Some Review

Lesson 17

Review of Where Stand

- Signals
  - Continuous vs Discrete Time

    $x(t) = e^{st},\ x(n)=z^n$
  - Periodic vs Aperiodic

    $x(t+T) = x(t)$ for all t
  - Bounded vs Unbounded
  - Symmetries

    Even vs Odd
  - Complex functions
- Unit Impulse And Unit Step Functions
  - Unit Impulse Function

$$\delta(t) = 0 \text{ for } t \neq 0$$
$$= \text{ undefined for } t = 0$$
$$\int_{-\infty}^{\infty} f(t)\delta(t-\tau)\,dt = f(\tau)$$
$$\int_{-\infty}^{\infty} \delta(t)\,dt = 1$$

Review Continues

- Unit Step Function

$$u(t) = 1 \text{ for } t \geq 0;$$

$$= 0 \text{ for } t < 0$$

$$u(t) = \int_{-\infty}^{t} \delta(\tau) d\tau$$

- Linear Time Invariant Systems
  - Linearity and superposition

$$\Sigma_k \, a_k x_k(t) \longrightarrow \Sigma_k \, a_k y_k(t)$$

  - Causality
  - Time Invariant $\quad x_k(t\text{-}t_0) \longrightarrow y_k(t\text{-}t_0)$

Review #3

- Differential and Difference Equations
  - 1st and 2nd Order Linear Ordinary Differential Equations
  - Response Components of the Solution to ODEs
  - Source Free Response
    - Characteristic and Homogenous Equation
    - Eigenfunctions with its Eigenvalues are solutions to these equations
    - Examples of the solution to the 2nd Order ODE (overdamped, underdamped & critically damped)
  - Source Response
    - Network response function

$$y(t) = \frac{B(p)}{A(p)} x(t) = H(p)x(t)$$

    - Poles and Zeroes

Review #4

- Sinusoidal Steady State Response
  - Replacing p with $j\omega$ in the Network Response Function yielded the $H(j\omega)$ in phasor form
  - Bode Plots
- Difference Equations
- Convolution
  - System Response of a system due to a Unit Impulse Function, $h(t)$
  - Response of a system due to other sources

$$y(t) = \int_{\tau} x(\tau)h(t-\tau)\,d\tau$$

Review #5

- Stability of Systems
  - The poles of $H(p)$ must lie in the left hand complex plane for continuous systems
  - The poles of $h(n)$ must lie in the unit circle for discrete systems
- Signal Analysis
  - Fourier Series
    - Using Orthogonal Functions
    - Periodic Functions

Review #6

– Continuous & Periodic in the Time Domain

– Infinite & Discrete in the Frequency Domain

$$a_{\mathbf{k}} = \frac{1}{T}\int_{-\frac{T}{2}}^{\frac{T}{2}} f(t)e^{\frac{-j2\pi kt}{T}}dt$$

$$f(t) = A_0 + \sum_{\mathbf{k}=1}^{\infty}[a_{\mathbf{k}}e^{\frac{j2\pi kt}{T}} + a_{\mathbf{k}}*e^{\frac{-j2\pi kt}{T}}] + = A_0 + \sum_{\mathbf{k}=\mathbf{1}}^{\infty} 2|a_k|\cos(\frac{j2\pi kt}{T} + \psi_k)$$

– Quadratic Content

– Sampling Function

Review #7

- Fourier Transform
  - Infinite Period
  - Continuous in the Frequency Domain
  - Spectral Density

$$\Im[f(t)] = F(j\omega) = \int_{-\infty}^{\infty} f(t)e^{-j\omega t}dt$$

$$\Im^{-1}[F(j\omega)] = f(t) = \frac{1}{2\pi}\int_{-\infty}^{\infty} F(j\omega)e^{j\omega t}d\omega$$

  - Properties and Dualities of the FT
  - FTs for discrete functions

Review #8

- Filters
  - Types of Filters
  - Idealized Filters
- Modulation
  - Amplitude and Angle
  - Frequency Spectrum
  - PAM
- Sampling Theorem
  - Nyquist Sampling Rate
  - TDM
- Pulse Code Modulation
  - Quantization Error
  - Amplitude and Angle Modulation