Last updated on February 6, 2025

BM2000 Control Systems

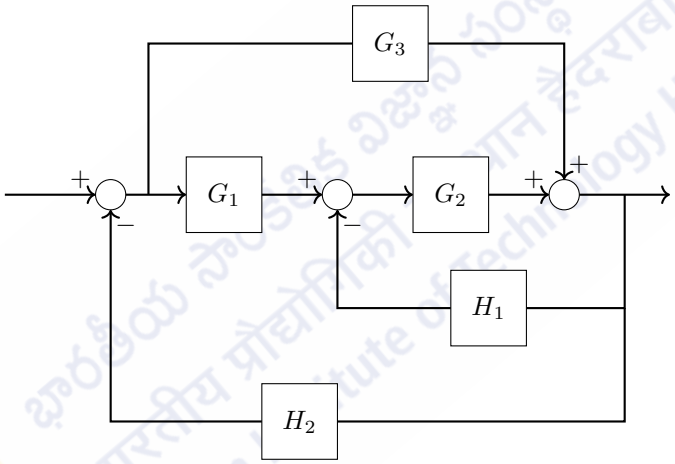
Problem set 3

Instructions

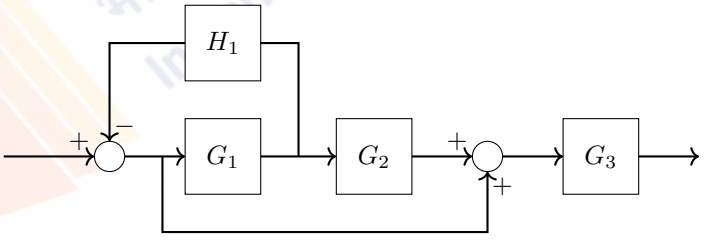
- You are not expected to submit the answers to these questions.

Questions

1. Reduce the following systems to a single transfer function.

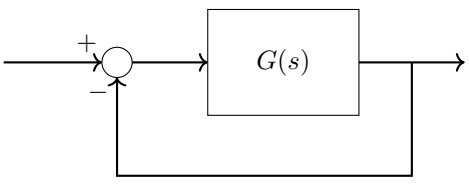


(a)



(b)

2. Consider the unity feedback system as shown below with



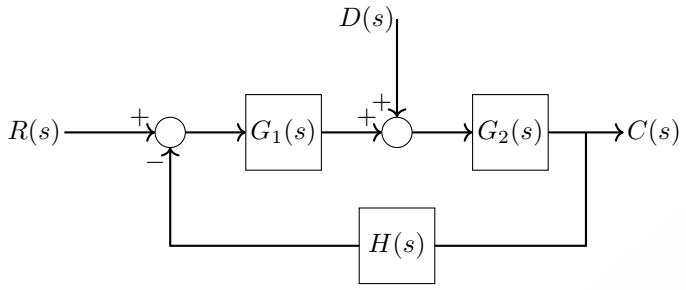
$$G(s) = \frac{K(s^2 + 6s + 6)}{(s+5)^2(s+3)}. \tag{1}$$

   (a) Find the system type.

   (b) What error can be expected for a unit step input?

(c) What error can be expected for a ramp input?

3. Consider the system shown in the figure below where $D(s)$ is a disturbance signal representing noise in the system.



(a) Derive the expression for the error, $E(s) = R(s) - C(s)$, in terms of $R(s)$ and $D(s)$.

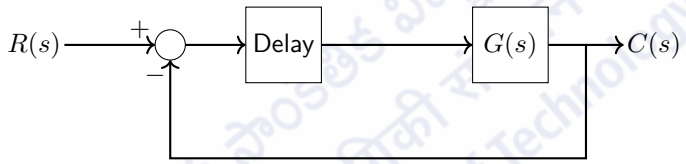
(b) What is the steady state error $e(\infty)$ if both $r(t)$ and $d(t)$ are unit step functions.

(c) Determine the attributes of $G_1(s)$, $G_2(s)$ and $H(s)$ necessary for the steady-state error to become zero.

4. Given a unity feedback system with t

$$G(s) = \frac{K}{(s+1)(s+3)(s+6)}$$

as shown in the figure



Delay is usually modeled with a transfer function

$$D(s) = e^{-Ts} \tag{2}$$

where T is the delay duration.

(a) Is this system LTI?

(b) For a delay $T = 0.5$ second, find the range of gain, K, to yield stability. Use Bode plots and frequency response techniques.