SOLUTIONS

Quiz #2

ECEn 380: Signals & Systems

Fall 2014

Closed book, closed note, closed neighbor, no calculators allowed. *Time limit is 10 minutes. 20 points total possible.*

1. Consider an LTI system described by the following linear constant coefficient differential equation (LCCDE):

$$\frac{d^2}{dt^2}y(t) + 2\frac{d}{dt}y(t) + 4y(t) = \frac{d}{dt}x(t)$$

   a. Write an expression for the frequency response $\hat{\mathbf{H}}(j\omega)$ of this system. (5 pts)

$$H(j\omega) = \frac{j\omega}{-\omega^2 + 2j\omega + 4}$$

   Now suppose (for parts b and c) that the input to this system is a sinusoid of angular frequency $\omega = 2$ rad/s.

   b. What is the phase difference between the input signal and the output signal at this frequency? (4 pts)

$$H(2j) = \frac{2j}{-4 + 4j + 4} = \frac{1}{2}$$

THIS IS REAL!

0 PHASE DIFFERENCE

   c. What is the gain of the system at this frequency? (4 pts)

$$\frac{1}{2}$$

2. Find the unilateral Laplace transform $\mathbf{X}(s)$ of the following signal: (4 pts)

$$x(t) = t^2\cos(3t - 2)\delta(t - \tfrac{2}{3})$$

$$X(j\omega) = \int_{0^-}^{\infty} x(t)\,e^{-st}\,dt = \frac{4e^{-\frac{2}{3}s}}{9}$$

3. Find the unilateral Laplace transform $\mathbf{X}(s)$ of the following signal: (4 pts)

$$x(t) = (3 + 2j)u(t)$$

$$X(j\omega) = \int_{0^-}^{\infty} (3+2j)u(t)\,e^{-st}\,dt = \frac{(3+2j)e^{-st}}{-s}\Bigg|_0^{\infty}$$

$$= \frac{3+2j}{s}$$