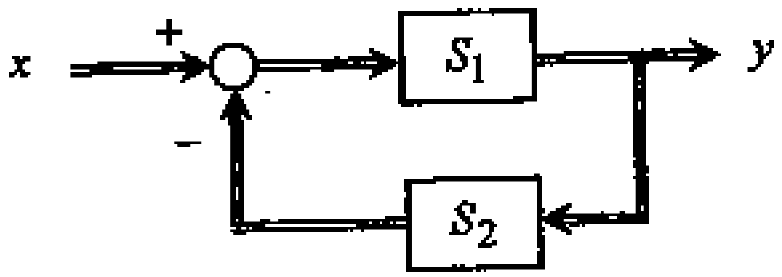
九十學年度 電機工程系 (所) 乙 組碩士班研究生招生考試

線性控制系統 4004

控制系統 科號 4106 共 2 頁第 1 頁 *請在試卷【答案卷】內作答

1. Consider the following feedback connection of two subsystems



Let $G_1(s)$ and $G_2(s)$ be the transfer function matrices of S_1 and S_2, respectively:

(a) Find the transfer function matrix $G(s)$ of the composite system.

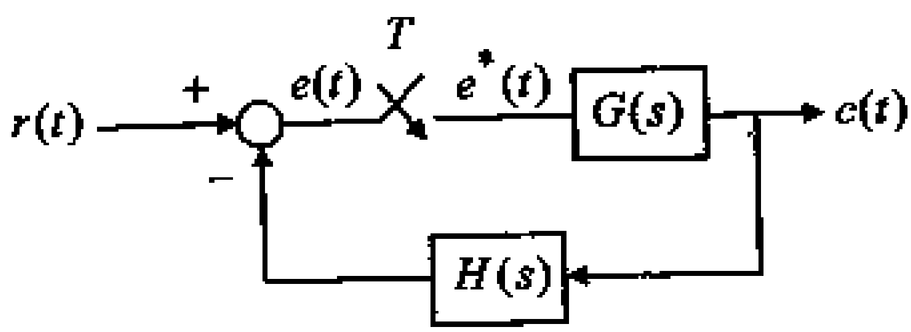
(b) Given

$$G_1(s)=\begin{bmatrix} -1 & \frac{1}{s} \\ \frac{1}{1+s} & \frac{-2-s}{1+s} \end{bmatrix},\quad G_2(s)=\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

find $G(s)$ and explain whether $G(s)$ is qualified for practical application.

(c) What is the necessary and sufficient condition for $G(s)$ to be proper? (20%)

2. Consider the following discrete data system with an ideal sampler in the forward path



(a) Find the transfer function between $r^*(t)$ and $c^*(t)$ in z transform form, i.e., $C(z)/R(z)=$?

(b) If

$$H(s)=1,\quad G(s)=\frac{10}{s(s+5)}$$

and the sampling period T=0.1sec, find $C(z)/R(z)=$? (20%)

3. Consider a linear system described by the equations

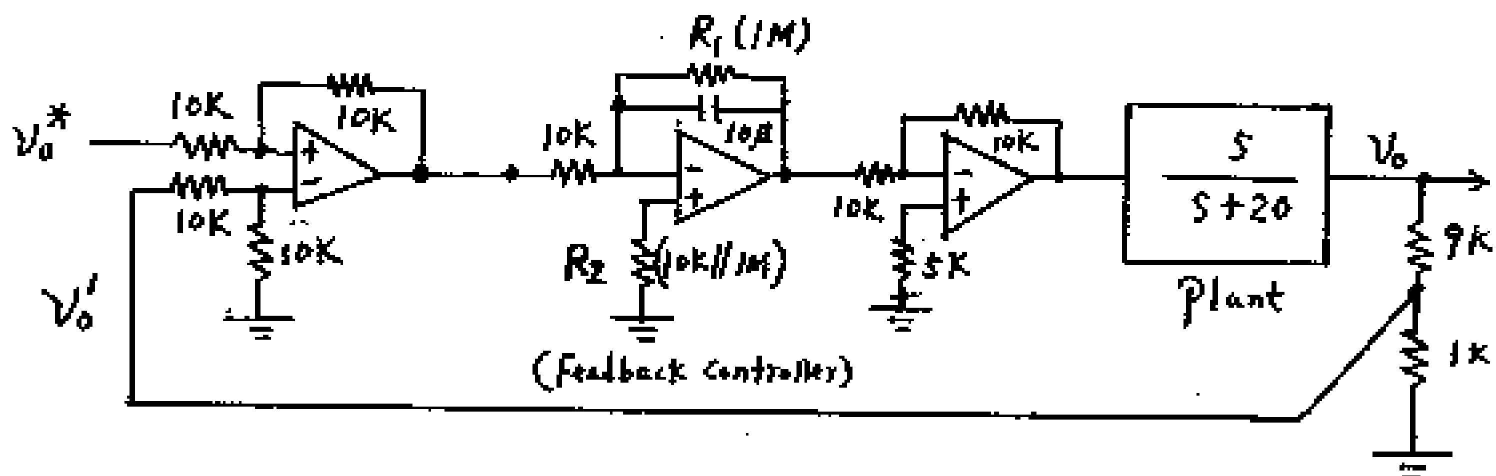
$$\dot{x} = \begin{bmatrix} 1 & 2 & 0 \\ 3 & -1 & 1 \\ 0 & 2 & 0 \end{bmatrix} x + \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix} u$$

$$y = [0 \quad 0 \quad 1]\, x$$

How do you design a state observer so that the eigenvalues of the system matrix of the observer are at $-4, -3 \pm j1$? (15%)

4. In the above problem, suppose an observer-based state feedback $u = F\hat{x}$ is employed to compensate the system so that all the eigenvalues of the system matrix are all at -2, where $\hat{x}$ denotes the estimated state vector. How do you specify F? (15%)

5. A control system is realized using OP Amps as shown:
   (1) Draw the corresponding control system block diagram and express the transfer functions of all blocks.
   (2) Describe the type of this controller.
   (3) Describe the functions of resistors R_1 and R_2 in this circuit. (15%)



6. (1) Determine the stability of the following difference equations:

(a) $y_n - 2.0 y_{n-1} + 2.0 y_{n-2} = 0$

(b) $y_n - 2 y_{n-1} + y_{n-2} = 10 x_{n-1}$

(2) For the discrete control system block diagram as shown, find the range of k_p for absolute stability. (15%)