國立成功大學75學年度工程科學研究所考試(控制系統 試題)

(一) For each of the following systems, please find the steady-state error $e_{ss} \triangleq \lim_{t\to\infty} e(t)$ where $e(t) \triangleq r(t) - c(t)$, between output and input, when the input $r(t)$ is a unit-step input.

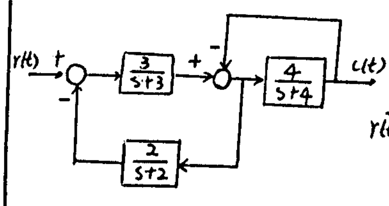


Fig (a).

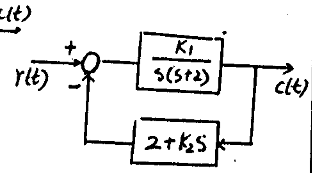


Fig (b).

(二) ⟨A⟩ Compare the two structures in Fig (a) and Fig (b) with respect to sensitivity to changes in overall gain due to changes in amplifier gain (K). Use $S_K^T \triangleq \frac{K}{T}\frac{dT}{dK}$ as the measure. Select H_1 and H_2 so that at the nominal values $C_1 = C_2$.

⟨i⟩ find $T_1 \triangleq \frac{C_1}{r}$ and $T_2 \triangleq \frac{C_2}{r}$

⟨ii⟩ compare $S_K^{T_1}$ with $S_K^{T_2}$.

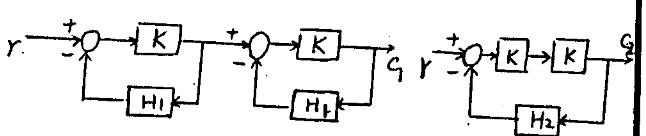


Fig (a) Fig (b).

⟨B⟩ For Fig (c), please find S_a^T, due to system parameter-variation. $T(s) \triangleq \frac{C(s)}{R(s)}$

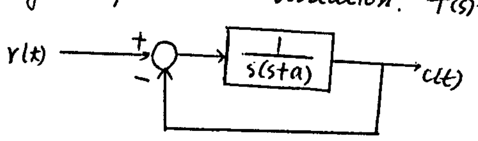


Fig (c)

(三) For the system

$$\begin{bmatrix}\dot{x}_1(t)\\ \dot{x}_2(t)\end{bmatrix} = \begin{bmatrix}-1 & 1\\ 2 & 0\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix} + \begin{bmatrix}0\\ 1\end{bmatrix} r(t)$$

$$c(t) = \begin{bmatrix}1 & 1\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}$$

please determine the state controllability, observability and stability of the system.

(四) For the following system, please find the stability and the steady-state output to a unit-step disturbance $d(t)$ for the different compensators $G_c(s)$.

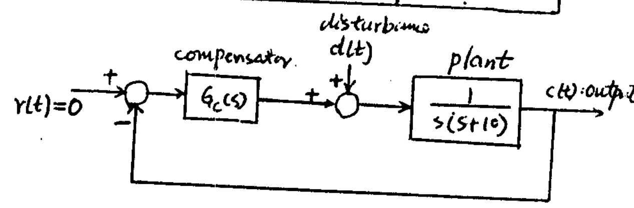
P : proportional compensation, $G_c(s) = K_p$, $K_p > 0$

I : integral compensation, $G_c(s) = \frac{K_i}{S}$, $K_i > 0$

PI : proportional-plus-integral compensation with $G_c(s) = K_p + \frac{K_i}{S}$, $K_p > 0$, $K_i > 0$

please find

compensator	stability ?	steady-state output
P	?	?
I	?	?
PI	?	?



(五) ⟨i⟩ please draw the (passive) phase-lag network and phase-lead network.

⟨ii⟩ what are advantages of phase-lag compensation ?

what are advantages of phase-lead compensation ?

⟨iii⟩ A unity feedback control system has an open-loop transfer function

$$G(s) = \frac{1}{s(s+K)} \qquad 0 < K < \infty$$

please sketch the root-locus diagram of the system.

⟨iv⟩ The open-loop transfer function of a feedback control system is given by

$$G(s)H(s) = \frac{K(s-1)}{s(s+2)}$$

please determine the values of K in which the closed-loop system is stable by means of the Routh-Hurwitz Criterion.