The Ohio State University
Department of Electrical and Computer Engineering

ECE 501 – Introduction to Analog and Digital Communications

Winter 2008

Instructor: Dr. Phil Schniter, Associate Professor
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Web Page: `http://www.ece.osu.edu/~schniter/ee501/index.html`

Homework assignments, homework modifications, homework solutions, and relevant handouts will be posted on the web page.

Lectures: MWF 4:30pm-5:18pm, 125 Scott Laboratories

Office Hours: To be posted on course web page.

Objectives: To develop a basic understanding of practical analog and digital communication systems.

Text: S. Haykin and M. Moher: *Introduction to Analog and Digital Communications, 2nd Ed.*, Wiley: New York, 2006.

Outline: *Introduction*: communication system overview, preview of modulation and pulse-shaping.

Review: Fourier transform, Dirac delta, linear systems, filtering, MATLAB implementation.

Analog Communication: AM, QAM, VSB, FM.

Channel and Noise Modeling: multipath propagation, additive white noise, autocorrelation, power spectrum, filtering of random processes, complex-baseband channel representation.

Digital Communication: pulse shaping, ISI, Nyquist criterion, raised-cosine pulse, SNR maximization, square-root raised-cosine pulses.

Implementation of Digital Comm Systems: review of sampling, downsampling, and reconstruction; discrete-time implementation of transmitter, receiver, and channel model.

Digital Communications Error Analysis: eye diagrams, constellation diagrams, symbol alphabets (QAM, PAM, PSK, BPSK, QPSK), nearest-element decisions, symbol error rate for PAM and QAM, Gray coding.

MMSE Equalization: mean-squared error, vector/matrix system representation, completing-the-square.

Prerequisites: Signals and systems (e.g., ECE 351-352).
Probability and random variables (e.g., Math 530 or Stats 472).

References:

1. M. P. Fitz, *Fundamentals of Communications Systems*, McGraw-Hill, 2007.
2. J. G. Proakis and M. Salehi, *Fundamentals of Communication Systems*, Prentice Hall, 2005.
3. J. G. Proakis and M. Salehi, *Contemporary Communication Systems Using Matlab*, 2nd Ed., Thomson-Engineering, 2003.
4. S. Haykin, *Communication Systems*, 4th Ed., Wiley, 2000.
5. M. K. Simon, S. M. Hinedi, and W. C. Lindsey, *Digital Communication Techniques*, Prentice Hall, 1994.
6. J. D. Gibson, *Principles of Digital and Analog Communications*, 2nd Ed., MacMillan, 1989.

Grading: The course grade will be based on homework and projects ($\sim 25\%$), one in-class midterm ($\sim 33\%$), and a comprehensive final exam ($\sim 42\%$). Note: These weightings are approximate and may change. Some homework problems will require MATLAB computer programming and not necessarily all problems on each homework assignment will be graded.

Late Policy: No late material (projects, homework, etc.) will be accepted unless prior arrangements have been made. Arrangements need to be made at least 24 hours in advance. Any emergency situation will be handled on a case-by-case basis.

Attendance: The student is responsible for all assignments, changes to assignments, announcements, and subject material presented during the regularly scheduled classroom lecture. Copies of lecture notes will not made available. If you miss a lecture, please obtain notes from a classmate.

Honor System: All homework and examinations in this course will must be accomplished in accordance with the ECE Honor System. This means that *all submitted work must be your own.* While discussions among students relating to the homework are permitted (and often encouraged), a student's submitted assignment must reflect his/her *own* understanding of the material. Discussion of an exam is strictly prohibited until after the exam is submitted.