大同大學97學年度研究所碩士班入學考試試題

考試科目：控制系統　　所別：電機工程研究所　　

註:本次考試 不可以參考自己的書籍及筆記;不可以使用字典;不可以使用計算器。

1. (14%) Consider the system shown in **Fig. P-1.** Let T(*s*) =Y(*s*)/R(*s*) denote the transfer function. Derive the transfer function T(*s*) by using Mason's signal flow gain formula.

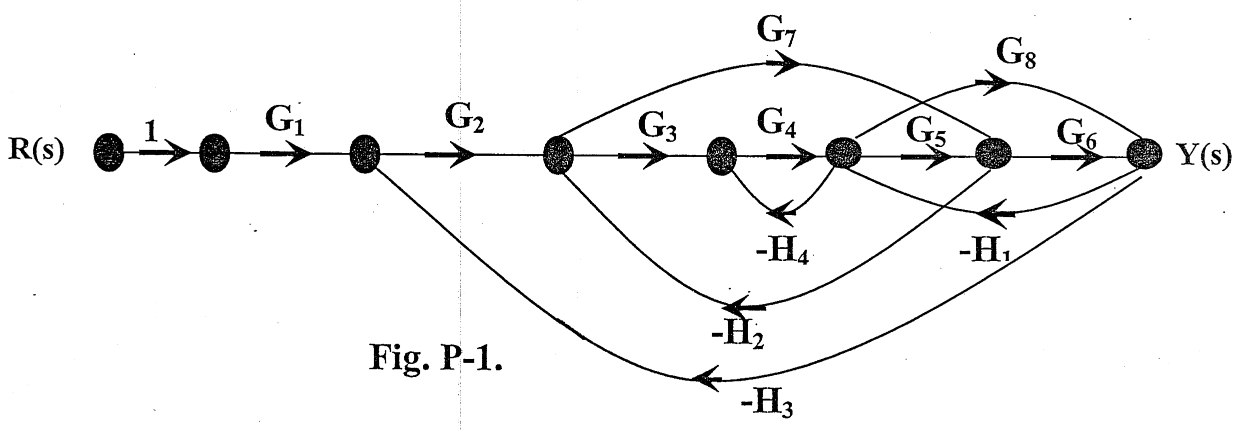
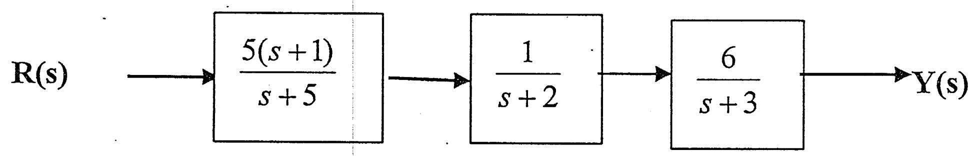


Fig. P-1.

2. Consider the following block diagram model of an open-loop system.



(a) (12%) Suppose the state variable differential equation of the system is obtained as

$$\frac{dx}{dt} = \begin{bmatrix} -3 & k_1 & k_2 \\ 0 & -2 & k_3 \\ 0 & 0 & k_4 \end{bmatrix} x + \begin{bmatrix} 0 \\ 5 \\ 1 \end{bmatrix} r \text{ , } y = [1 \quad 0 \quad 0]x$$

Find k_1, k_2, k_3, and k_4.

(b) (12%) Suppose the state variable differential equation of the system is obtained as

$$\frac{dx}{dt} = \begin{bmatrix} -3 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & -5 \end{bmatrix} x + \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} r \text{ , } y = [k_5 \quad k_6 \quad k_7]x$$

Find k_5, k_6, and k_7.

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3. (12%) Determine the condition on $b_{11}, b_{12}, b_{21}, b_{22}, c_{11}, c_{12}, c_{21}$, and c_{22} so that the following system is completely controllable and observable.

$$\frac{d\mathbf{x}}{dt} = \mathbf{A}\mathbf{x} + \mathbf{B}u\,,\quad y = \mathbf{C}\mathbf{x}$$

$$\mathbf{A} = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \qquad \mathbf{B} = \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} \qquad \mathbf{C} = \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix}$$

4. Consider the continuous-time system with the following differential equation

$$\frac{d^2 y(t)}{dt^2} = u(t)$$

(a) (5%) Determine the state-space representation of the above continuous-time system.
(b) (10%) Describe the discrete-time state-space representation of the above continuous-time system with the sampling period h.
(c) (10%) Determine the transfer function, poles, and zeros of the above sampled-data (or discrete-time) system with the sampling period h=1, respectively.

5. Consider the discrete-time system with the transfer function

$$H(z) = \frac{z^{-1} + z^{-2}}{2(1 - z^{-1} + z^{-2})}$$

(a) (10%) Determine the state-space representation of the above discrete-time system.
(b) (5%) Determine a state-feedback controller such that the characteristic equation of the closed-loop system is $z^2 + p_1 z + p_2 = 0$. (in terms of p_1 and p_2)
(c) (10%) Using the results of (b), find the control strategy to achieve the purpose of deadbeat control.

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