KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
ELECTRICAL ENGINEERING DEPARTMENT
Spring Semester 2014-2015 (142)

EE 571 Digital Communications I

- **Prerequisites:** EE370, EE315 or equivalent courses.
- **Instructor:** Prof. Salam A. Zummo, Office: 59-2086 or 68-261, Phone: 7776, 2844
  E-mail: zummo@kfupm.edu.sa
  Web Site: http://faculty.kfupm.edu.sa/ee/zummo/courses.htm or WebCT
- **Course Objectives:**
  - Understand basic components of digital communication systems.
  - Design optimum receivers for digital modulation techniques.
  - Analyze the error performance of digital modulation techniques.
  - Design digital communication systems under given power, spectral and error performance constrains.
- **Course Description:** Time and frequency representation of signals. Spectral density and autocorrelation. A/D and D/A conversion. PAM and PCM systems. Detection of binary and M-ary signals in Gaussian noise. Matched filter and correlator receivers. Pulse shaping. Band pass modulation and demodulation techniques. Error performance for binary and M-ary systems. Spectral Analysis of digital signals. Communication link analysis.
- **Course Outline:** (Time and emphasis may be adjusted as needed)
  - **Review:** (2 Weeks)
    Sampling theorem, analog-to-digital conversion and PCM, random variables and stochastic processes.
  - **Detection Theory:** ($2\frac{1}{2}$ Weeks)
    Vector channels, detection of signals in noise, decision rules such as MAP and maximum likelihood rules, waveform channels, error probability of baseband signals.
  - **Modulation Techniques:** (4 Weeks)
    Bandpass signal representation, noise characterization in bandpass systems, orthogonal expansion of signals, phase and frequency shift keying, quadrature modulation, differential and M-ary modulation schemes, coherent and non-coherent receivers, correlator, matched filter and envelop detector.
  - **Performance of Modulation Techniques:** (2 Week)
    Computation of the error probability for different modulation techniques and water-fall error curves.
  - **Spectral Characterization:** (2 Week)
    Spectral characterization of modulation techniques, bandwidth definitions, pulse shaping, spectrally-efficient modulation schemes such as OQPSK, $\frac{\pi}{4}$-QPSK, MSK, GMSK and CPM.

- **Comparison of Modulation techniques:** ($1\frac{1}{2}$ Week)
  Channel capacity theorem, maximum information rate in a communication system, power and spectral efficiency of modulation techniques, link budget.
- **Projects' Presentations:** (2 lectures)

• Textbook:

- J. Proakis, Digital Communications, McGraw-Hill Prentice-Hall, 5th edition, 2008.
- Lecture notes.

• References:

1. A. Papoulis, Probability, Random Variables, and Stochastic Processes, McGraw-Hill, 1965.
2. J. Wozencraft and I. Jacobs, Principles of Communication Engineering, John Wiley & Sons, 1965.
3. H. Van Trees, Detection, Estimation and Modulation Theory, John Wiley & Sons, 2001.
4. S. Wilson, Digital Modulation and Coding, Prentice-Hall, 1995.
5. Gallager, Information Theory and Reliable Communication, John Wiley & Sons, 1968.

• Homework Assignments:

Homework assignments will be issued about once every two weeks. Collaborative work is encouraged between students. However, solutions are to be worked out and submitted individually.

• Grading Policy:

- Homeworks 20%
- Exam I 20% Tuesday of Week 6 - Class time (March 3)
- Exam II 20% Tuesday of Week 12 - Class time (April 21)
- Final Exam 30% Tuesday May 26 at 7:00 PM
- Projects 10%