EECE 5430 Communication Theory I

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This course presents a general analysis of modern digital and analog communications systems at the first-year graduate level. We start with fundamentals of analog modulation because digital modulation is just a special case of generalized analog modulation, especially in how the waveforms look in time and frequency. Next we cover digital modulation ASK, PSK, FSK and QAM plus some commonly used variants, CPFSK and MSK. The last section covers basics of spread spectrum and OFDM. Homework is mandatory but not graded. Solutions are posted each week and discussed at the beginning of each class. The exams are based on the homework. Note that the more you put into the course in terms of homework and projects, the more you will get out of this class.

Grading: Midterm Exam 35%, Final Exam 40%. There are 4 mini-projects (Project 0: Demonstrate Central Limit Theorem, Project 1: AM, Project 2: FM, Project 3 Three matched filter bears. 20%, 05% on completion of Homework which must be submitted each week on **blackboard**

Prerequisites (A must for this course): Linear Systems including Fourier Transform Theory and a course in probability and random processes. (e.g. EECE 3620 and EECE 3630) Please do not take this course if you have not taken both courses or equivalent.

Textbook: *Communication Systems Engineering*, by Proakis and Salehi, plus Class notes

Course Schedule (website schedule supersedes this schedule)

Thurs Sep 6: Introduction to amplitude modulation and its variants: AM-SC, AM-LC, heterodyning, coherent and non-coherent detection of AM, single sideband.

Thurs Sep 13: Amplitude Modulation Continued. Assign Matlab 1. Due 10/18

Thurs Sept 20: Angle and frequency modulation, representation, generation, and spectral characteristics of FM and PM. Discriminators and PLL implementation of demodulators. Assign Matlab 2: Due Oct 18.

Thurs Sept 27: Angle Modulation Continued

Thurs Oct 4: Applications of analog modulation, AM radio, FM broadcast, TV signals, FDM, Performance of AM, FM and PM in the presence of Noise

Thurs Oct 11: Monday Schedule, No Class

Thurs Oct 18: Review of Probability and catch-up if we need it. Matlab Projects 1 and 2 due. Assign Matlab 3: Due Oct 26.

Thurs Oct 25: Mid Term Exam 3 Hours in Class, (tentative) Materials through Oct 12 lecture.

Thurs Nov 01: Introduction to Digital Communication. Geometric representation of pulse modulation signals, Optimum receiver for pulse modulated signals in AWGN. The matched filter, maximum likelihood detection. The Shannon bound.

Thurs Nov 08: Review of the matched filter and detection theory. Carrier modulation I. Modulating amplitude, frequency, and phase (ASK, PSK, FSK), and hybrid QAM systems. Performance of digital signals in noise. Demodulation and detection of signals. Review for Exam I. Matlab 4 "Three matched filter bears" assigned: Due 12/7

Thurs Nov 15: Digital modulation via carrier modulation II. Spectral Characteristics of Digital modulation systems, CPFSK and MSK, special cases with unique spectral properties. Spectral shaping for band limited channels.

Thurs Nov 22: Thanksgiving Recess: No Class, take home project

Thurs Nov 29: Effects of filtering, band limiting, multipath, and Intersymbol interference on performance of digital communication systems. Bit and carrier Synchronization

Thurs Dec 06: Introduction to Spread Spectrum and CDMA. Direct sequence spreading and how it can be used to deal with multipath, interference, and jamming. Extending concept of spread spectrum to CDMA for 3rd generation wireless systems.

Thurs Dec 13: Introduction to Orthogonal Frequency Division Multiplexing OFDM for 4th generation wireless systems and beyond.

TBA: Final Exam, 3 hours in class

Password for Course notes: "uml"

Academic Integrity: I strongly encourage you to help each other out. But, I and the university consider academic dishonesty to be taking credit for work done by others. This includes direct copying of homework, computer problems, or exams. If you do not have time to put into this course, take fewer credits or take it when you have the time, if you find the material too hard, get help. If you are not interested in the material, take a different course!