Ch8 Digital Filter

8.1 Figure 1 shows a typical closed-form discrete-time feedback control system in which $G(z)$ is the plant and $C(z)$ is the compensator. If

$$G(z) = \frac{z^{-2}}{1+1.5z^{-1}+0.5z^{-2}}$$

and $C(z) = K$. Determine the range of value of K for which the overall structure is stable.

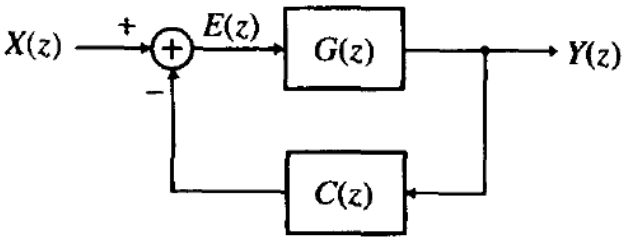

Figure 1

8.2 Repeat the problem 8.1 for

$$G(z) = \frac{z^{-1}}{1+1.5z^{-1}+0.5z^{-2}}$$

8.3 Develop a minimum-multiplier realization of length-9 Type 3 FIR transfer function.

8.4 Develop a canonic direct form II realization of the following transfer function:

$$H(z) = \frac{2+0.6z^{-1}}{1+0.9z^{-1}+0.18z^{-2}}$$

8.5 Develop two different cascade canonic realization of the following transfer function:

$$H(z) = \frac{(0.3z^{-1}-z^{-2})(3+1.8z^{-1})}{(1+4z^{-1}-1.5z^{-2})(1+0.5z^{-1})}$$

8.6 Consider the cascade of three causal first-order LTI discrete-time systems shown in Figure 2, where

$$H_1(z) = \frac{1-0.6z^{-1}}{1+0.25z^{-1}} \qquad H_2(z) = \frac{0.2+z^{-1}}{1+0.3z^{-1}} \qquad H_3(z) = \frac{2}{1+0.25z^{-1}}$$

a) Determine the transfer function of the overall system as a ratio of two polynomials in z^{-1};

b) Determine the different equation characterizing the overall system;
c) Develop the realization of the overall system with each section realized in direct form II;
d) Develop a parallel form I realization of the overall system;
e) Determine the impulse response of the overall system in closed form.

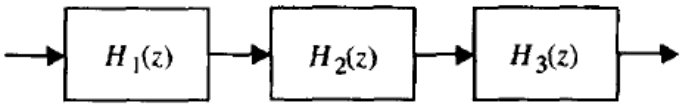

Figure 2

8.7 A causal LTI discrete-time system develops an output

$$y[n] = (0.3)^n \mu[n] - 0.5(0.3)^{n-1} \mu[n-1]$$

for an input $x[n] = (0.7)^n \mu[n]$.

a) Determine the transfer function of the system;
b) Determine the difference equation characterizing the system;
c) Develop a canonic direct form realization of the system with no more than three multipliers;
d) Develop a parallel form I realization of the system;
e) Determine the impulse response of the system in closed form.
f) Determine the output $y[n]$ of the system for an input

$$x[n] = (0.2)^n \mu[n] - 0.4(0.2)^{n-1} \mu[n-1]$$