Name _____

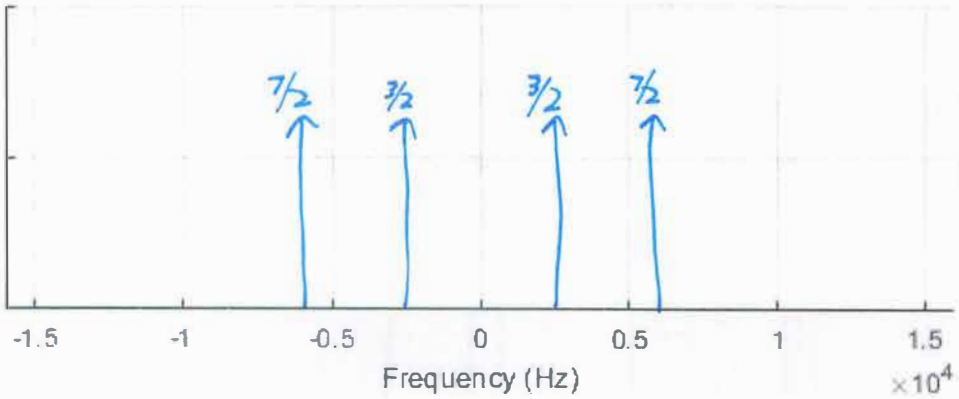
EE-3221 – Dr. Durant – Quiz 3
Winter 2020-'21, Week 3

This is a ***closed***-book quiz. But, as always, you may refer to your homework that is due today.

$F\{\cos(\omega_0 t)\} = \pi((\delta(\omega-\omega_0) + \delta(\omega+\omega_0)) = (1/2)\,((\delta(f-f_0) + \delta(f+f_0))$

In the above FT pair, the change from rad/sec to hertz requires dividing Fourier Transform by 2π.

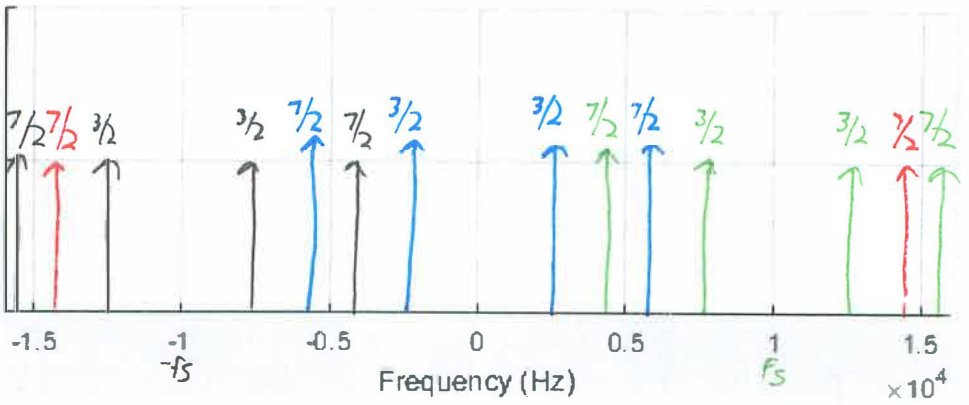
1. (3 points) Let $x(t) = 3\cos(2\pi \times 2500t) + 7\cos(2\pi \times 5500t)$. Plot the magnitude spectrum $|X(f)|$. Note the multiplier of $10^4 = 10{,}000$ on the frequency axis.



2. (4 points) Let x(t) be sampled at sampling frequency f_s = ~~8~~ 10 kHz with no anti-alias (lowpass) filter applied. Plot the magnitude spectrum $|X_s(f)|$ of the sampled signal to at least ~~f~~ f = ±16 kHz.

blue: $n=0$
green: $n=1$
black: $n=-1$
red: $n=\pm 2$

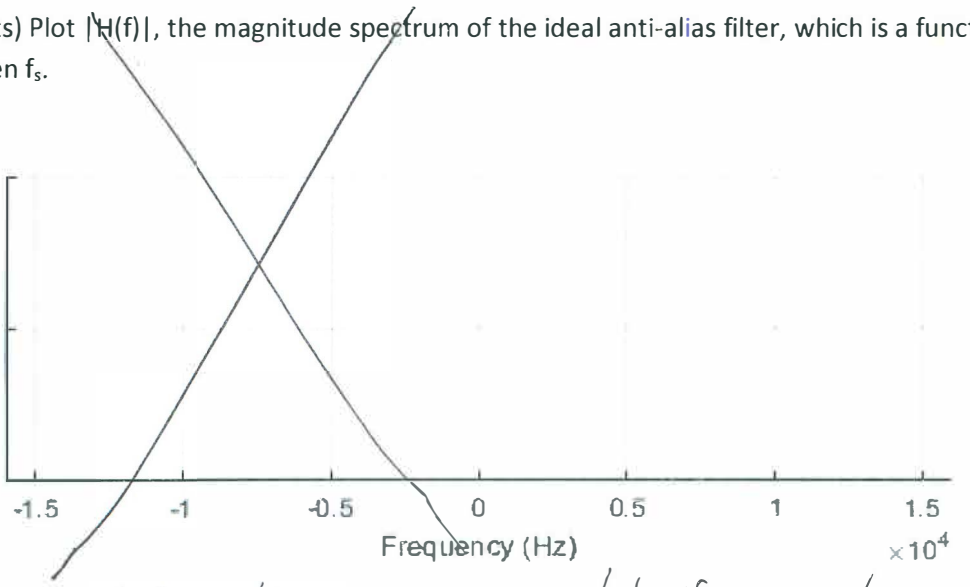
Images @ nf_s for all integers n



$n=1$: $10k \pm \{2.5k, 5.5k\} = 4.5k, 7.5k, 12.5k, 15.5k$

$n=2$: $20k \pm \{2.5k, 5.5k\} = 14.5k, 17.5k, 22.5k, 25.5k$

3. (3 points) Plot $|H(f)|$, the magnitude spectrum of the ideal anti-alias filter, which is a function of the given f_s.



Discuss whether aliasing occurs and what, if any, aliased frequencies appear.

Yes. Nyquist violated $5.5kHz > \frac{f_s}{2} = 5kHz$

Alias at $|5.5kHz - f_s| = 4.5kHz$, as seen in graph in ②.