**KING FAHD UNIVERSITY OF PETROLEUM & MINERALS**

**ELECTRICAL ENGINEERING DEPARTMENT**

**EE406- DIGITAL SIGNAL PROCESSING**

**FIRST SEMESTER 2009-2010**

| Instructor | Office | Sec | Phone | E-mail | Office Hours |
|---|---|---|---|---|---|
| **Dr. Ali A. Al-Shaikhi** | **59/0074** | **1** | **2610** | **shaikhi@kfupm.edu.sa** | S&M @ 09:00 am – 10:00 am<br>S&M @ 12:15 pm – 01:00 pm<br>Or by appointment |

## EE 406 Digital Signal Processing 3, 0, 3

Classification of signals and their mathematical representation. Discrete-time systems classification. Linear shift-invariant system response, difference equations, convolution sum, and frequency response. Discrete Fourier transform. Z-transform and its application to system analysis. Realization forms. Sampling and aliasing. Finite-impulse response (FIR). Design windowing technique. Introduction to infinite impulse response (IIR). Filter design techniques.

**Pre-requisite:** EE 370

**Textbook:**

**1.** J. G. Proakis and D. G. Manolakis, *Digital Signal Processing: Principles, Algorithms and Applications, 4*rd Edition, Prentice Hall, 2007.

**Other references:**

**2.** A. V. Oppenheim and W. Schafer, *Digital-Time Signal Processing,* 4th Edition, Oxford Publishing, 1998.

3. S. K. Mitra, *Digital-Time Signal Processing- A Computer-based Approach, 4*nd Edition, McGraw-Hill Oxford Publishing, 2009.

**4.** R. A. Roberts and C. T. Mullis, *Digital Signal Processing,* Addison-Wesley, 1987.

**5.** L. B. Jackson, *Digital Filters and Signal Processing,* 3rd Edition, KAP, 1995.

**Content Breakdown:**

- Signals and Systems: Classification of signals; Linear shift-invariant systems; System response; Convolution; Stability and causality.
- The z-Transform: Definitions and region of convergence; Inverse z-transform; Properties of the z-transform; Realization; System function; Frequency response; Difference equations.
- Discrete-Time Networks: Signal flow graphs; Realizations forms: Direct, cascade, and parallel forms.
- Sampling and Discrete-Time Fourier Transform: Definitions; Convergence conditions; Properties of the DTFT; Aliasing; Analog-to-digital and digital-to-analog conversions.
- Introduction to Discrete Fourier Transform: Definitions; Properties; Efficient computation of the DFT; FFT algorithms.
- Introduction to Digital Filters Design: FIR versus IIR; Linear-phase filters; Windowing design techniques for FIR.

**Course Objective:**

The student should be able to:

- Apply mathematical tools to discrete systems in the time-domain (convolution, difference equation, impulse response h(n), step response, etc.).
- Analyze digital systems in the z-domain (transfer function of systems H(z) and realization of systems).
- Apply mathematical tools to discrete systems in the frequency-domain (DTFT, DFT, FFT, frequency response of systems $H(e^{j\omega})$).
- Convert system from digital to analog and analog to digital (sampling theorem, aliasing, up-sampling and down-sampling).
- Design filters to meet frequency domain specifications (FIR and IIR).
- Use MATLAB to analyze and design DSP systems to master all the above objectives (convolution, FFT, Z-domain plots, FIR and IIR filters).

**Course Outcomes:**

Outcome1: An ability to apply knowledge of mathematics, science, and engineering to the analysis and design of digital system

Outcome 2: An ability to identify, formulate, and solve engineering problems in the area signal processing.

Outcome 3: An ability to use the techniques, skills, and modern engineering tools such as Matlab and digital processors.

Outcome 4: An ability to function on multi-disciplinary teams

Outcome 5: An ability to design a system, components or process to meet desired needs within realistic constraints such as economic, environmental, social political, ethical, health and safety, manufacturability and sustainability

**Grading:**

10 % Homework (5 homeworks)
6 % quizzes (4 quizzes)
6 % computer assignment (3-4 assignments)
14 % projects (3-4 mini projects)
4 % Literature Survey
25 % Midterm Exam Wednesday, 9th, December, 2009. (3:00-5:00)
35 % Final Exam Wednesday, 3rd, February, 2010. (07:00 pm – 09:00 pm)

**Course Policies:**

- Homework. Homework assignments will be given regularly. It is often helpful to work in study groups when doing homework problems to discuss the material, but each student must still work the assignment and write it up or program it individually. Late homework assignments will not be accepted except in the case of an excused absence.
- Projects. The projects will be contain a written portion and a programming portion. All work on the projects must be individual work.
- Attendance. Attendance will be taken daily. It is important that students attend class regularly in order to do well in the course. Perfect attendance will result in a 1% (out of 100%) increase in your final grade. For each unexcused absence, there will be a 0.5 mark deduction. More than 20 % absences (9) from the total number of classes will result in a DN grade.
- Cheating. Any form of cheating will result in a zero for that assignment and possibly additional penalties, including a failing grade in the class. It is the responsibility of each student to safeguard his work from being copied.
- Policy Changes. The instructor reserves the right to modify the course outline and policies mentioned in this syllabus at any time during the semester.

***This information and more will be available on Blackboard CE 8***