Solution of ECE 316 Test #7 S04

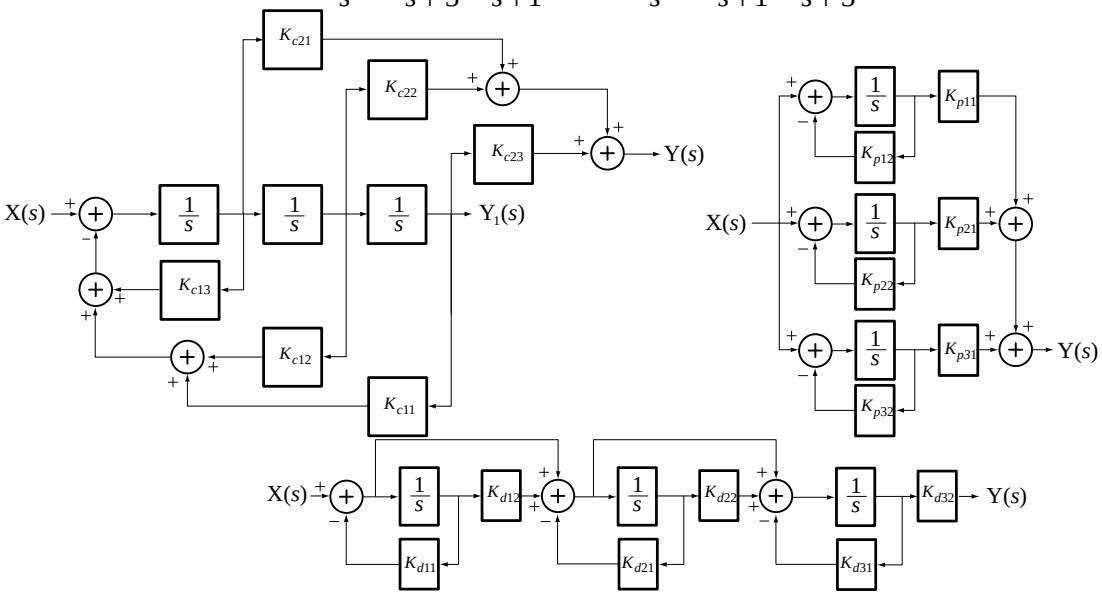
A system has a transfer function, $\mathrm{H}(s)=10\dfrac{s^2-16}{s\left(s^2+4s+3\right)}$. Three realizations are illustrated below, canonical, cascade and parallel. Find the values of all the gains, *K*. (Some may be zero.)

Canonical: $\dfrac{\mathrm{Y}(s)}{\mathrm{X}(s)}=10\dfrac{s^2-16}{s^3+4s^2+3s}\Rightarrow 10\left(s^2-16\right)\mathrm{X}(s)=\left(s^3+4s^2+3s\right)\mathrm{Y}(s)$

$s^3\,\mathrm{Y}_1(s)=\mathrm{X}(s)-4s^2\,\mathrm{Y}_1(s)-3s\,\mathrm{Y}_1(s)$ and $\mathrm{Y}(s)=10\left(s^2-16\right)\mathrm{Y}_1(s)$

Parallel: $\mathrm{H}(s)=\dfrac{-\frac{160}{3}}{s}+\dfrac{-\frac{70}{6}}{s+3}+\dfrac{75}{s+1}=\dfrac{-53.33}{s}+\dfrac{-11.67}{s+3}+\dfrac{75}{s+1}$

Cascade: $\mathrm{H}(s)=10\times\dfrac{s-4}{s}\times\dfrac{s+4}{s+3}\times\dfrac{1}{s+1}=10\times\dfrac{s+4}{s}\times\dfrac{s-4}{s+1}\times\dfrac{1}{s+3}=\cdots$



$K_{c11}=0$ $K_{c12}=3$ $K_{c13}=4$

$K_{c21}=10$ $K_{c22}=0$ $K_{c23}=-160$

In the parallel case, the order of the subsystems does not matter but the coefficients must occur in these pairs.

$K_{p11}=-53.33$ $K_{p12}=0$

$K_{p21}=-11.67$ $K_{p22}=3$

$K_{p31}=75$ $K_{p32}=1$

In the cascade case, the coefficients in the left-hand column can be in any order and the -4 and 4 in the right-hand column can also be reversed. However, because of the way the system is drawn, K_{d32} must be 10.

$K_{d11}=0$ $K_{d12}=-4$

$K_{d21}=3$ $K_{d22}=4$

$K_{d31}=1$ $K_{d32}=10$