Signals and Systems May 16, 2012
Sharif University of Technology CE 40-242
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Date Due: Khordad 11, 1391

Homework 8

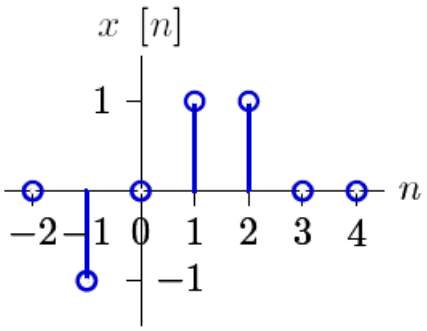
Problems

1. Determine the Laplace transforms (including the regions of convergence) of each of the following signals.

   a. $x[n] = (\frac{1}{2})^n u[n-3]$

   b. $x[n] = (1+n)(\frac{1}{3})^n u(n)$

   c. $x[n] = n(\frac{1}{2})^{|n|}$

   d.

2. Determine the inverse z-transform of each of the following.

   a. $X(Z) = \frac{1}{z-1}$

   b. $X(Z) = \frac{1}{z^2+z+1}$

   c. $X(Z) = \frac{3z^{-3}}{(1-\frac{1}{4}z^{-1})^2}$, $x[n]$ is left sided.

   d. $X(Z) = sin(z)$, ROC includes $|z| = 1$.

   e. $X(Z) = \frac{z^7-2}{1-z^{-7}}$, $|z| > 1$.

   f. $X(Z) = e^z + e^{1/z}, z \neq 0$

3. Determine the unit step response of the causal system for which the z-transform of the impulse response is:

$$H(z) = \frac{1-z^3}{1-z^4}$$

4. If the input $x[n]$ to an LTI system is $x[n] = u[n]$,the output is

$$y[n] = (\frac{1}{2})^{n-1} u[n+1]$$

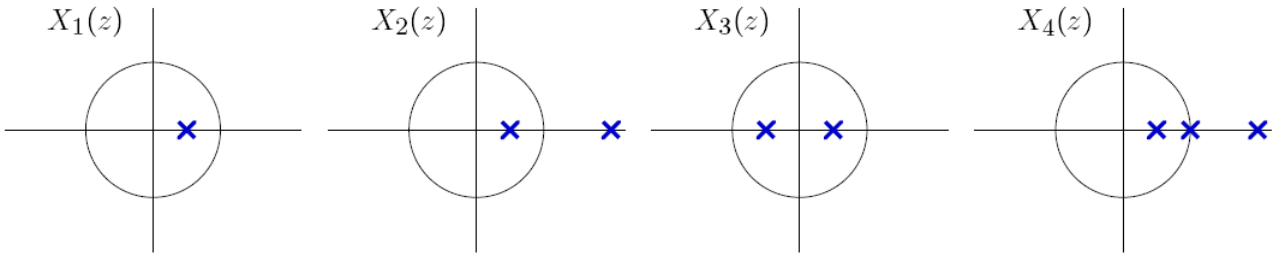
   a. Find $H(z)$, the z-transform of the system impulse response, and plot its pole-zero diagram.

   b. Find the impulse response $h[n]$.

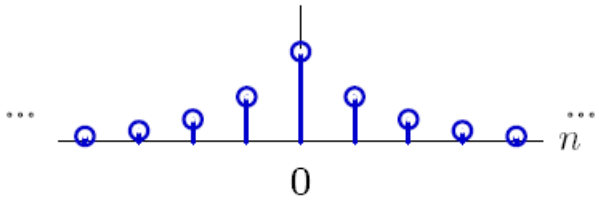
c. Is the system stable.

d. Is the system casual.

5. Consider the following DT pole-zero diagrams, where the circles have unit radius.



a. Which if any of the pole-zero plots could represent the z-transform of the following DT signal?



b. Which if any of the pole-zero diagrams could represent a system that is stable?

c. Which if any of the pole-zero diagrams could represent a system that is casual?

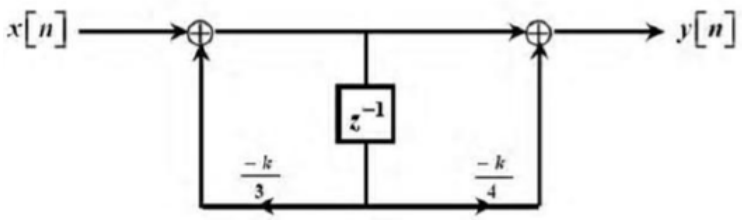
d. Which if any of the pole-zero diagrams could represent a system that is both stable and casual?

6. Consider and LTI system with input $x[n]$ and output $y[n]$ that satisfies the difference equation

$$y[n] - \tfrac{2}{5}y[n-1] + y[n-2] = x[n] - x[n-1]$$

Determine all possible values for the systems's impulse response $h[n]$ at $n = 0$.

7. Consider the digital filter structure shown below.



a. Find $H(z)$ for this casual filter. Plot the pole-zero pattern and indicate the region of convergence.

b. For what value of k is the system stable.

c. Determine $y[n]$ if $k = 1$ and $x[n] = (\frac{2}{3})^n$ for all n.