Name $\underline{\text{Answers}}$

EE-3220-11 – Dr. Durant – Quiz 3
Winter 2014-'15, Week 3

1. (2 points) Let f_s = 1000 Hz, f_1 = 0 Hz, f_2 = 300 Hz, and f_3 = 600 Hz. Calculate the digital frequencies, ω_n, for each frequency, f_n. for f_1 through f_3. Recall that the digital frequency is how many radians a sinusoid moves through between samples. For example, if a signal is sampled 10 times per period, its digital frequency is 2π/10. Do ***not*** make any adjustments for aliasing.

$$\omega_1 = \frac{f_1}{f_s} \cdot 2\pi = 0$$
$$\omega_2 = \frac{f_2}{f_s} \cdot 2\pi = \frac{300}{1000} \cdot 2\pi = \frac{3\pi}{5} = 0.6\pi$$
$$\omega_3 = \frac{f_3}{f_s} \cdot 2\pi = \frac{600}{1000} \cdot 2\pi = \frac{6\pi}{5} = 1.2\pi$$

2. (2 points) Explain whether any of the 3 sinusoids above are aliased. For each frequency that is aliased, assuming it was not stopped by a suitable antialias filter, calculate what frequency would be observed at the output of the system due to aliasing.

$|\omega_3| > \pi \therefore$ it aliases try $k=1$

Method 1 $\rightarrow$ $\frac{6\pi}{5} - \underbrace{k2\pi}_{\text{periodic freq.}} = \frac{-4\pi}{5} = \frac{f_{3a}}{f_s} \cdot 2\pi \rightarrow \frac{f_{3a}}{f_s} = \frac{-2}{5} \rightarrow f_{3a} = -400\,Hz \Rightarrow \boxed{400\,Hz}$

Method 2 $\rightarrow$ $f_{3a} = f_3 - k \cdot f_s = 600 - 1000 = -400 \Rightarrow \boxed{400\,Hz}$
$\binom{\text{try } k}{=1}$

3. (4 points) Calculate the first 4 samples of the unit step response of y(n) – 0.3 y(n-1) = x(n) + 5x(n-1) - 2x(n-2). Recall that the step response is y(n) when x(n) = u(n).

$(-1\frac{1}{4})\ y(n-1)$
$(7/4)\ x(n) - \delta(n)$

$$y(n) = 0.3y(n-1) + x(n) + 5x(n-1) - 2x(n-2)$$

n	x	y
0	1	$0.3 \times 0 + 1 + 5\times 0 - 2\times 0 = 1$
1	1	$0.3 \times 1 + 1 + 5\times 1 - 2\times 0 = 6.3$
2	1	$0.3 \times 5.3 + 1 + 5\times 1 - 2\times 1 = 5.89$
3	1	$0.3 \times 5.59 + 1 + 5\times 1 - 2\times 1 = 5.767$

~~5.59 × 0.3 = 1.677~~

6.3 × .3 = 1.89

5.89 × .3 = 1.767

4. (2 points) What is the vector of "a" or autoregressive or IIR (infinite impulse response) coefficients in the above equation? (Recall that the "b" or FIR coefficients correspond to a weighted sum of inputs.)

$$a = [1 \quad -0.3] = [a_0 \quad a_1]$$

$-1/4$