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CHAPTER 6

6.2-1. Consider the closed-loop system of Fig. P6.2-1.

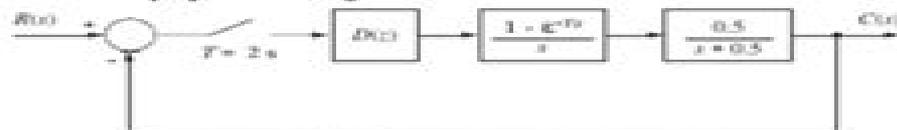


Figure P6.2-1 System for Problem 6.2-1.

- Calculate and plot the unit-step response at the sampling instants, for the case that $D(z) = 1$.
- Calculate the system unit-step response of the analog system, that is, with the sampler, digital controller, and data hold removed. Plot the response on the same graph with the results of part (a).
- For the system of Fig. P6.2-1, let $D(z) = 1$ and $T = 0.4$ s. Calculate the unit-step response and plot these results on the same graph used for parts (a) and (b).
- Use the system dc gains to calculate the steady-state responses for each of the systems of parts (a), (b), and (c). Why are these gains equal?

Solution:

$$(a) \quad G(z) = \frac{z-1}{z} \left[\frac{0.5}{s(s+0.5)} \right] \Big|_{z=e^{Ts}} = \frac{z-1}{z} \frac{(1-e^{-Ts})}{(z-1)(z-e^{-Ts})} = \frac{0.6321}{z-0.3679}$$

$$\frac{G(z)}{1+G(z)} = \frac{0.6321}{z-0.2642}$$

$$C(z) = \frac{0.6321}{z-0.2642} = \frac{0.5}{z-0.2642} + \frac{-0.5}{z-0.2642}$$

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