Quiz #4

ECEn 380: Signals & Systems

Fall 2015

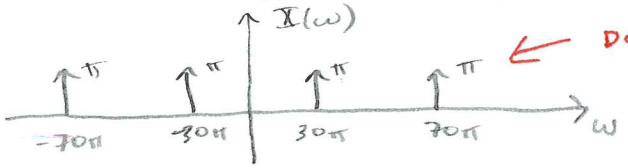
SOLUTIONS

Closed book, closed note, closed neighbor, no calculators allowed. *Time limit is 15 minutes. 20 points + 2 extra credit points possible.*

HOMEWORK:

1. The continuous-time signal $x(t) = \cos(30\pi t) + \cos(70\pi t)$ is impulse-train (delta-train) sampled by a system with sampling period (or sampling interval) $T_S = 0.02$s. Note that the signal is sampled without first sending it through an anti-aliasing filter.

   a. Sketch the Fourier transform of $x(t)$, with the frequency axis in radians/s. That is, sketch $X(\omega)$. (2 pts)



DO NOT TAKE POINTS OFF FOR SCALING

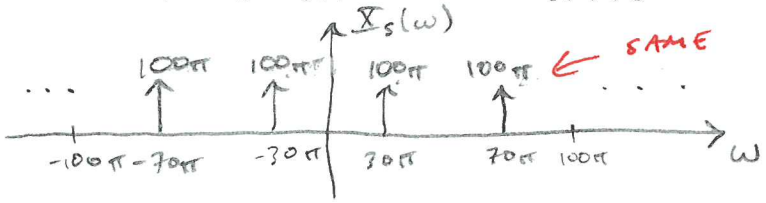
   b. What is the Nyquist rate (in **samples/s**) of the signal $x(t)$? (2 pts)

140π radians/s = 70 samples/s

   c. Sketch the Fourier transform of the sampled signal $x_s(t)$. That is, sketch $X_s(\omega)$ (again with the frequency axis in radians/s). (2 pts)

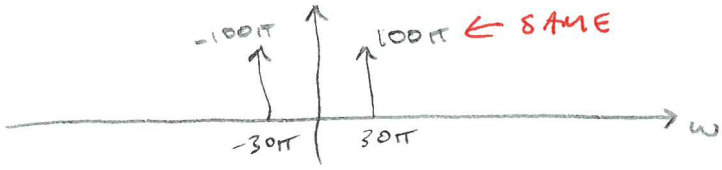
$T_S = 0.02$ s

$\omega_S = \frac{2\pi}{T_S} = \frac{2\pi}{\frac{1}{50}} = 100\pi$



SAME

   d. The sampled signal is passed through an ideal brick-wall lowpass filter with a cutoff frequency of 25 Hz (50π radians/s). Sketch the spectrum of the output signal, again with the frequency axis in radians/s. (3 pts)



SAME

2. Consider the discrete-time signal $x[n] = (2 - 3j)\cos(0.02\pi n + 3)$. Is the signal periodic, and if so, what is its fundamental frequency in radians/sample? (3 pts)

YES. $\Omega_0 = 0.02\pi$

$N_0 = \frac{2\pi}{\omega_0} = \frac{2\pi}{0.02\pi} = 100$

3. Express the discrete-time signal $x[n] = nu[n] - nu[n-4]$ in bracket notation. (3 pts)

$x[n] = \{ \underline{0}, 1, 2, 3 \}$

LECTURE:

4. A discrete-time LTI system has impulse response $h[n] = \{ 1, 0, \underline{1}, 2 \}$.

   a. Is the system causal? (2 pts) No.

   b. Is the system BIBO stable? (2 pts) YES.

1 0 1 2

   c. What is the output of the system if the input is $x[n] = \{ \underline{2}, 1, 2 \}$? (3 pts)

2 1 2

$\{2, 1, \underline{4}, 5, 4, 4\}$