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Birzeit University
ENC431: Digital Signal Processing

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Fist Exam

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1. Consider two systems described by the following linear constant coefficient difference equations:

$H_1(z) \leftarrow Y[n] = 0.2y[n-1] + x[n] + 0.3x[n-1] + 0.02x[n-2]$

$H(z)$

$H_2(z) \leftarrow Y[n] = x[n] - 0.1x[n-1]$

Prove that the systems are equivalent.

2. The input $x[n]$ and the output of a casual system obeys the relationship

$Y[n] = x[n] + 0.3y[n-2]$

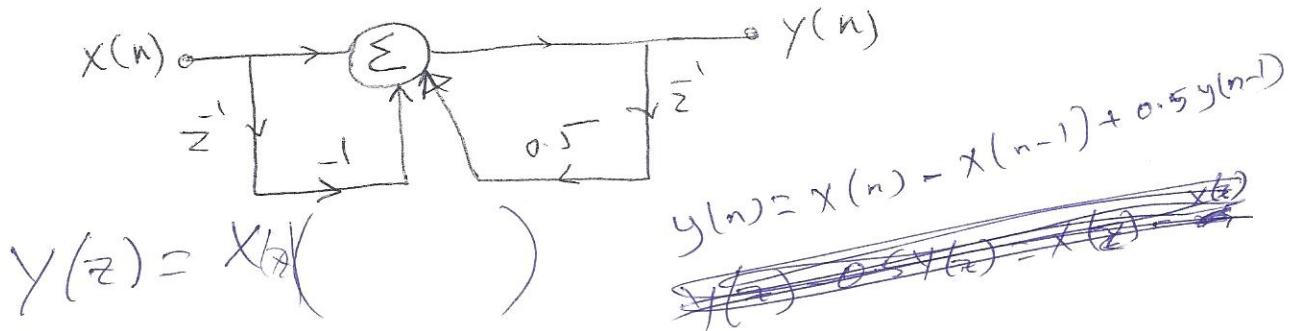
$H(z) \rightarrow h(n)$

$Y(z) = X(z) + 0.3 Y(z) z^{-2}$

A. Find the impulse response.

B. Determine if the system is stable or not.

3. Consider the following LTI system:



Determine a closed form expression for the response $y[n]$ of the system to the following input signal:

$x[n] = \begin{cases} 1 & n \geq 4 \\ 0 & \text{otherwise} \end{cases}$

If the system is casual and initially at rest.

4. Consider the following discrete time signal $x[n]$

$$\sum_{-\infty}^{\infty} x(n) z^{-n}$$

$$z^{-1} < 1$$

$$1 < z$$

$$x[n] = \begin{cases} n+1 & 0 \leq n \leq 3 \\ 4 & n \geq 4 \\ 0 & \text{otherwise} \end{cases}$$

A. Determine the z-transform $x(z)$ of $x[n]$, and represent it as a ratio of polynomials in z^{-1} .

B. What is the region of convergence (ROC) of the z transform.

5. Consider the following system:

$$h[n] = \delta[n] + 2\delta[n-1] + 3\delta[n-2] + 3.5\delta[n-3] + 3.5\delta[n-4] + 3.5\delta[n-5] + 3\delta[n-6] + 2\delta[n-7] + \delta[n-8].$$

$$\delta \leftrightarrow 1$$

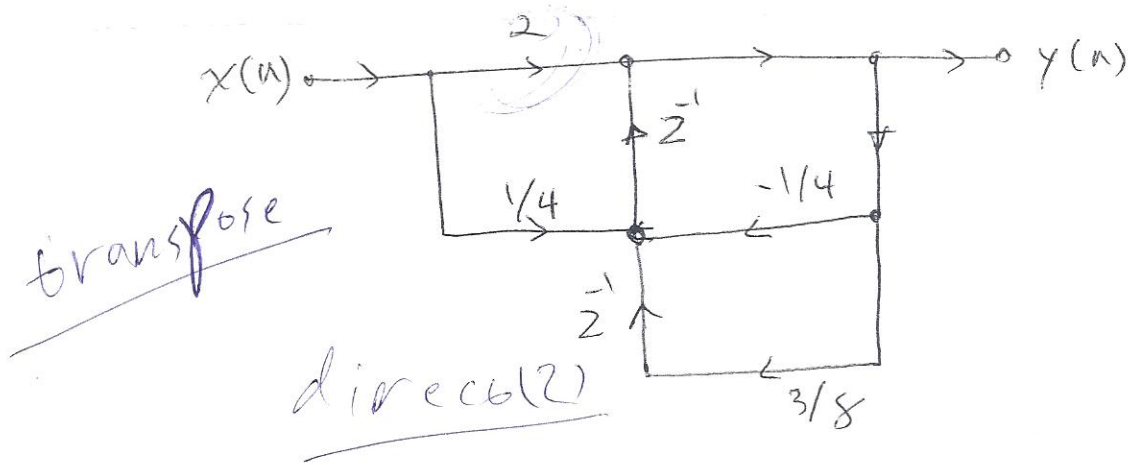
A. Find $H(e^{j\omega})$.

B. Find the group delay for the system.

$$\delta \leftrightarrow 1$$

$$x(n) z^{-n_0} \leftrightarrow x(n - n_0)$$

6. Consider the system represented by the figure:



A. Find the system function relating the z-transform of the input and output.

B. Write the difference equation of the system.

$$1/4, -3/8$$

$$1/4$$

$$\frac{z + 1/4 z^{-1}}{z^2 + 1/4 z^{-1} - 3/8 z^{-2}}$$