EE538 Digital Signal Processing I Fall 2025

Topic:	*Lectures*	*Read: P&M 5th*
I. Review: Discrete-Time Signals, Systems, & Transforms	24	
A. Basic Discrete-Time (DT) Signals and Basic DT Systems		1.1-1.2
B. Discrete-Time Linear Time-Invariant Systems		2.1-2.2
1. Discrete-Time Convolution		2.3,2.4.1, 2.4.2,
2. Autocorrelation, Cross-Correlation. VIP: Matched Filter		2.6
3. Apps: Radar, GPS, Wireless Comm: CDMA, OFDM, Speech Processing		
C. Z Transform		3.1-3.5
D. Discrete-Time Fourier Transform/Continuous Time Fourier Transform		4.1-4.5
E. Frequency Selective Linear Filtering		5.1-5.4
F. Sampling and Reconstruction: CTFT-DTFT Relationship		6.1-6.6
G. Multirate DSP ****most emphasis****		11.2-11.4
1. Efficient Upsampling: Fractional Time-Shift Filters		11.1, 11.5
2. Multi-Stage Upsampling; Noble's Identities		11.5.2, 11.6
3. Digital Subbanding: Transmultiplexer		11.5
4. Two-Channel Perfect Reconstruction Filter Bank		12.2
5. M-Channel Perfect Reconstruction Filter Bank		12.1, 12.3
I. Apps: CD/DVD Players, Audio Compression		11.9
II. Discrete Fourier Transform	6	
A. Definition and Properties		7.1-7.4
B. Fast Fourier Transform Algorithms		
1. Divide and Conquer Approach		8.1.1, 8.1.2
2. Radix-2 FFT		8.1.3
C. OFDM Application (Wireless Comm)		7.3, 8.2-8.3
III. Digital Filter Design	4	
A. IIR Filters		
1. Common analog filters		10.3.5
2. Bilinear transformation		10.3.3
3. Frequency transformations via All-Pass Filters		10.4
B. FIR Filters – Equiripple Designs		10.2.4-10.2.6
IV. Nonparametric methods of power spectrum estimation	2	
A. Discrete random processes		13.1
B. Estimation of autocorrelation sequence		15.1
C. Periodogram; Smoothed periodograms		15.2
V. Model-Based Spectrum Estimation	6	
A. Autoregressive (AR) Modelling		15.3
B. Forward/Backward Linear Prediction		13.3
C. Levinson-Durbin Algorithm		13.4, 15.4
D. Minimum Variance Method		15.5.2
E. Eigenstructure Methods I: MUSIC		15.6.3
F. Eigenstructure Methods II: ESPRIT		15.6.4
G. Applications in Speech Processing, Communications, and Acoustics		