EE 451 – HW4

8.3 $Y(Z)/X(Z) = 2/(1+3z^{-1}+2K)$

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: $Y(Z)/X(Z) = H(Z) = -k_1z^{-1}/(1+(k_1^2+k_1k_2-2)z^{-1}+(1-k_1k_2)z^{-2})$

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) $H_1(Z) = 0.3*(z^{-1}+3z^{-2})/(1-1.6z^{-1}+2.1z^{-2})*(1-0.8z^{-1})/(1-0.75z^{-1})$
$H_1(Z) = 0.3*(z^{-1}-0.8z^{-2})/(1-1.6z^{-1}+2.1z^{-2})*(1+3z^{-1})/(1-0.75z^{-1})$

(b) $H_2(Z) = (3.1+0.853z^{-1})/(1-0.15z^{-1})*(1-4.5z^{-1})/(1+0.2z^{-1})*(3-0.5z^{-1})/(1+0.5z^{-1}+0.1z^{-2})$
$H_2(Z) = (1-4.5z^{-1})/(1-0.15z^{-1})*(3.1+0.853z^{-1})/(1+0.2z^{-1})*(3-0.5z^{-1})/(1+0.5z^{-1}+0.1z^{-2})$

These could be realized using Direct Form II structures.

8.27 Using partial fraction expansion:
$H(Z)= (4-5.6z^{-1})/(1+0.2z^{-1}-0.08z^{-2}) = G1/(1+0.4z^{-1})+G1/(1-0.2z^{-1})$
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 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 $G_{21}(Z) = H_{12}^{-1}(Z)$