Tutorial 7

4. For the system shown in Figure P7.3, what steady-state error can be expected for the following test inputs: $15u(t)$, $15tu(t)$, $15t^2u(t)$. [Section: 7.2]

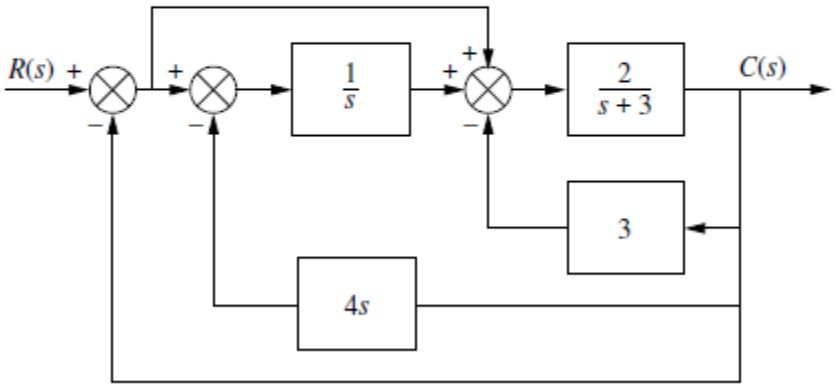

FIGURE P7.3

16. What are the restrictions on the feedforward transfer function $G_2(s)$ in the system of Figure P7.6 to obtain zero steady-state error for step inputs if: [Section: 7.3]

a. $G_1(s)$ is a Type 0 transfer function;

b. $G_1(s)$ is a Type 1 transfer function;

c. $G_1(s)$ is a Type 2 transfer function?

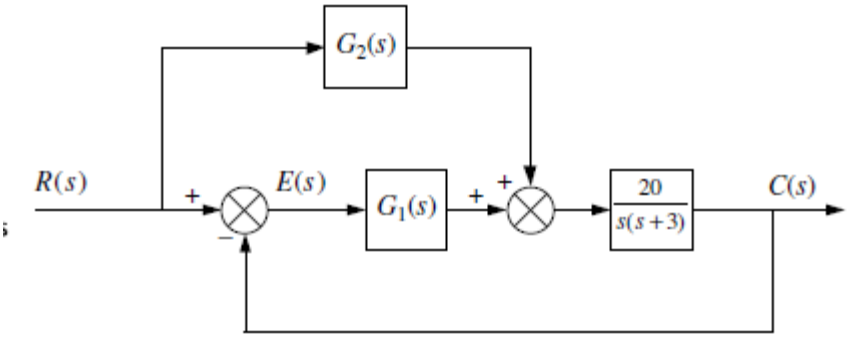

FIGURE P7.6

27. The unity feedback system of Figure P7.1, where

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$$G(s) = \frac{K(s+\alpha)}{(s+\beta)^2}$$

is to be designed to meet the following specifications: steady-state error for a unit step input = 0.1; damping ratio = 0.5; natural frequency = $\sqrt{10}$. Find K, α, and β. [Section: 7.4]

36. The transfer function from elevator deflection to altitude change in a Tower Trainer 60 Unmanned Aerial Vehicle is

$$P(s) = \frac{h(s)}{\delta(s)_e} = \frac{-34.16s^3 - 144.4s^2 + 7047s + 557.2}{s^5 + 13.18s^4 + 95.93s^3 + 14.61s^2 + 31.94s}$$

An autopilot is built around the aircraft as shown in Figure P7.13, with $F(s) = H(s) = 1$ and

$$G(s) = \frac{0.00842(s + 7.895)(s^2 + 0.108s + 0.3393)}{(s + 0.07895)(s^2 + 4s + 8)}$$

(*Barkana, 2005*). The steady-state error for a ramp input in this system is $e_{ss} = 25$. Find the slope of the ramp input.

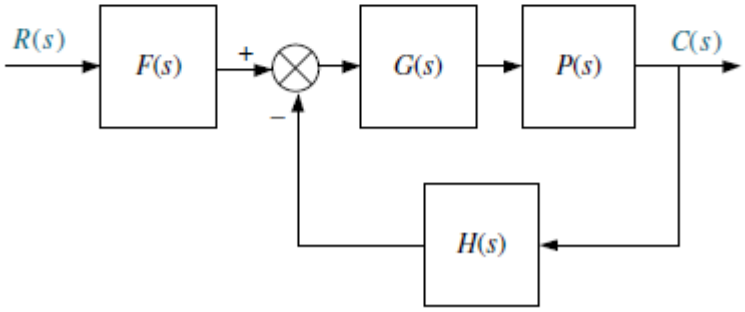

FIGURE P7.13

44. Given the system shown in Figure P7.19, find the following: [Section: 7.6]

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a. The system type

b. The value of K to yield 0.1% error in the steady state

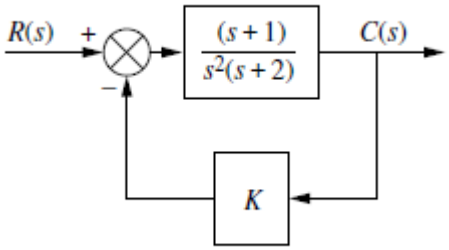

FIGURE P7.19