The Johns Hopkins University
Department of Electrical and Computer Engineering

505.460 — Introduction to Linear Systems — Fall 1997

Final exam

Name: _____

Problems

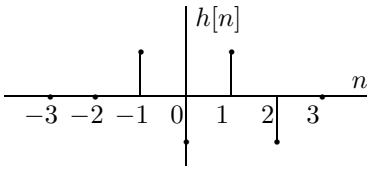
1. What is the even component of the following signal?

   $$x(t) = 3u(t) + \sin(2\pi t)$$

2. Which of these properties does the system described by $y(t) = x(t)x(t-2))u(t)$ possess? Linear, invertible, memoryless, causal?

3. If $h[n] = u[n+1] + \delta[n-1]$ and $x[n] = \delta[n] + u[n-1]$, then what is the output $y[n]$?

4. For a discrete-time LTI system with impulse response $h[n] = n\delta[n+3]$ and input sketched below,



Compute the output

5. The Fourier series representation of a function has non-zero coefficients $a_0 = 2$, $a_3 = a_{-3} = -2$ and $a_1 = a_{-1}^* = j$ and period $T_0 = 1$. What is the function?

6. If $x(t) = 4 \cos t \sin t$, compute the Fourier transform.

7. Show how to construct an ideal band-pass filter with cut-off frequencies of 20 Hz and 100 Hz, if all you have is a have are ideal low pass filters.

8. For the signal

$$x(t) = 25\sin(2\pi t)\cos(30\pi t)$$

What is the minimum sampling frequency that can be used to obtain samples of $x(t)$ without loss of information?

9. In the double-side band modulation scheme:

$$y(t) = x(t)\cos(2\pi f_m t)$$

and demodulation:

$$z(t) = y(t)\cos(2\pi f_d t)$$

and $w(t) = (h * z)(t)$.

What is the relationship between f_m, f_d and the bandwidth of $x(t)$? Also, what type of system is h if we are going to have $w(t) = x(t)$?

10. If the system $y(t) = (h * x)(t)$ is described by

$$\frac{dy(t)}{dt} = y(t-1) + x(t)$$

What is the transfer function $H(j\omega)$?