King Saud University **EE322-Digital Communications**
College of Engineering **2nd Semester 1429-30**
Elect. Eng. Dept.

Instructor: Dr. Ibrahim Elshafiey
Office 2C115 - Phone 467-6751

Lectures Schedule and Location: Sat., Mon. and Wed. at 1C3
11-11:50 am

Text Book:

Simon Haykin, *Communication Systems*, John Wiley & Sons, Inc., New York, 4th Edition, 2001.

References:

1. S. Haykin, and M. Moher, "Introduction to Analog & Digital Communications, John Wiley & Sons, Inc., New York, 2nd Edition, 2007.
2. B. P. Lathi, *Modern Digital and Analog Communication Systems*, Oxford University Press, New York, 3rd Edition, 1998.

Measurable Objectives:

After finishing this course the student should be able to:

1. identify the fundamental concepts of a digital telecommunication system.
2. describe the architecture of common digital communication systems.
3. analyze baseband transmission of digital signals.
4. perform the geometric representation of signals.
5. analyze and design passband digital communications techniques.
6. determine the bit error rate of basic modulation formats when operating in white Gausian Noise environment.
7. identify the advantages of error correcting codes on the performance of digital communication systems.
8. design digital communication systems to operate in noisy environments.
9. recognize the basic concepts of source coding.

Relationship to Program Outcomes:

This course contributes to the following general outcomes listed for the Electrical Engineering Department. The main outcomes of this course are:

a. Ability to apply knowledge of mathematics, science, and engineering

This course focuses on mathematical formulation of communication systems.

c. Ability to design a system, component, or process to meet desired needs within realistic constraints

Students are given assignments to design digital communication systems in noisy environment to achieve basic system specifications on bandwidth usage, data rate, and error rate performance.

e. Ability to identify, formulate, and solve engineering problems

The course incorporates analysis of engineering problems related to digital communication systems.

k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

The course makes use of computer tools to analyze and design digital communication systems. Students are required to conduct simulation experiments under matlab simulink environment.

The secondary outcomes are:

g. Ability to communicate effectively.

Focus is given in grading homework, quizzes and term exams on the ability of student to formulate his thinking in a correct way in terms of logic and mathematical formulation. Class discussions also focus on these aspects.

h. The broad education necessary to understand the impact of engineering.

The impact of applying communication theories on modern technologies is discussed throughout the course.

i. Recognition of the need for, and an ability to engage in life-long learning.

Students are urged to read and follow communication engineering magazines.

j. knowledge of contemporary issues.

Students are engaged during lectures in discussions of contemporary issues related to modern communication systems.

Course Timetable

Topic 1: Background (Week 1)

- Review of Probability Theory and Random Variables
- Random Processes: Stationary Processes; Mean, Correlation and Covariance Functions; Ergodic Processes; Transmission of a Random Process through a Linear Time-Invariant Filter; Power Spectral Density.

Topic 2: Baseband Pulse Transmission (Week 2-3)

- Detection of binary signals in Gaussian noise
  - Matched Filter
  - Bit Error Probability Performance of Binary Signaling
- Inersymbol Interference
  - Nyquist Criterion for Distortionless Baseband Binary Transmission
  - Pulse shaping to reduce ISI
  - Correlative-Level Coding
  - Adaptive Equalization
  - The Eye Pattern

Topic 3: Signal-Space Analysis (Week 4)

- Gram-Schmidt Orthogonalization Procedure.
- Geometric Representation of signals.
- Maximum Likelihood Decoding
- Correlation Receiver
- Probability of Error

Topic 4: Passband Digital Transmission-Coherent Digital Modulation Schemes (Week 5-7)

- Introduction to Coherent Modulation Schemes.
- Binary Phase Shift Keying (BPSK).

- Binary Frequency Shift Keying (BFSK).
- Binary Amplitude Shift Keying (BASK).
- M-ary Modulation Schemes (M-PSK, M-FSK, M-QAM).
- Power Spectra of Binary PSK Signals.
- Power Spectra of Binary FSK Signals.
- Power Spectra of M-PSK Signals.
- Power Spectra of M-FSK Signals.
- Bandwidth Efficiencies of M-FSK and M-PSK Signals.
- Performance of Different Modulation Techniques.
- Synchronization

Topic 5: Non-coherent Digital Modulation Schemes (Week 8)

- Binary DPSK.
- Noncoherent binary FSK.

Topic 6: Information Theory (Week 9-11)

- Uncertainty, Information, and Entropy.
- Source-Coding Theorem
- Discrete Memoryless Channels.
- Channel Capacity
- Channel-Coding Theorem

Topic 7: Error Control Coding (Week 12-13)

- Linear Block Codes.
- Convolutional Codes.
- Viterbi Decoder for Convolutional Codes.

Grading:

20 %	Homework and Quizzes	
20 %	First Mid-Term Exam	(Saturday 15/4/30- 4 pm)
20 %	Second Mid-Term Exam	(Saturday 28/5/30 – 4 pm)
40 %	Final Exam	

Attendance: According to KSU policy, attendance is mandatory in lectures and tutorials. A student who misses more than 25% of classes will not be allowed to take the final exam.