Course Outline

EE301: Signals and Systems

I. Introduction
- A. Review of course policies
- B. Why linear systems theory is important

II. Signals [OW 1.0-1.4]
- A. Types - continuous time, discrete time, and digital [OW 1.0-1.1]
- B. Transformations of the independent variable [OW 1.2]
  1. Time reversal
  2. Time delay
  3. Time scaling
- C. Signal Properties
  1. Periodic signals
  2. Even/odd signals
  3. Energy
  4. Power
  5. Average value
- D. Exponential Signals [OW 1.3]
  1. Continuous time
  2. Discrete time
- E. Impulse and step functions [OW 1.4]
  1. Discrete time
     a. Relationship between impulse and step functions
     b. Representation of DT signals with DT impulses (Sifting Prop.)
  2. Continuous time
     a. Definition of CT impulse [OW 2.5]
     b. Relationship between impulse and step functions
     c. Representation of CT signals with CT impulses (Sifting Prop.)

III. Systems [OW 1.5-1.6]
- A. Input/output models for systems [OW 1.5]
- B. System Properties [OW 1.6]
  0. Review of formal logic [From notes/handouts]
  1. Continuous time and Discrete time systems
  2. Causal and noncausal systems
  3. Memory and memoryless systems
  4. Linear and nonlinear systems
  5. Time varying and time invariant systems
  6. Stable and unstable systems
  7. Formal definitions of system properties

IV. Linear Time-Invariant Systems [OW 2.0-2.4]
- A. Time domain analysis of linear systems [OW 2.0]
  1. Discrete time systems [OW 2.1]
     a. impulse function and impulse response

b. discrete time convolution
2. Continuous time [OW 2.2]
a. impulse function and impulse response
b. continuous time convolution

B. Properties for LTI systems [OW 2.3]
1. Memoryless
2. Causal and anticausal
3. Stable

C. LTI analysis of linear differential equations [OW 2.4]]

D. Complex exponential inputs to LTI systems [OW 3.2]

V. Frequency Analysis

A. Orthonormal Tranforms [From notes]
1. General analysis of orthonormal transformations
2. Functions as vectors
3. Innerproducts on functions
4. Parseval's theorem for orthonormal transforms

B. Continuous time Fourier series (CTFS) [OW 3.0-3.3,3.5,3.8-3.9]
1. Derivation as orthogonal transform [OW 3.0-3.3]
2. CTFS examples
3. Properties of CTFS [OW 3.5]
4. LTI system analysis using CTFS [OW 3.8,3.9]

C. Overview of transforms we will cover [From notes and handout]

D. Continuous time Fourier transform (CTFT) [OW 4.0-4.8]
1. Derivation of tranform [OW 4.0-4.1]
2. The convolution property and LTI systems [OW 4.4]
3. CTFT properties [OW 4.3]
4. Transform pairs for aperiodic signals [See OW 4.6]
5. CTFT of periodic functions [OW 4.2]
6. Transform pairs for periodic signals [See OW 4.6]
7. Impulse train sampling [OW 7.1.1]
8. Systems characterized by linear differential equations [OW 4.7]

E. The DFT [OW 3.6-3.7]
1. Derivation as orthogonal transform [From notes and OW 3.6]
2. Example transforms
3. DFT properties and circular convolution [OW 3.7]

F. Discrete time Fourier transform (DTFT) [OW 5.0-5.1,5.3-5.6,5.8]
1. Tranform definition [OW 5.0,5.1]
2. DTFT properties [OW 5.3]
3. Transform pairs [See OW 5.6]
4. The convolution property and LTI systems [OW 5.4]
8. Systems characterized by linear difference equations [OW 5.8]

VI. Sampling and reconstruction [From Notes, OW Chapter 7]

A. Overview of sampling systems [OW 7.0]

B. Sampling
1. Relationship between CTFT and DTFT

2. Aliasing and the Nyquist frequency

C. Reconstruction

1. Relationship between DTFT and CTFT
2. Aliasing and reconstruction filters
3. Zero order sample and holds

VII. (Didn't get to this) The Z-Transform [OW 10.0-10.7]

A. Definition of Z-transform

B. Region of convergence

C. The inverse Z-transform

D. More on the Z-transform

1. Left and right hand signals
2. Stable and unstable signals
3. Causal and anticausal signals
4. Z-transform properties

E. Analysis of DT systems

1. FIR systems
2. IIR systems
3. Stability analysis

[OW] - Refers to Oppenheim and Willsky text