ECE 2713
Homework 7

Spring 2025 Dr. Havlicek

1. Text problem P-9.3.
2. Text problem P-9.8, parts (a), (b), and (d) **only**.
3. A discrete-time LTI system H has input $x[n]$ and output $y[n]$ related by the linear constant coefficient difference equation

$$y[n] - \frac{1}{2}y[n-1] = x[n] + \frac{1}{3}x[n-1].$$

   (a) Find the transfer function $H(z)$. **Note:** you can find the functional form of $H(z)$, but in this part you do not yet have enough information to find the ROC. In parts (c) and (e) you will be given more information so that you can find the ROC.

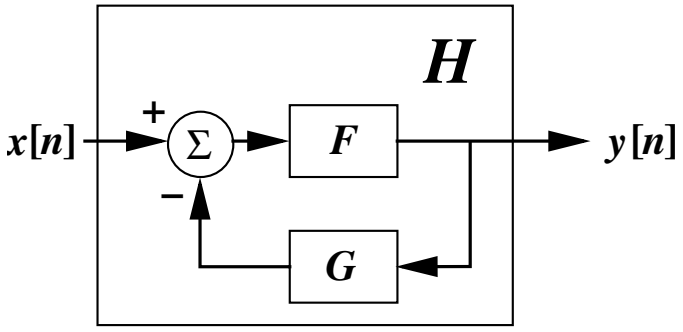
   (b) Give a pole-zero plot for $H(z)$.

   (c) Now assume that the system frequency response $H(e^{j\omega})$ exists. For this assumption, give the ROC of $H(z)$ and find the system impulse response $h[n]$.

   (d) Under the assumption of part (c) – that $H(e^{j\omega})$ exists – is the system causal? Is it stable?

   (e) Now assume that the system H is unstable and is *not* causal. For these assumptions, give the ROC of $H(z)$ and find the impulse response $h[n]$.

4. Consider the **causal** LTI system H shown below.



   The impulse response of LTI system G is given by $g[n] = \frac{3}{2}\delta[n-1]$.

   When the overall system input is

$$x[n] = \left(\frac{1}{2}\right)^n u[n-1] = \left(\frac{1}{2}\right)\left(\frac{1}{2}\right)^{n-1} u[n-1],$$

   the overall system output is observed to be

$$y[n] = n\left(\frac{1}{2}\right)^n u[n].$$

(a) Find the overall system transfer function $H(z)$.

(b) Is the system H stable? *Justify your answer.*

(c) Find the impulse response $f[n]$ of system F.

(d) Is the system F stable? *Justify your answer.*

5. The input $x[n]$ and output $y[n]$ of a discrete-time LTI system H are related by the difference equation

$$y[n] + \frac{5}{2}y[n-1] - \frac{3}{2}y[n-2] = x[n] - 4x[n-1].$$

(a) Find the system transfer function $H(z)$ and give a pole/zero plot. **Note:** you can find the functional form of $H(z)$, but in this part you do not yet have enough information to find the ROC. In parts (b) and (c) you will be given more information so that you can find the ROC.

(b) Now assume that the system H is **stable**. For this assumption, give the ROC of $H(z)$ and find the impulse response $h[n]$.

(c) Now assume that the system H is **causal**, but not necessarily stable. For this assumption, give the ROC of $H(z)$ and find the impulse response $h[n]$.

(d) For this difference equation, does a system H exist that is both causal and stable? Justify your answer.

Scan or photograph your paper and upload to Canvas.

DUE: 4/29/2025 11:59 PM

CAN BE TURNED IN LATE WITHOUT PENALTY UNTIL 11:59 PM ON 5/2/2025