ECE 2050 Autumn 2023 Homework 3
Due 5:00 pm, Friday September 15, 2023 upload to Carmen as a single PDF document

BC:3.1 For the discrete time function

$$f[n] = (0.6)^{n-1} \sin(\pi n + 90^o) \cdot u[n+3]$$

a.) Sketch (by hand) the waveform for $f[n]$ vs n. Label the value of the signal for the first 5 nonzero samples.

b.) Sketch the waveform,

$$x[n] = 10f[n](u[n+5] - u[n-4)$$

vs n. Label the values of $x[n]$ for samples where $-6 \leq n \leq 5$.

c.) Sketch the waveform for $g[n] = f[n+1]$ vs n. Label the value of the signal, $g[n]$, for the first 5 nonzero samples.

d.) Sketch the waveform for $\alpha[n] = f[n-3]$ vs n. Label the value of the signal, $\alpha[n]$, for the first 5 nonzero samples.

e.) Sketch the waveform for $\beta[n] = f[5-n]$ vs n. Label the value of the signal, $\beta[n]$, for the last 5 nonzero samples.

BC:3.2 For the discrete time function

$$f[n] = \left(0.9e^{-j\pi n/3} + 0.9^{+j\pi n/3}\right)(u[n+4] - u[n-4])$$

Make a table of the values of $f[n]$ for values of $|n| \leq 5$. Hand sketch the following signals that are manipulations of $f[n]$ and label all nonzero values. If values are complex sketch signal strength as the magnitude, and label values in polar form with the angle in degrees. In cases where the argument of $f[\ ]$ is not an integer, use the value of zero for the signal.

a.)
$$x[n] = f[2n]$$

b.)
$$g[n] = f[n/3]$$

c.)
$$\alpha[n] = f[1 - n/2]$$

d.)
$$\gamma[n] = f\left[\frac{|\sqrt{n}|}{2}\right]$$

BC:3.3 For each of the following systems, the input is $x[n]$ and the output is $y[n]$. For each system determine if the system is linear and if the system is time invariant. Briefly justify your answer.

a.)
$$y[n] = 7x[n+2] - 13x[n-1]$$

b.)
$$y[n] = x[n-1] + (3+n)x[n-5]$$

c.)
$$y[n] = x[n] - u[n]$$

d.)
$$y[n] = 3x[1-n]$$

e.)
$$y[n] = 17\cos(2\pi x[n+3])$$

BC:3.4 Consider the LTI (linear time invariant) discrete time systems with the following impulse responses, $h[n]$. For each system, determine whether or not the system is causal or noncausal and whether or not the system is FIR (finite impulse response) or IIR (infinite impulse response). Give a brief justification.

a.)
$$h[n] = (100)^{1-n} \sin(0.1\pi n)u[n-3]$$

b.)
$$h[n] = (100)^{1-n} \sin(0.1\pi n)u[n+3]$$

c.)
$$h[n] = (100)^{1-n} \sin(0.1\pi n)(u[n+3] - u[n-3])$$

d.)
$$h[n] = (121e^{-j0.15\pi})^{3-n}u[n-3] - (121e^{-j0.15\pi})^{3-n}u[n-17]$$

e.)
$$h[n] = (121e^{-j0.15\pi})^{3-n}u[n-3] - (121e^{-j0.15\pi})^{17-n}u[n-17]$$