ECE Department
University of Arizona

ECE 435: Introduction to Digital Communications

Fall 2010

Course Objectives

To give the student an introduction to digital communication principles. The successful student will be prepared for further study in this area at the graduate level and will be qualified for an entry-level position in communications in industry.

Instructor

Ivan B. Djordjevic, Assistant Professor
Office: ECE 456B
Phone: (520) 626-5119
Email: ivan@ece.arizona.edu

Reference Textbook

S. Haykin and M. Moher, *Communication Systems*, 5th Ed., John Wiley & Sons, 2009.
S. Haykin, *Communication Systems*, 4th Ed., John Wiley & Sons, 2001.

Office Hours

11:00 AM – 12:00 AM, Monday and Wednesday

Prerequisites

ECE 340 (or equivalent)

Homeworks

Homeworks will be assigned approximately every 1-2 weeks.

Exams

If you miss an exam (due to legitimate, unavoidable circumstances), the *comprehensive exam* will be organized, as the substitute of your missed exam.

Final Exam

TBD

Grading

Homework	10%
Exam #1	10%
Exam #2	15%
Exam #3	15%
Project	25%
Final Exam	25%

Tentative Course Outline

- Introduction
- Signals and Systems Review
    - Spectral density and autocorrelation
    - Fourier series and Fourier transform
    - Transmission of signals though linear systems
    - Low-pass and band-pass signals and systems
    - Phase and group delay
- Continuous-Wave Modulations
    - Amplitude modulations: DSB, AM, SSB, QAM, VSB
    - Angle modulations: FM, PM, super-heterodyne receiver, FM stereo
- Probability Theory and Random Processes
    - Probability, random variables and statistical averages
    - Random processes, mean, correlation and covariance
    - Transmission of a random process over a linear system
    - Power spectral density
    - Gaussian process
    - Noise, narrowband noise, and mobile radio channels
    - Wireless LAN channels
- Pulse Modulation
    - Sampling (revisited), PAM
    - PCM, TDM, digital multiplexers
    - DM, D-ΣM
    - DPCM, ADPCM
    - JPEG 2000
- Baseband Digital Transmission
    - On/Off, orthogonal, and antipodal signaling
    - Minimum Euclidean distance receiver, correlation receiver and matched filter receiver
    - Performance
    - Intersymbol interference (ISI)

    - Baseband *M*-ary transmission
    - Equalization
    - Correlative coding
- Digital Band-Pass Transmission
    - Signal-space theory
    - Maximum *a posteriori* probability (MAP) and maximum likelihood detection
    - Minimum Euclidean distance receiver, correlation receiver and matched filter receiver
    - PSK, FSK, ASK
    - *M*-ary data transmission systems: MPSK, MQAM and MFSK
    - Detection of signals with unknown phase, noncoherent orthogonal modulation, noncoherent FSK, and DPSK
    - Comparison of single carrier modulation schemes
    - Orthogonal frequency division multiplexing (OFDM)
- Information Theory and Error Control Coding
    - Uncertainty, information and entropy
    - Source-coding theorem; lossless data compression; Lempel-Ziv algorithm
    - Discrete memoryless channels; mutual information
    - Channel capacity; channel coding theorem; capacity of a Gaussian channel
    - Error control coding
    - Linear block codes
    - Cyclic codes (if time allows)
    - BCH and RS codes (if time allows)
    - Low-density parity-check (LDPC) codes (if time allows)