CMPE 422: Digital Signal Processing

Catalog Description: Discrete-time signals and system analysis and the z-transform; sampling of continuous-time signals, analog-to-digital and digital-to-analog conversion; design of finite impulse response and infinite impulse response digital filters, direct and computer-aided designs; the Discrete Fourier Transform (DFT) and Fast Fourier Transform (FFT); effects of quantization and finite word-length arithmetic.
Course Prerequisite(s): CMPE 323

Class Time: MW: 7:10-8:25pm
Location: ITE 241

For homework and project assignments, see
http://www.csee.umbc.edu/~chettri/ENE610/DSP.html

Instructor: Samir Chettri *(chettri@csee.umbc.edu)* *Office:* ITE 373
Office Hours: After class

TA: Ms. Haleh Safavi (haleh1@umbc.edu)
Office Hours: Wednesday 3:00pm-5:00 pm

Text: Discrete-Time Signal Processing by A. V. Oppenheim, R. W. Schafer, and J. R. Buck

Reference (supplemental reading): Digital Signal Processing: A Computer-based Approach by S. K. Mitra

Course Goals and Performance Measures:

(1) **Goal:** Understand the basic properties and representation of discrete-time signals and systems
Performance Measure: Homework problems and tests

(2) **Goal:** Can analyze discrete-time linear systems in the time and transform domains
Performance Measure: Homework problems and tests

(3) **Goal:** Can effectively use transforms for the analysis of systems
Performance Measure: Projects and classroom presentation and discussion of their results

(4) **Goal:** Understand the effect of sampling and aliasing in both the frequency- and time-domains
Performance Measure: Class demonstration, related homework and project

(5) **Goal:** Can design practical filters through pole and zero placement
Performance Measure: Project using a graphical user interface that helps visualize the time and frequency-domain responses instantaneously as the students move the poles and zeros on a pole/zero plot

(6) **Goal:** Can design filters using analytical techniques and test their performance
Performance Measure: Homework and test problems

(7) **Goal:** Can design filters using numerical methods
Performance Measure: Homework problems and project

(8) **Goal:** Can use software tools for the design of filters with various specifications
Performance Measure: Project in which the filter specifications are given *a priori*

(9) **Goal:** Can determine the filter needed from a general specification
Performance Measure: Project in which the system requirements are given and the students are asked to determine the numerical specifications of the filter required for the system in question

(10)
Goal: Understand the practical issues in the implementation of digital filters
Performance Measure: Project formulation that addresses the tradeoffs in design, e.g. magnitude distortion against transition band and finite precision issues. Classroom presentation and discussion.

Topics and number of lectures for each (approximate number of 75-minute lectures):

1. Discrete-time signal and system representation
2. The z-transform
3. Discrete-time system analysis
4. Sampling of continuous-time signals, A/D and D/A conversion
5. IIR and FIR digital filter design
6. Discrete Fourier transform
7. Implementation of digital filters, structures and finite precision issues

Course will use Matlab based class examples, homework problems, and projects. Audio signals and realistic communications examples will be used to demonstrate the application of the filters as well as the effects of processing of signals.

Contribution of course to meeting the professional component: The course introduces the student to engineering concepts such as design optimization, trade-off analysis formulation of a problem from given constraints, reporting of their results both in a written and oral form. Group projects will be used to enhance students' ability to work in a group.