EEL 3135 Quiz 2

Name: ___________________________ UFID: ___________________________

\[ x[n] = A \cos(\omega_0 n + \phi) \]

With: \( A = 3 \), \( \omega_0 = 0.7 \pi \), \( \phi = \frac{3\pi}{4} \), \( f_s = 1,000 \text{ samples/second} \)

\( x[n] \) was obtained by sampling a continuous-time signal: \( x(t) = A \cos(2\pi f t + \phi) \) at a rate of 1,000 samples/second.

1. Determine **THREE DIFFERENT** continuous-time signals \( [x(t)] \) that could have produced \( x[n] \). Each signal must have a frequency **LESS** than 1,500 Hz. Write out the equation for each of the signals.

\[
X[n] = 3 \cos \left( \frac{7\pi}{2} n + \frac{3\pi}{4} \right)
\]

\[
X_1(t) = 3 \cos \left( 2\pi \left( \frac{3}{5} \right) t + \frac{3\pi}{4} \right)
\]

\[
X_2(t) = 3 \cos \left( 2\pi \left( \frac{13}{5} \right) t + \frac{3\pi}{4} \right)
\]

\[
X_3(t) = 3 \cos \left( 2\pi \left( \frac{6}{5} \right) t - \frac{3\pi}{4} \right)
\]

2. For **EACH** of the three signals found above \( [x(t)] \) state the minimum sampling frequency that must be used to avoid aliasing.

\( X_1(t) \) must be sampled faster than 2700 samp/sec

\( X_2(t) \) must be sampled faster than 1300 samp/sec

\( X_3(t) \) must be sampled faster than 700 samp/sec
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\[ x[n] = A \cos(\omega_0 n + \phi) \]

With: \( A = 5 \), \( \omega_0 = 0.5\pi \), \( \phi = \frac{\pi}{4} \), \( f_s = 1000 \text{ samples/second} \)

\( x[n] \) was obtained by sampling a continuous-time signal: \( x(t) = A \cos(2\pi f t + \phi) \) at a rate of 1,000 samples/second.

1. Determine THREE DIFFERENT continuous-time signals \( [x(t)] \) that could have produced \( x[n] \). Each signal must have a frequency LESS than 1,500 Hz. Write out the equation for each of the signals.

\[ x[n] = 5 \cos \left( 0.5\pi n + \frac{\pi}{4} \right) \]

\( x_1(t) = 5 \cos \left( 2\pi \left( \frac{250}{1000} \right) t + \frac{\pi}{4} \right) \]

\( x_2(t) = 5 \cos \left( 2\pi \left( \frac{1250}{1000} \right) t + \frac{\pi}{4} \right) \]

\( x_3(t) = 5 \cos \left( 2\pi \left( \frac{1750}{1000} \right) t - \frac{\pi}{4} \right) \]

2. For EACH of the three signals found above \([x(t)]\) state the minimum sampling frequency that must be used to avoid aliasing.

\( x_1(t) \) must be sampled above \( 500 \text{ samples/sec} \)

\( x_2(t) \) must be sampled above \( 2500 \text{ samples/sec} \)

\( x_3(t) \) must be sampled above \( 1500 \text{ samples/sec} \)
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\[ x[n] = A \cos(\omega_0 n + \phi) \]

With: \( A = 7 \), \( \omega_0 = 0.3\pi \), \( \phi = \frac{\pi}{6} \), \( f_s = 1,000 \) samples/second

\( x[n] \) was obtained by sampling a continuous-time signal: \( x(t) = A \cos(2\pi ft + \phi) \) at a rate of 1,000 samples/second.

1. Determine THREE DIFFERENT continuous-time signals \( x(t) \) that could have produced \( x[n] \). Each signal must have a frequency LESS than 1,500 Hz. Write out the equation for each of the signals.

\[ x[n] = 7 \cos \left( \frac{3\pi n}{6} + \frac{\pi}{6} \right) \]

\[ x_1(t) = 7 \cos \left( \frac{2\pi (150)}{f_s} t + \frac{\pi}{6} \right) + 1 \]

\[ x_2(t) = 7 \cos \left( \frac{2\pi (1150)}{f_s} t + \frac{\pi}{6} \right) + 1 \]

\[ x_3(t) = 7 \cos \left( \frac{2\pi (850)}{f_s} t - \frac{\pi}{6} \right) + 1 \]

\[ \frac{3\pi}{6} = \frac{2\pi f_0}{f_s} \]

\[ f_1 = 150 \text{ Hz} \]

\[ \frac{(2\pi + 3\pi)n}{f_s} = \frac{2\pi f_2}{f_s} \]

\[ f_2 = 1150 \text{ Hz} \]

\[ \frac{(2\pi - 3\pi)n}{f_s} = \frac{2\pi f_3}{f_s} \]

\[ f_3 = 850 \text{ Hz} \]

\( \text{Since we negated } \omega_0, \text{ we must negate the phase so } \phi_3 = -\frac{\pi}{6} \)

2. For EACH of the three signals found above \( x(t) \) state the minimum sampling frequency that must be used to avoid aliasing.

\( x_1(t) \) must be sampled above \( 300 \) samples/sec.

\( x_2(t) \) must be sampled above \( 2300 \) samples/sec.

\( x_3(t) \) must be sampled above \( 1900 \) samples/sec.