大同大學95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. Consider the system shown in **Fig. P-1a.** Let $T(s)$ denote the closed loop transfer function, i.e.,$T(s) = Y(s)/R(s)$.

(1) Find the S_α^T (the sensitivity of the $T(s)$ to the variation in α). (8%)

(2) Find the region in the K versus α plane for the system to be asymptotically stable (Use K as the vertical axis andα as the horizontal axis.) (8%)

(3) Let K =α= −1. It is assumed that every subsystem is completely characterized by its transfer function. If all initial conditions are zero, will the output $y(t)$ is bounded for any bounded $r(t)$? What if initial conditions are not zero ? (Explain !) (8%)

(4) Let K=α=1. It is assumed that every subsystem is completely characterized by its transfer function. **Fig. P-1b** shows the state diagram of the system in **Fig. P-1a**. Find the $\boldsymbol{k}_1$, $\boldsymbol{k}_2$, $\boldsymbol{k}_3$, and $\boldsymbol{k}_4$ shown in **Fig. P-1b**. (8%)

(5) In problem (4), find the state and output equations in vector-matrix form: $\dot{\mathbf{x}}(t) = A\mathbf{x}(t) + Br(t)$ and y(t)=C**x**(t), respectively, where $\mathbf{x}(t) \equiv [\, x_1(t) \;\; x_2(t)\,]^{\mathrm{T}}$. (5%)

(6) In problem (5), find the eigenvalues of this system. (5%)

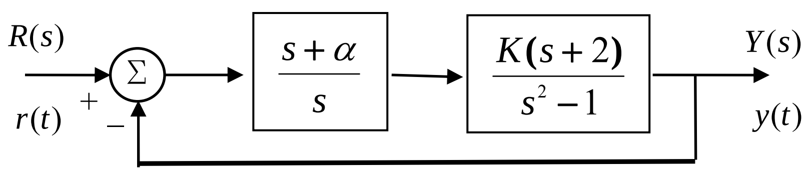

Fig. P-1a

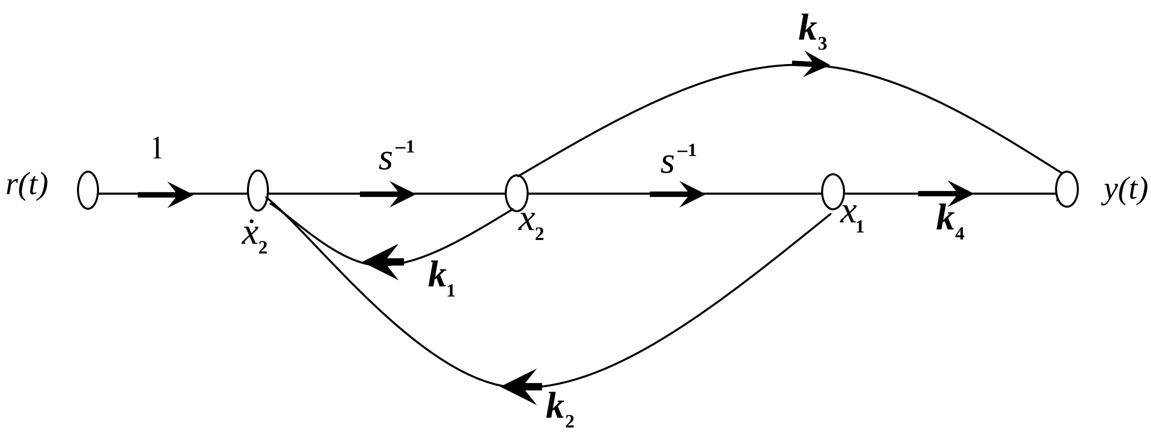

Fig. P-1b

TO BE CONTINUED

2. Find the following transfer functions of the signal-flow graph shown in **Fig. P-2**. (8%)

$$\left.\frac{Y_1(s)}{R_1(s)}\right|_{R_2=0} \quad \textbf{and} \quad \left.\frac{Y_2(s)}{R_1(s)}\right|_{R_2=0}$$

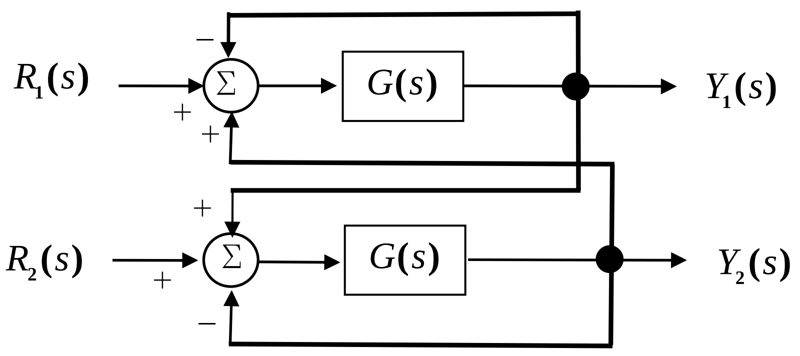

Fig. P-2

3. A continuous-time system with the transfer function

$$G(s) = \frac{1}{s^2}$$

is sampled with the sampled period $h = 1$.

(a) Determine the discrete state equation of the sampled-data (or discrete-time) system. (8%)

(b) Determine the transfer function, poles, and zeros of the sampled-data system, respectively. (8%)

4. Given the system

$$\mathbf{x}(k+1) = \begin{bmatrix} 0 & 1 & 2 \\ 0 & 0 & 3 \\ 0 & 0 & 0 \end{bmatrix} \mathbf{x}(k) + \begin{bmatrix} 0 \\ 1 \\ 0 \end{bmatrix} u(k)$$

(a) Determine a control sequence $u(k)$ such that the system is taken from the initial state $\mathbf{x}^{\mathrm{T}}(0) = \begin{bmatrix} 1 & 1 & 1 \end{bmatrix}$ to the origin. (8%)

(b) Explain whether it is possible to find a control sequence $u(k)$ such that the state $\begin{bmatrix} 1 & 1 & 1 \end{bmatrix}^{\mathrm{T}}$ is reached from the origin. (8%)

5. The discrete-time double integrator system can be described as follows:

$$\mathbf{x}(k+1) = \begin{bmatrix} 1 & 0.5 \\ 0 & 1 \end{bmatrix} \mathbf{x}(k) + \begin{bmatrix} 0.125 \\ 0.5 \end{bmatrix} u(k),$$

where $u(k) = -\begin{bmatrix} \ell_1 & \ell_2 \end{bmatrix} \mathbf{x}(k)$.

(a) In order to satisfy the desired characteristic equation $z^2 + p_1 z + p_2 = 0$, please determine the condition(s) on ℓ_1, ℓ_2 (in terms of p_1 and p_2). (10%)

(b) Find the controller for a deadbeat response. (8%)

THE END