

EECS 360
Semester Review
Fall 2021

- 1) Classification of signals:
 - a) Periodic
 - b) Aperiodic
 - c) Energy
 - d) Power
 - e) Continuous time
 - f) Discrete time
 - g) Deterministic
 - h) Random (not considered in this class)
- 2) Phasor representation of sin & cos and complex numbers, magnitude and phase
- 3) Classification of Systems
 - a) Linear/Nonlinear
 - b) Time varying/Time invariant
 - c) Causal/non-causal
 - d) Continuous time/Discrete time
- 4) Special functions
 - a) $\delta(t)$, $\delta[n]$,
 - b) $\text{tri}(t)$
 - c) $u(t)$, $u[n]$
 - d) $\text{rect}(t)$
- 5) Convolution
 - a) Continuous time
 - b) Discrete time
- 6) Impulse response of linear time invariant systems, $h(t)$, $h[n]$
- 7) Step response of systems $a(t)$, $a[n]$
- 8) Impulse response of cascaded linear time invariant systems, $h(t)$, $h[n]$.
- 9) Bounded input/Bounded output (BIBO) stability and constraints on $h(t)$ and $h[n]$ for stability
- 10) Causality and constraints on $h(t)$, $h[n]$ for causality
- 11) Fourier Series
 - a) Complex exponential
 - b) Sin/Cos
 - c) Cos
- 12) Power-Parsaval's theorem for periodic signals
- 13) Spectral plots for periodic signals: one sided and double sided
- 14) Fourier Transform
- 15) Fourier Transform theorems and properties
- 16) Energy-Parsaval's theorem for aperiodic signals
- 17) Transfer Function of linear time invariant systems - $H(f)$ and $H(z)$
- 18) Amplitude and phase response of linear time invariant systems, $H(f)$ and $H(z)$.
- 19) Transfer Function of cascaded linear time invariant systems - $H(f)$ and $H(z)$
- 20) Criteria for an ideal linear time invariant system, - $H(f)$ - $H(z)$, $h(t)$ - $h[n]$

- a) ILPF
 - b) IBPF
- 21) Distortion for linear time invariant systems
- a) Amplitude distortion
 - b) Phase distortion
- 22) Signals and systems
- a) Finding system output given input and system description
 - b) Bandwidth and its definitions
 - c) Inverse time duration-bandwidth relationship
 - d) Inverse rise time and bandwidth relationship
 - e) If $B_h \gg B_s$ then minimal distortion,
where B_h =system bandwidth and B_s =signal bandwidth
- 23) Sampling theorem
- a) Minimum sample rate
 - b) Spectrum of a sampled signal
 - c) Aliasing
 - d) Recovering $x(t)$ from its sampled version $x_s(t)$
- 24) Discrete Fourier Transform (DFT)
- a) Definition
 - b) DFT is the Fourier Series of a periodic sampled (discrete) signal
 - c) Parameters of the DFT, frequency resolution= Δf , record length= L , number of points in the DFT= N , sample rate f_s , time resolution= Δt , maximum frequency (bandwidth)= B
 - i. $\Delta f = 1/L$
 - ii. $N = L f_s = L / \Delta t$
 - iii. $B = (N/2) * \Delta f$
 - d) Conjugate symmetry of the DFT
 - e) Picket fence effect
 - f) Spectral leakage
 - i. Windows
 - ii. Main lobe width and Side lobe attenuation
 - g) Circular convolution
 - h) Using the DFT for linear convolution, role of padding with zeros
- 25) z-Transform and digital filters
- a) Definition
 - b) Frequency response, $H(e^{j\Omega})$, is $H(z)$ evaluated on the unit circle
 - c) Properties of z-transforms
 - i. Linearity
 - ii. Delay
 - iii. Convolution
 - d) Poles and zeros for the general difference equation (ARMA system)
 - e) All poles of $H(z)$ must be inside the unit circle for the system to be stable
 - f) Relationship of pole and zero locations to the frequency response

- g) Analysis-given the general difference equation find:
 - i. Location of poles and zeros
 - ii. Frequency response, $H(e^{j\Omega})$
 - iii. Or given $H(z)$ find the ARMA (implementation) equation
 - iv. Convert among, $H(z)$, difference equations, $H(e^{j\Omega})$, pole/zero diagram
- h) Design of digital filters
 - i. Position the poles and zeros in the z-plane to get desired frequency response
 - ii. Construct $H(z)$
 - iii. Draw system implementations
- i) Determine the coefficients for the difference equation
- j) Feedback & stability for discrete time systems