EECS 644 HW 1: due 9 Sept. 2025

1. For the following discrete sinusoids, determine whether or not each is periodic. If so, what is the fundamental period (in samples)?

   a) $x(n) = 8\, e^{j0.3\pi n}$

   b) $x(n) = 2\cos(0.01n)$

   c) $x(n) = 3\cos(0.08\pi n) + 2\cos(0.11\pi n)$

   d) $x(n) = [\cos(0.5\pi n + \pi/4)]^{-1}$

2. For the following discrete systems, state (and justify as necessary) whether or not each is *i*) linear and *ii*) time invariant. (Assume inputs are causal)

   a) $y(n) = [x(n)]^3$

   b) $y(n) = b_1 y(n-1) + b_2 y(n-2) + x(n)$

   c) $y(n) = 2\, x(n)$

   d) $y(n) = x(n) + 2$

   e) $y(n) = x(n)\cos(0.01\pi n)$

3. For $x(n) = \{4, \underset{\uparrow}{1}, 3\}$ and $h(n) = \{2, \underset{\uparrow}{3}, 1\}$ use the Matlab 'conv' function to compute:

   a) $y(n) = x(n) * h(n)$

   b) $y(n) = h(n-1) * x(n)$

   c) $y(n) = h(-n) * x(n)$

   d) $y(n) = h(-n) * h(n) * x(n)$

   Note: indicate $n = 0$ location with an arrow as above.

4. Use the direct approach to compute the first ten terms of the impulse response of:

$$y(n) = -0.5\,y(n-1) + 0.25\,y(n-2) + 0.5\,x(n) + 0.25\,x(n-1)$$

Use Matlab to plot the impulse response terms. What can be observed about the nature of this impulse response?

5. Analytically determine the DTFT of the following system:

$$y(n) = \alpha^n\,u(n) + \beta^{-n}\,u(-n+1) \qquad |\alpha| < 1,\ |\beta| < 1$$

Use Matlab to plot the magnitude ('abs') and phase ('angle') responses for values of ω from $-\pi$ to $+\pi$ and for $\alpha = 0.5$ and $\beta = -0.5$. {*Hint: use the 'linspace' command to establish an equal-spaced sampling of the frequency domain*}

6. Analytically determine the even and odd components of

$$x(n) = e^{j\,0.5\,\pi\,n} + 1 + \delta(n+2) - \delta(n-2)$$