ECE 520 - Digital Signal Processing

Catalog Data: ECE 520: Digital Signal Processing. 3hrs Credits. Prerequisite: Signals & Linear Systems (ECE 420). Co-requisite: ECE 521. Discrete time signals and systems; Discrete Fourier Transforms, FFT algorithms, flow graph and the matrix representation of digital filters; FIR and IIR filter design techniques; quantization effects; spectral estimation; current applications of digital signal processing.

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Course Learning Outcomes:
1. Study the representation of a periodic signal by Fourier series.
2. Calculate Fourier series coefficients using the all-familiar FFT algorithm.
3. Study the process of digitization of a continuous-time signal into a discrete-time sequence.
4. Study reconstruction of functions from its sampled version.
5. Compute the sequence Fourier transform of a sequence and correspond it with the continuous time Fourier transform, and examine the effect of changing the sampling rate.
6. Study the frequency response of common window functions.
7. Design a general purpose FIR digital filter based on the windowing method.
8. Evaluate an estimate of the power spectrum of a signal.
9. Study linear convolution using the FFT algorithm

Topics:
I. AN OVERVIEW OF CONTINUOUS-TIME SIGNALS AND SYSTEMS (Notes-Chap. 1)
   I.1 Continuous-Time Systems
   I.2 Linear Systems
   I.3 Fourier Transforms
   I.4 Impulse Sampling
II. DISCRETE-TIME SIGNALS AND SYSTEMS (Chap. 2)
   II.1 Sequences
   II.2 Discrete-Time Systems
   II.3 Linear Time-Invariant Systems
   II.4 Sequence Fourier Transform
III. SAMPLING OF CONTINUOUS-TIME SIGNALS (Chap. 3)
   III.1 Periodic Sampling
   III.2 Frequency Domain Representation of Sampling
   III.3 Reconstruction of a Bandlimited Signal for its Samples
   III.4 Changing the Sampling Rate Using Discrete-Time Processing

IV. THE Z-TRANSFORM (Chap. 4)
   IV.1 Definition of Z-transform
   IV.2 Region of Convergence of the Z-transform
   IV.3 The Inverse Z-Transform
   IV.4 Properties of the Z-Transform

V. THE DISCRETE FOURIER TRANSFORM (Chap. 8)
   V.1 The Discrete Fourier Series
   V.2 Fourier Representation of Finite Duration Sequences
   V.3 The Discrete Fourier Transform
   V.4 Linear Convolution Using the Discrete Fourier Transform
   V.5 The Fast Fourier Transform (FFT) Algorithm(s)

VI. TRANSFORM ANALYSIS OF LTI-SYSTEMS (Chap. 5)
   VI.1 Frequency Response of LTI Systems
   VI.2 System Functions for Systems
   VI.3 Frequency Response for Rational System Functions

VII. STRUCTURES FOR DISCRETE-TIME SYSTEMS (Chap. 6)
   VII.1 Representation of Linear Constant-Coefficient Difference
   Equations
   VII.2 Basic Structures for IIR Systems
   VII.3 Basic Structures for FIR Systems

VIII. FILTER DESIGN TECHNIQUES (Chap. 7)
   VIII.1 Design of Discrete-Time IIR Filters from Continuous-Time
   Filters
   VIII.2 Frequency Transformations of Lowpass IIR Filters
   VIII.3 Design of FIR Filters by Windowing
   VIII.4 Optimum Approximation of FIR Filters

X. APPLICATIONS (Chap. 11, 12, and Notes)
   X.1 Classical and Modern Methods for Spectrum Estimation
   X.2 Homomorphic Deconvolution
   X.2 Speech Recognition

Grading Policy:
1. Homeworks (15%),
2. Three one-hour exams (45%).
3. Comprehensive final exam (25%)
4. Projects (15%) and 100% of ECE521 Grade

Total grade will be normalized to 100 points and the final grade will be assigned such that:

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