EELE445 Telecommunications Systems – Spring 2015

Course Description:	An introduction to analog and digital communication systems with lab. Topics include signals in communications; noise characterizations; bandwidth considerations; probability of error; analog and digital modulation; frequency domain analysis; matched filter applications. Experiments involve modulation, demodulation, A/Ds, sampling theory, and aliasing.
Instructor:	Andy V. Olson, 631Cobl, 994-5967 andyo@ece.montana.edu
TA:	Glen Dower, Cobleigh 507
Prerequisites:	EELE308- Signal and Systems Analysis or equivalent or consent of the instructor EELE317- Electronics
Text:	**Digital and Analog Communications Systems, 8th edition, Prentice Hall, Leon W. Couch, 2013, ISBN 0-13-291538-3**
Other References:	Modern Digital and Analog Communication Systems, B. P. Lathi Communication Systems, A. Bruce Carlson Fundamentals of Communications Systems, J. G. Proakis The student version of Matlab will also be used in class
Class:	1:10 pm - 2:00 pm, MWF Roberts Hall 321
Grading:	Homework ....25% Midterm1 –………………….…......25% Final Examination –…....................25% Lab Work ………………….……25%

Homework

Homework assignments cover approximately every 3 lectures and are due on the following Friday. Please be sure your homework is <u>clear and legible</u>! Late homework will be accepted with a reasonable excuse <u>before</u> the solutions are posted on the following Wednesday. Students may study together on the homework but do the problems individually. Many exam problems are drawn from homework problems. Office hours will be posted to answer questions but you may try to get me anytime I am not busy to ask a question.

Reading Assignments and Course Notes

Reading assignments are not given in this course. Lecture notes with problem examples worked in class will be posted on a weekly basis for the students review. The notes should be studied in conjunction with the appropriate sections of the text for the best understanding of the material and to achieve the best performance on exams.

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Exams

There will be1midterm and a final. Each exam will cover approximately on third of the course material. The final exam will also include one topic from the first exam and one topic from the second exam. One 8.5x11 sheet of paper with notes (both sides) may also be used during the exam. No other reference material may be used. Tentative exam dates are provided and will be confirmed as the exam dates approach.

Course Topics

Review of Signals and Spectra
Classification and properties of signals, unit impulse function, correlation, exponential Fourier series, Fourier Transforms, properties of Fourier transforms, energy spectral densities, power spectral densities

Analysis and Transmission of Signals
Signal transmission through a linear system, ideal and practical filters and signal distortion over a communication channel, antennas, link budgets

Sampling and pulse code modulation
Nyquist sampling theorem, quantization, quantization noise, signal to noise ratio considerations, bit rates

Principles of Digital Baseband Signals
PAM –pulse amplitude modulation, PCM – pulse code modulation, Digital baseband signal vectors, Line Codes, ISI –inter-symbol interference, Speech Coding, TDM, PWM, occupied bandwidths, pulse shaping, regenerative repeaters, digital multiplexing

Bandpass Signaling Principles and Circuits
The Complex Envelope, Modulation Theorem, Demodulation, Filtering, Receivers, Transmitters

Bandpass Modulated Systems
- Amplitude (linear) Modulation -Basic modulation theorem, double sideband, amplitude modulation, superheterodyne receivers
- Angle (FM, PM) modulation - Instantaneous frequency, generation of FM, occupied bandwidth of FM, demodulation of FM, performance of FM systems, stereo FM
- Digital modulation – BPSK, QPSK, M-ary, MSK, GMSK

Introduction to the theory of probability
Basic concepts, random variables, Gaussian amplitude probability density, statistical averages, statistical definitions of noise

Analog systems in the presence of noise
DSB-SC systems, AM systems, FM systems

Behavior of digital systems in the presence of noise
Optimum threshold detection, optimum binary receiver, probability of bit error P_e,

Error correcting codes
Forward error correction FEC, linear block codes, performance improvement

Example systems
Several current communications will be chosen and discussed in class.

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Lab Work

Lab Goals**:**
The primary purpose of this lab is to reinforce the concepts introduced in the course lectures. The lab will also augment the ability to assemble, test, and analyze simple electronic circuits used in communications. Requirements for notebooks and memo reports will be posted on the class website.

Lab General Guidelines:
- Work together in groups of **no more** than three people. Labs will be posted on the website prior to the lab period.
- Most Labs will have pre-lab work to be done prior to the lab period. Pre-lab questions will be checked and initialed by the TA at the beginning of the lab period. This will then be turned in with the memo report of that lab one week after the lab is performed.
- Several of the labs will require a formal report.
- Maintain separate laboratory notebooks.   These are **VERY** useful for the exams! Notebooks will not be collected
- Check the website for work and other information

Lab Grading:
- The lab work is 20% of your final course grade. The lab grade is composed of:
  - Reports and pre-labs   90%
  - Final Examination   10%

- Notebooks will not be collected or graded but may be used for the lab final so you will find them usefull!
- A memo report for each lab is due one week after the lab is performed. It should be typed. **Be sure to attach your prelab questions to your memo report as this is part of the report grade!** Only one report with all lab partners listed needs to be turned in. The final is 10 questions based on the labs that have been performed. Lab notebooks may be used during the exam. You may be asked to set up the equipment and perform a measurement for the instructor as part of the exam.

Parts for the labs may be purchased from the stock room. Parts cost is not covered by the general laboratory fee, but the cost is minimal.