

Name: Key

EE432 Fall 2011 Quiz 5

Work problem 1 OR 2 (not both), and problems 3 AND 4.

1. Find the transfer function for the system characterized by the difference equation:
 $y[n] = x[n] - 0.1x[n-1] + 0.3x[n-2] + 0.25y[n-1] + y[n-3]$.

$$y[n] - 0.25y[n-1] - y[n-3] = x[n] - 0.1x[n-1] + 0.3x[n-2]$$

$$Y(z) (1 - 0.25z^{-1} - z^{-3}) = X(z) (1 - 0.1z^{-1} + 0.3z^{-2})$$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{1 - 0.1z^{-1} + 0.3z^{-2}}{1 - 0.25z^{-1} - z^{-3}}$$

OR

$$\frac{z^3 - 0.1z^2 + 0.3z}{z^3 - 0.25z^2 - 1}$$

2. Find the difference equation associated with the following transfer function:

$$H(z) = \frac{0.9z^2 + 1}{z^2 - 0.2z + 1}$$

$$H(z) = \frac{Y(z)}{X(z)} = \frac{0.9z^2 + 1}{z^2 - 0.2z + 1} = \frac{0.9 + z^{-2}}{1 - 0.2z^{-1} + z^{-2}} \quad \left(\text{mult by } \frac{z^{-2}}{z^{-2}} \right)$$

$$Y(z)(1 - 0.2z^{-1} + z^{-2}) = X(z)(0.9 + z^{-2})$$

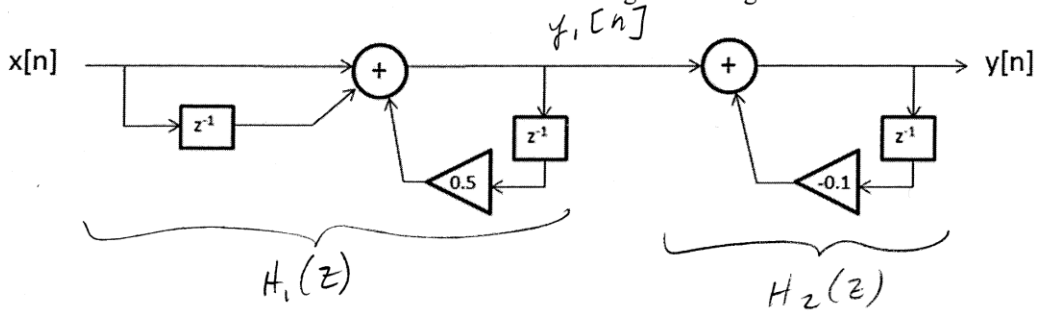
$$y[n] - 0.2y[n-1] + y[n-2] = 0.9x[n] + x[n-2]$$

OR

$$y[n] = 0.9x[n] + x[n-2] + 0.2y[n-1] - y[n-2]$$

4

3. Find the transfer function associated with the following block diagram.



$$y_1[n] = x[n] + x[n-1] + 0.5y_1[n-1]$$

$$y_1[n] - 0.5y_1[n-1] = x[n] + x[n-1]$$

$$Y_1(z)(1 - 0.5z^{-1}) = X(z)(1 + z^{-1})$$

$$H_1(z) = \frac{Y_1(z)}{X(z)} = \frac{1 + z^{-1}}{1 - 0.5z^{-1}}$$

$$y[n] = y_1[n] - 0.1y[n-1]$$

$$y[n] + 0.1y[n-1] = y_1[n]$$

$$Y(z)(1 + 0.1z^{-1}) = Y_1(z)$$

$$H_2(z) = \frac{Y(z)}{Y_1(z)} = \frac{1}{1 + 0.1z^{-1}}$$

Series system:

$$H(z) = H_1(z)H_2(z) = \frac{1 + z^{-1}}{(1 - 0.5z^{-1})(1 + 0.1z^{-1})}$$

$$\text{or} = \frac{z(z+1)}{(z-0.5)(z+0.1)}$$

4. Use your ZT tables to find the ZT of the following. Include the ROC.

2

$$(a) \delta[n] + (-0.25)^n u[n] \longleftrightarrow 1 + \frac{z}{z+0.25} \stackrel{\text{OR}}{=} \frac{2z+0.25}{z+0.25} \quad \text{ROC } |z| > 0.25$$

2

$$(a) (n-2)(0.5)^{n-2} u[n-2]$$

↑ ↑
delay of 2 gives
a factor of z^{-2} in ZT

since $n(0.5)^n u[n] \longleftrightarrow \frac{0.5z}{(z-0.5)^2}$

$$\frac{0.5z^{-1}}{(z-0.5)^2} = \frac{0.5}{z(z-0.5)^2} \quad |z| > 0.5$$

Bonus: What Japanese Admiral was killed when his transport plane was shot down in Operation Vengeance in 1943? Hint: This operation was a direct result of Magic communication intercepts.

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