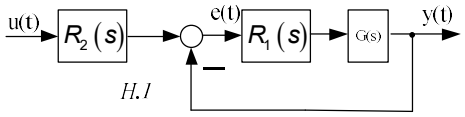
School of Electrical Engineering, Hanoi University of Science and Technology	EXAM OF CONTROL THEORY 1 (EE3280) Exam Number: 01 Time: 90 Minutes	Signature of Lecturer

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



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 Nyquist property to ensure the stability of Closed system and static error equals to 0 ?;

b. We assume

$$u(t) = a1(t)(a:\text{Const}); G(s) = \frac{k}{s(1+T_2 s)};\ k = 0{,}5;\ T_2 = 2;\ R_1(s)$$ 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.

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) Cho $a = 1$, Please to find state feedback controller satisfying the convergence speed of free state trajectory is slower than e^{-3t} and observer error is faster than e^{-3t};
d) Drawing the control system using state feedback control law and observer. Please to check the Controllability Property? Analysis?
e) Consider the systems $\frac{d\underline{x}}{dt} = \begin{pmatrix} 1 & 0 & 1 \\ 0 & 2 & 1 \\ 0 & 1 & 1 \end{pmatrix}\underline{x} + \begin{pmatrix} 1 & 1 \\ 0 & 2 \\ 1 & 2 \end{pmatrix}\underline{u}$. Applying the previous contents to find state feedback controller to stabilize System.

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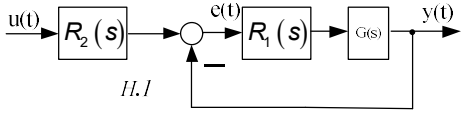
School of Electrical Engineering, Hanoi University of Science and Technology	EXAM OF CONTROL THEORY 1 (EE3280) Exam Number: 02 Time: 90 Minutes	Signature of Lecturer

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



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 Nyquist property to ensure the stability of Closed system and static error equals to 0 ?;

b. We assume

$$u(t) = a1(t)(a:\text{Const}); G(s) = \frac{k}{s(1+T_2 s)};\ k = 0{,}5;\ T_2 = 2;\ R_1(s)$$ 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.

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) Cho $a = 1$, Please to find state feedback controller satisfying the convergence speed of free state trajectory is slower than e^{-3t} and observer error is faster than e^{-3t};
d) Drawing the control system using state feedback control law and observer. Please to check the Controllability Property? Analysis?
f) Consider the systems $\frac{d\underline{x}}{dt} = \begin{pmatrix} 2 & 0 & 1 \\ 0 & 1 & 2 \\ 0 & 2 & 2 \end{pmatrix}\underline{x} + \begin{pmatrix} 1 & 1 \\ 0 & 2 \\ 1 & 2 \end{pmatrix}\underline{u}$. Applying the previous contents to find state feedback controller to stabilize System.

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