Department of Electrical and Computer Engineering
The University of Alabama in Huntsville

CPE 381: Fundamentals of Signals and Systems for Computer Engineers

Quiz #4 Solution

Q1. Impulse response of the system with transfer function

$$H(s) = \frac{1}{s + 1.3}$$

is

$$h(t) = e^{-1.3t}$$

The system is **stable** since

$$\int_0^{\infty} e^{-1.3t} = \frac{e^{-\infty} - e^{-0}}{-1.3} = 0.769 < \infty$$

Q2. Integral

$$\int_0^{\infty} e^{-1.3t} = \frac{e^{-\infty} - e^{-0}}{-1.3} = \mathbf{0.769} < \infty$$

Q2. A low-pass filter is implemented using R=1KΩ and C = 1 μF (series of resistor and capacitor, and capacitor is parallel to output).

What is the magnitude of the transfer function at frequency 1000 rad/s?

Transfer function of the filter is

$$H(s) = \frac{\frac{1}{Cs}}{R+\frac{1}{Cs}} = \frac{1}{RCs+1}$$

and

$$H(j\Omega) = \frac{1}{jRC\Omega+1}$$

Magnitude of the transfer function is:

$$|H(j\Omega)| = \left|\frac{1}{jRC\Omega+1}\right| = \left|\frac{1}{j10^3 10^{-6} 10^3+1}\right| = \left|\frac{1}{j+1}\right| = 0.707$$

Q3. Fourier transform of the modulated signal

$$x(t)=3+8*\cos(10t)*\cos(100t)$$

How many frequency components do you have in Fourier transform X(Ω)?

Spectrum has **5** frequency components.

Signal $cos(10t)$ has two frequency components: { X(-10), X(10) }

The Fourier transform of the modulated signal is

$$0.5\left[X\left((\Omega-\Omega_0)\right)+X\left((\Omega+\Omega_0)\right)\right]$$

Signal $cos(10t)*cos(100t)$ has four frequency components: { X(-110), X(-90), X(90), X(110) }

and signal x(t) has 5 components: { X(-110), X(-90), X(0), X(90), X(110) }
with values: { 2, 2, 3, 2, 2 }

Q4. X(90) = 2 (see Q3)

Q5. X(100) = 0 (see Q3)