frequency division multiplexing (OFDM)  
- Maximum Likelihood Sequence Detection and the Viterbi algorithm.  
- Convolution coding and decoding  
- Trellis coding and decoding
• Signal Acquisition and Synchronization (Time allowing)

**Required Textbook (Course Reader)**
J. Cioffi, *Digital Communications.*
This unpublished book was chosen because it is rigorous and systematic, and also much less expensive than any of the alternatives. You can get a copy of the current version from Eta Kappa Nu (HKN), they should be available by the first week of class, hopefully earlier. Please get a copy ASAP, so if they run out more can be ordered and printed in time for your first homework set. Please be aware that there are still a number of typos in this manuscript, so if something is truly vexing, talk to a classmate or the instructor before ripping your hair out.

**Supplemental Textbooks**
A number of interesting digital communication books have been published since the last time the course was taught in 2008. Interested in student feedback on any of these.

J. Proakis (and Salehi), *Digital Communications*, 5th Ed, McGraw Hill. This is the classic text, and a great research reference. Universally agreed, though, that it is difficult to teach a class from.

R. Gallager *Principles of Digital Communication*, Cambridge, 2008. A very extensive treatment of the fundamentals of narrowband channels; but a main focus in my view of a graduate digital communications course should be dealing with ISI (wideband) channels.


**Web Resources**
The class webpage is accessible at:
http://www.ece.utexas.edu/wncg/ee381k2/

Here, you will be able to find all handouts for the class, except homework solutions, for which only hardcopies will be available.

The online class system is called Blackboard. Most handouts will be distributed on the public web page (above), but we’ll send group e-mails and do online grading through Blackboard (so you can view your grades there). Please make sure you know how to access Blackboard and that you are listed there as a student.

**Grading**
22.5% Exam 1 [February 24]
22.5% Exam 2 [March 31]
35% Final [May 14, 7-10pm]
10% Homework
5% Equalization Project
5% Quizzes

**Other Information**
Homework will typically be assigned Wednesday, due one week later by the start of class, either in class or to a drop box outside Prof. Andrews’s office. Students are encouraged to try the
homework problems on their own, and then refine their understanding and solution with another student or group of students. Unfortunately, there is no TA for the course and my time out of class that can be spent helping on HWs is limited to e-mail exchanges and office hours. Hence, it is important that you identify a study group of fellow students to discuss the homework problems with, as the homework in this class will frequently be challenging (or so I hope!).

Late homework will be accepted only in the most extraordinary of circumstances (if you aren’t sure that your excuse is extraordinary, then it isn’t). This said, please note that homework is not worth a very large portion of your grade. Your best strategy is probably to treat the homework as a study tool so that you can excel on the exams, which are what will determine your grade.

Short (10 minute) pop quizzes will be given most weeks. They will not figure heavily in your grade (about 5%), but will help both you and the professor assess whether you are learning the key concepts presented in lecture. Typically, the quizzes will be worth 10 points and your lowest quiz grade will be dropped when computing the final grades (there are no make-up quizzes). They will typically be given on Thursday at the end of class and discussed on Tuesday at the beginning of class.

There will probably be two mini-projects where you will design a digital communication system for a channel model that we give you; the first being on equalization and second on multicarrier modulation. It will probably take longer than a normal homework, and be worth 2-3 times as much. Exact details will be given later.

Regrade Policy
All requests for regrades, on homework or exam, must be submitted in writing within a week of their return to you. No verbal complaints will be considered. Mistakes can be made in the grading process and we will correct those, but it is unlikely that more partial credit will be given. The basic idea here is that we don’t want to indirectly penalize those students who don’t ask for regrades. Also be aware that the result of a regrade can actually be a lower score as we will regrade the entire problem being protested.

College Drop/Add Policy
An engineering student must have the Dean’s approval to add or drop a course after the fourth class day of the semester.

Students with Disabilities
The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4641 TDD or the College of Engineering Director of Students with Disabilities at 471-4382.