EE 451 – HW4

8.3 \[ Y(Z)/X(Z) = \frac{2}{1+3z^{-1}+2K} \]

The transfer function of the closed-loop discrete-time feedback system has one single pole at \( z_p = -3/(1+2K) \). For stability (|z|<1) the gain K should assume values: \( K > 1 \) or \( K < -2 \)

8.9 By using auxiliary variables (usually placed at the output of adders), the T.F.s of the digital filter is: \( Y(Z)/X(Z) = H(Z) = -k_1 z^{-1}/(1+(k_1^2+k_2)z^{-1}+(1-k_1)z^2) \)

8.21 In order to implement the T.F.s using cascaded canonic implementations (using a minimum number of delay units). The T.F.s can be factorized as follows:

(a) \[ H_1(Z) = 0.3(z^{-1}+3z^{-2})/(1-1.6z^{-1}+2.1z^{-2})(1+0.8z^{-1})/(1-0.75z^{-1}) \]
(b) \[ H_2(Z) = (3.1+0.853z^{-1})(1-0.15z^{-1})(1+4.5z^{-1})(1+0.2z^{-1})(3-0.5z^{-1})(1+0.5z^{-1}+0.1z^{-2}) \]

These could be realized using Direct Form II structures.

8.27 Using partial fraction expansion:
\( H(Z)= (-4.5z^{-1})(1+0.2z^{-1}-0.08z^{-2}) = G1/(1+0.4z^{-1}) + G1/(1-0.2z^{-1}) \)
where \( G1 = 12 \) and \( G2 = -8 \)
The gain \( A = -8 \) can be factored out of the two T.F.s: \( -8[1.5/(1+0.4z^{-1})+1/(1-0.2z^{-1})] \). Therefore
\[ A = -8 \text{ and } b = -0.4 \]

8.55 \[
\begin{bmatrix}
V_1(Z) \\
V_2(Z)
\end{bmatrix} = \begin{bmatrix}
1 - G_{12}(Z)H_{12}(Z) & H_{12}(Z) - G_{12}(Z) \\
H_{21}(Z) - G_{12}(Z) & 1 - G_{21}(Z)H_{12}(Z)
\end{bmatrix} \begin{bmatrix}
X_1(Z) \\
X_2(Z)
\end{bmatrix}
\]

Crosstalk is eliminated if \( V_1(z) = f(X_1(Z)) \) or \( f(X_2(Z)) \), and \( V_2(S) = f(X_1(Z)) \) or \( f(X_2(Z)) \)

Two possible set of conditions for channel separation would be:

a) \( G_{12}(Z) = H_{12}(Z) \) and \( H_{21}(Z) = G_{21}(Z) \)
b) \( G_{12}(Z) = H_{21}^{-1}(Z) \) and \( G_{21}(Z) = H_{12}^{-1}(Z) \)