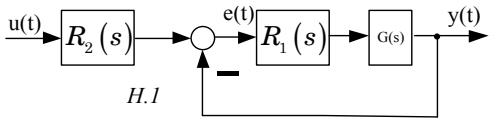
Hanoi University of Science and Technology School of Electrical Enginering	EXAM OF CONTROL THEORY (EE3359) Exam Number: 01 Time: 90 Minutes	Signature of Lecturer

1. Consider the System $G(s)$ and two Controllers are described by $R_1(s)$, $R_2(s)$ (Fig. 01).



H.1

a. We assume $u(t) = a1(t)(a:\text{Const}); G(s) = \dfrac{k}{s(1+T_2 s)^2}$; $k = 0,5$; $T_2 = 2$ and $R_1(s) = k_1$, $R_2(s) = k_2$ (k_1, k_2 are constant numbers). Please to find k_1, k_2 based on algebraic property to ensure the stability of Closed system and static error equals to 0 ?

b. We assume

$u(t) = a1(t)(a:\text{Const}); G(s) = \dfrac{k}{s(1+T_2 s)^2}$; $k = 0,5$; $T_2 = 2$; $R_1(s)$ is PID Controller and $R_2(s)$ is the first order inertia block. Please to find all of parameters $R_1(s)$, $R_2(s)$ to obtain the Stable System. Please to find the stability reserve of closed system.

c. We assume $u(t) = \sin(\omega t)1(t); G(s) = \dfrac{1}{s^2}; R_2(s) = 1$. Prove that If $R_1(s)$ is PI Controller then we do not obtain $\lim_{t\to\infty} e(t) = 0$. Please to find the control scheme satisfying $\lim_{t\to\infty} e(t) = 0$

2. Consider the System as follows:

$$\frac{d\underline{x}}{dt} = \begin{pmatrix} 1 & 0 & 1 \\ 0 & 2 & 1 \\ 0 & 1 & 1 \end{pmatrix}\underline{x} + \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}\underline{u}, \quad y = a\,x_1 + x_3$$

a) Please to check the Stability Property and Controllability Property?
b) Please to consider the Observability Property?.
c) $a = 1$, Please to find state feedback controller sastisfying the convergence speed of free state trajectory is slower than e^{-2t} and observer error is faster than e^{-2t} ;
d) Drawing the control system using state feedback control law and observer. Please to check the Controllability Property?

Notice: Students are able to use documents .

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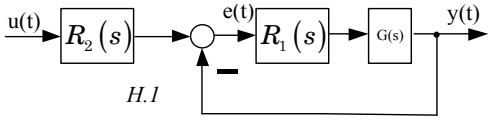

H.1

a. We assume $u(t) = a1(t)(a:\text{Const}); G(s) = \dfrac{k}{s(1+T_2 s)^2}$; $k = 10$; $T_2 = 1$ and $R_1(s) = k_1$, $R_2(s) = k_2$ (k_1, k_2 are constant numbers). Please to find k_1, k_2 based on algebraic property to ensure the stability of Closed system and static error equals to 0 ?

b. We assume

$u(t) = a1(t)(a:\text{Const}); G(s) = \dfrac{k}{s(1+T_2 s)^2}$; $k = 0,5$; $T_2 = 2$; $R_1(s)$ is PID Controller and $R_2(s)$ is the first order inertia block. Please to find all of parameters $R_1(s)$, $R_2(s)$ to obtain the Stable System. Please to find the stability reserve of closed system.

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2. Consider the System as follows:

$$\frac{d\underline{x}}{dt} = \begin{pmatrix} 2 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 2 & 2 \end{pmatrix}\underline{x} + \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}\underline{u}, \quad y = x_1 + a x_2$$

a) Please to check the Stability Property and Controllability Property?
b) Please to consider the Observability Property?.
c) $a = 1$, Please to find state feedback controller sastisfying the convergence speed of free state trajectory is slower than e^{-2t} and observer error is faster than e^{-2t} ;
d) Drawing the control system using state feedback control law and observer. Please to check the Controllability Property?

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