EE538 Digital Signal Processing I  

**Fall 2008**

**Topic:**

I. Review: Discrete-Time Signals, Systems, & Transforms  

A. Basic Sampling Theory and D/A Conversion  
   Lectures: 15  
   Reading: P&M Text: 1.1-1.4

B. Discrete-Time Linear Systems  
   Lectures: 2.1-2.3  
   Reading: P&M Text: 2.4.1, 2.4.2, 2.5, 2.6

C. Z Transform  
   Lectures: 3.1-3.5  
   Reading: P&M Text: 3.5

D. Discrete-Time Fourier Transform  
   Lectures: 4.1-4.5  

E. Frequency Selective Linear Filtering  
   Lectures: 5.1-5.4  

F. Sampling and Reconstruction  
   Lectures: 6.1-6.6  

G. Multirate DSP ***most emphasis***  
   1. Efficient Up-sampling/Down-sampling  
   2. Multi-Stage Interpolation  
   3. Digital Subbanding  
   Lectures: 11.2-11.4  

H. Applications: CD Players, Cell Phones, wireless networks  
   Lectures: 11.9

II. Digital Filter Design  
   Lectures: 6  

A. FIR Filters – Equiripple Designs  
   Lectures: 10.2.4-10.2.6

B. IIR Filters  
   Lectures: 10.3.5  

   1. Common analog filters  
   2. Bilinear transformation  
   3. Frequency transformations  
   Lectures: 10.3.3, 10.4

III. Discrete Fourier Transform  
   Lectures: 3  

A. Definition and Properties  
   Lectures: 7.1-7.4

B. Fast Fourier Transform Algorithms  
   Lectures: 8.1.1, 8.1.2, 8.1.3

   1. Divide and Conquer Approach  
   2. Radix-2 FFT  
   3. Sectioned Convolution  
   Lectures: 7.3, 8.2-8.3

IV. Nonparametric methods of power spectrum estimation  
   Lectures: 3  

A. Discrete random processes  
   Lectures: 12.1-12.2

B. Estimation of autocorrelation sequence  
   Lectures: 14.1.2

C. Periodogram; Smoothed periodograms  
   Lectures: 14.2

V. Model-Based Spectrum Estimation  
   Lectures: 9  

A. Autoregressive (AR) Modelling  
   Lectures: 14.3

B. Forward/Backward Linear Prediction  
   Lectures: 12.3

C. Levinson-Durbin Algorithm  
   Lectures: 12.4

D. Minimum Variance Method  
   Lectures: 14.4

E. Eigenstructure Methods I: MUSIC  
   Lectures: 14.5.2, 14.5.3

F. Eigenstructure Methods II: ESPRIT  
   Lectures: 14.5.1, 14.5.4

G. Applications in Speech Processing, Communications, and Acoustics

VI. Adaptive Signal Processing  
   Lectures: 6  

A. Applications: Equalization, etc  
   Lectures: 13.1

B. Adaptive Direct-Form FIR Filters - LMS  
   Lectures: 13.2

C. Adaptive Direct-Form FIR Filters - RLS  
   Lectures: 13.3