EECS 644 HW 2: due 9/18/2025

1. Assuming no initial conditions, use the direct approach to compute the first five terms of the impulse response of:

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

Verify your answer by Power Series Expansion of the z-transform (show work). *{Impulse response implies causality}*

2. Repeat Prob. 1 for:

$$y(n) = 0.5\, y(n-1) - 0.5\, y(n-2) + 0.75\, x(n) - 0.75\, x(n-1)$$

3. Determine the stable impulse response $h(n)$ associated with the z-transform:

$$H(z) = \frac{(z+1)}{(z-0.25)\,(z+0.5)}$$

4. Repeat Prob. 3 for:

$$H(z) = \frac{(z-1)\,(z+1)}{(z-0.25)\,(z+0.5)}$$

5. Compute the z-transform (including ROC) of the following system for causal input and denote as $H(z)$:

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

a) Is the system stable?
b) Plot (by hand) the locations of the poles and zeros of the system.
c) What is the time-domain response $y(n)$ to step input $x(n)$? (*Hint*: $Y(z) = H(z)\, X(z)$)
d) Use the Final Value Theorem to determine the "steady-state" value of the system impulse response $h(n)$ as $n \to \infty$.

6. Repeat Prob. 5 for

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