EECS 361
Test 2 Topics

1) Find the Fourier Transform of aperiodic signals
2) Find the Fourier Transform of periodic signals
3) Find the Fourier Series of a periodic signal using the relationship between Fourier Transform and Fourier Series

   $$x_P(t) = \sum_{k=-\infty}^{\infty} x(t - kT_0) = \sum_{n=-\infty}^{\infty} x_n e^{jn\omega_0 t}$$

   $$x(t) \leftrightarrow X(\omega)$$

   $$x_n = \frac{1}{T_0} X(n\omega_0)$$

4) Apply the Fourier Transform theorems and properties to find X(ω)
5) Find signal power and energy using Parsaval's theorem
6) Determine the Transfer Function of linear time invariant systems - $H(\omega) = | H(\omega) | e^{j\theta(\omega)}$
   Finding H(ω) from block diagram and/or LCCDE
7) Determine the output of an LTI system given its input
8) Understand the concept of bandwidth and the inverse signal duration/bandwidth relationship
   - First zero definition
   - 3 dB definition
   - Inverse time duration-bandwidth relationship
9) Criteria for an ideal linear time invariant system – Ideal Filters & Distortionless Transmission
   a) Distortionless transmission y(t)=Kx(t-τ) $H(\omega)=Ke^{-j\omega\tau}$ for all ω, i.e., | H(ω) |=K and θ(ω)=−ωτ.
   b) Signal x(t) has bandwidth B_{signal} then distortionless transmission with respect to x(t) if H(ω) has constant amplitude and linear phase ($H(\omega)=Ke^{-j\omega\tau}$) over the signal bandwidth, B_{signal}.
   c) ILPF → $H(\omega)=Ke^{-j\omega\tau}$ for system bandwidth, B_H.
   d) IBPF, IBRF, IHPF
   e) If $B_{System} \gg B_{signal}$ then negligible distortion, where B_{System}=system bandwidth and B_{signal}=signal bandwidth

16) Basic modulation: DSB-SC, DSB-LC (AM), and FDM: Transmitters and Receivers
17) Sampling
   a) Sampling Theorem
   b) Sampling rate f_s>2B (Nyquist sampling rate =2B)
   c) Understanding the periodic nature of the spectrum of a sampled signal
   d) Aliasing; causes and remedies
   e) Recovery of x(t) from $x_s(t)$ using an LPF

18) Discrete Time Signals and Systems

a) Discrete signal notation, e.g., $x[n]=\{a, b, \underline{c}, d, \ldots\}$ then $x[0]=c$

b) Discrete Time Signals $u[n]$, $\delta[n]$, $\cos(\Omega n+\varphi)$, $\mathbf{p}^n u[n]$

where Ω= the discrete-time angular frequency

c) Discrete time LTI systems

- Difference equations
- ARMA format for difference equations
- Block diagrams with delay blocks
- Properties of Discrete Time Systems
    - Linearity
        - Scaling
        - Additivity
    - Time-invariance
    - Memoryless (static) vs Memory (dynamic)
    - BIBO stable
    - Casual
    - Discrete time impulse response, $h[n]$

19) Discrete Time Convolution

20) z-transform

a) Finding $X(z)$ given $x[n]$

b) Finding $x[n]$ given $X(z)$

c) Finding transfer function $H(z)$ given

- The impulse response
- Difference equation
- Block diagram

d) Finding locations of poles and zeros of $H(z)$

e) Finding frequency response $H(e^{j\Omega})$ and understanding its relationship to the unit circle.

f) Finding the system output given input = $A\cos(\Omega_{in}n+\phi)$