Monday, November 25, 2024 A

EE 313 Signals and Systems (Fall 2024) Quiz #7

Name Key A

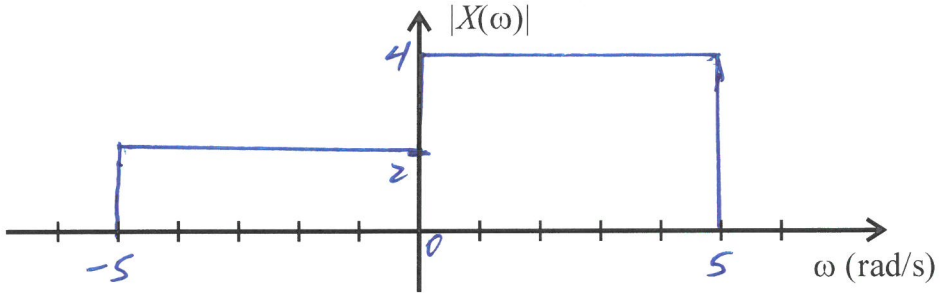
Instructions: Open book and notes. Place answers in indicated spaces & show all work for credit.

Cousins Fourier and Nyquist have composed a quiz before Thanksgiving dinner to determine seating. Pass to sit at the adult table. Fail and you will sit with Uncle Laplace's obnoxious brood of loud and querulous brats at a wobbly card table in a cold and dank basement.

A signal $x(t)$ has the Fourier transform $X(\omega) = 2p_{10}(\omega) + 2p_5(\omega - 2.5)$.

a) Draw a fully labeled sketch of $|X(\omega)|$ on the provided axes.

$2p_{10}(\omega)$ ← 10 wide, centered @ 0
$2p_5(\omega - 2.5)$ ← 5 wide, centered @ 2.5 rad/s



b) What are the maximum sampling rate T_{max} and corresponding minimum sampling frequency $\omega_{s,min}$ that will prevent aliasing error? Per Nyquist sampling theorem,

$\omega_{s,min} = 2B = 10$ rad/s
$T_{max} = 2\pi/\omega_{s,min} = 2\pi/10 = \pi/5 = 0.62832$ s

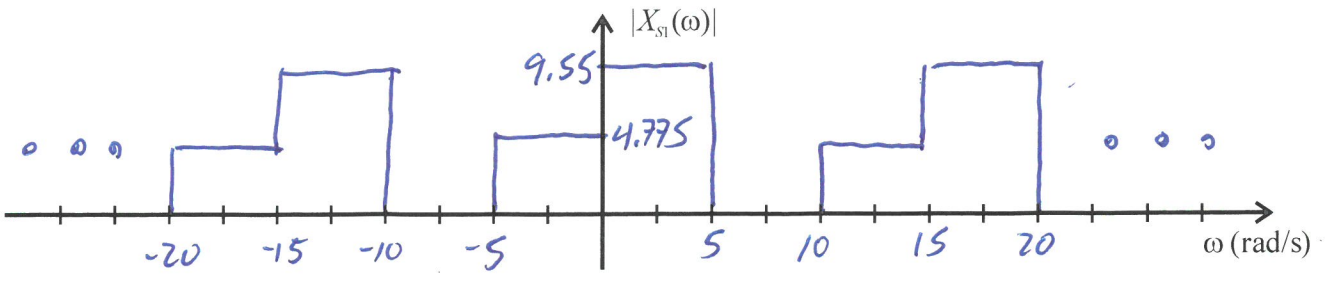
$T_{max} =$ $\pi/5 = 0.62832$ s $\quad \omega_{s,min} =$ 10 rad/s

c) For a sampling rate $T_1 = 0.418879$ s, sketch the fully labeled sampled frequency spectrum $|X_{S1}(\omega)|$ on the provided axes.

$\omega_{S1} = 2\pi/T_1 = \frac{2\pi}{0.418879} = 15$ rad/s $> \omega_{s,min}$

$\frac{4}{T_1} = \frac{4}{0.418879} = 9.55$ & $2/T_1 = 4.775$

$$(5.51)\quad X_{S1}(\omega) = \frac{1}{T_1}\sum_{k=-\infty}^{\infty} X(\omega - k\omega_{S1})$$



Monday, November 25, 2024 B

EE 313 Signals and Systems (Fall 2024) Quiz #7

Name Key B

Instructions: Open book and notes. Place answers in indicated spaces & show all work for credit.

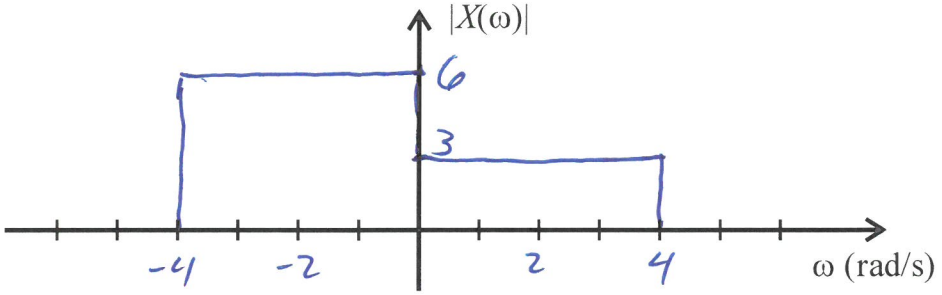
Cousins Fourier and Nyquist have composed a quiz before Thanksgiving dinner to determine seating. Pass to sit at the adult table. Fail and you will sit with Uncle Laplace's dreadful brood of noisy and petulant hellions at a wobbly card table on a cold and drafty porch.

A signal $x(t)$ has the Fourier transform $X(\omega) = 3p_8(\omega) + 3p_4(\omega + 2)$.

a) Draw a fully labeled sketch of $|X(\omega)|$ on the provided axes.

$3p_8(\omega)$ ← 8 wide, centered @ $\omega = 0$

$3p_4(\omega)$ ← 4 wide, centered @ $\omega = -2$



b) What are the maximum sampling rate T_{max} and corresponding minimum sampling frequency $\omega_{s,min}$ that will prevent aliasing error? Per Nyquist sampling theorem,

$\omega_{s,min} = 2B = 8$ rad/s

$T_{max} = \frac{2\pi}{\omega_{s,min}} = \frac{2\pi}{8} = \pi/4 = 0.7853985$

$T_{max} =$ $\pi/4 = 0.7854$ s $\qquad \omega_{s,min} =$ 8 rad/s

c) For a sampling rate $T_2 = 0.523599$ s, sketch the fully labeled sampled frequency spectrum $|X_{s2}(\omega)|$ on the provided axes.

$\omega_{s2} = \frac{2\pi}{T_2} = \frac{2\pi}{0.523599} = 12$ rad/s $> \omega_{s,min}$

$\frac{6}{T_2} = 11.46$ & $\frac{3}{T_2} = 5.73$

(5.51) $X_{s2}(\omega) = \frac{1}{T_2} \sum_{k=-\infty}^{\infty} X(\omega - k\omega_{s2})$