

EE150: Signals and Systems, Spring 2022

Homework 7

(Due Monday, Jun. 13 at 11:59pm (CST))

1. [15 points] Consider a left-sided sequence $x[n]$ with z-transform

$$X(z) = \frac{1}{(1 - \frac{1}{2}z^{-1})(1 - z^{-1})}$$

- (a) Write $X(z)$ as a ratio of polynomials in z instead of z^{-1} .
- (b) Using a partial-fraction expression, express $X(z)$ as a sum of terms, where each term represents a pole from your answer in part (a).
- (c) Determine $x[n]$.

2. [15 points] A causal LTI system is described by the difference equation

$$y[n] = y[n-1] + y[n-2] + x[n-1]$$

- (a) Find the system function $H(z) = Y(z)/X(z)$ for this system. Plot the poles and zeros of $H(z)$ and indicate the region of convergence.
- (b) Find the unit sample response of the system.
- (c) Using the properties in the lecture to show that the system is not stable, and find a stable (noncausal) unit sample response that satisfies the difference equation.

3. [20 points] The input $x[n]$ and output $y[n]$ of a causal LTI system A are related through the block-diagram representation shown in Figure 1:

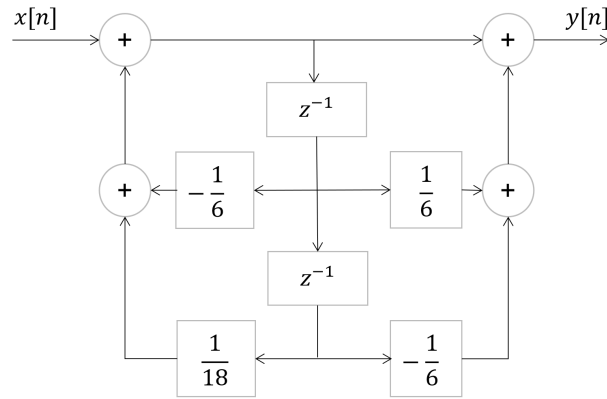


Figure 1: System A

- (a) Find the system function $H(z) = Y(z)/X(z)$ for this system (We will talk about ROC in the next question) and describe the system with difference equation.
- (b) Write its ROC and judge if it is stable.
- (c) Now we rewrite the system as the following two block diagrams B and C , please fill the blank of $a_1 - a_4$ and $b_1 - b_4$ so that the two diagrams are both equivalent to the system A . You can have additional lines and blocks if necessary.

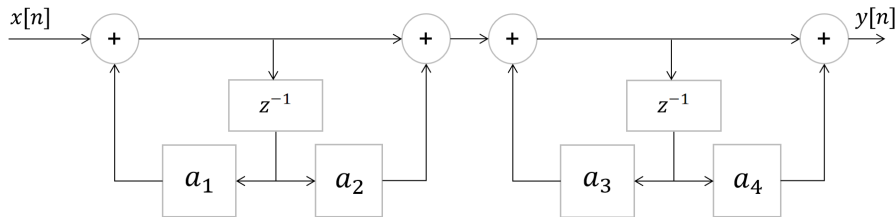


Figure 2: System B

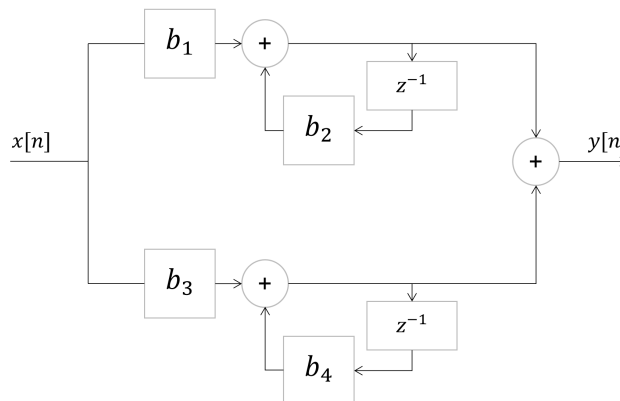


Figure 3: System C