大同大學 98 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 PI feedback system shown in Fig. P-1, where $Y(s)$ is the output and $R(s)$ is the input.

   (a) (8%) Use Routh's criterion to determine the region in the K versus K_I plane for which the system is stable (Use K as the vertical axis and K_I as the horizontal axis.)

   (b) (8%) What condition must PI controller gains (K , K_I) satisfy so that the system output can track a step reference input with constant steady-state error ?

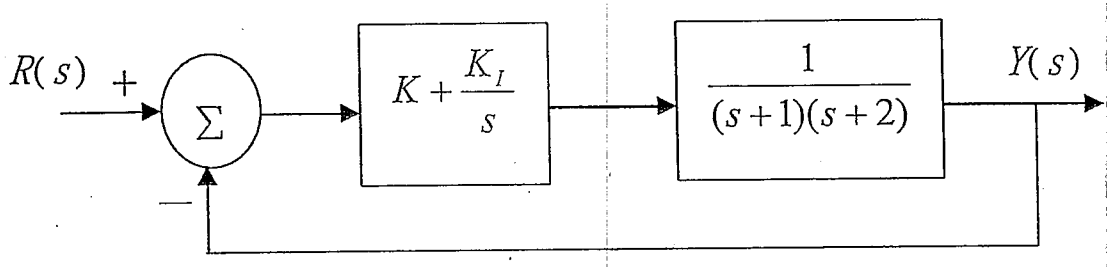

Fig. P-1

2. Consider the equivalent systems shown in Figs. P-2a and P-2b, where k_1, k_2, and k_3 are constant parameters to be determined.

   (a) (8%) Using the state variables x_1 and x_2, write the state equations for the system of Fig. P-2a.

   (b) (10%) Using the state equations from (a) and the equivalent system of Fig. P-2b, find k_1, k_2, and k_3 so that the determinant of the controllability matrix is 1.

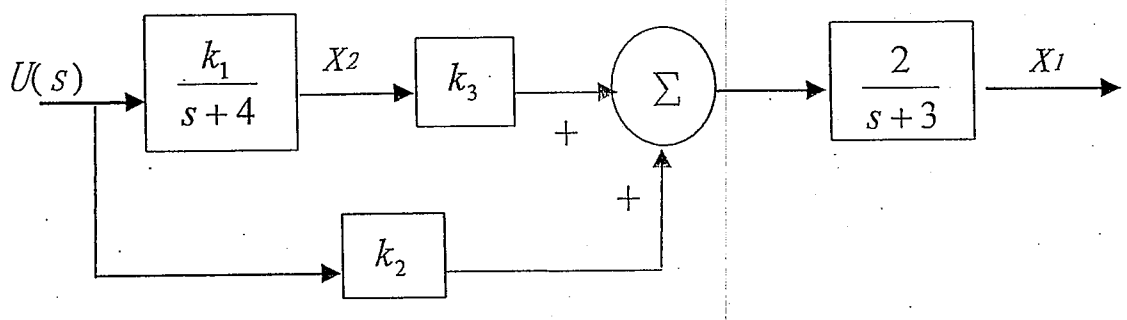

Fig. P-2a

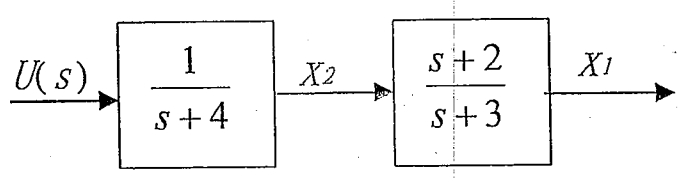

Fig. P-2b

<背面試題>

〈接前頁〉

3. A certain system $G(s)$ is represented by the asymptotic Bode diagram shown in Fig. P-3.

(a) (8%) Find $G(s)$.

(b) (8%) Find the time response of this system to a unit step input (assuming zero initial conditions).

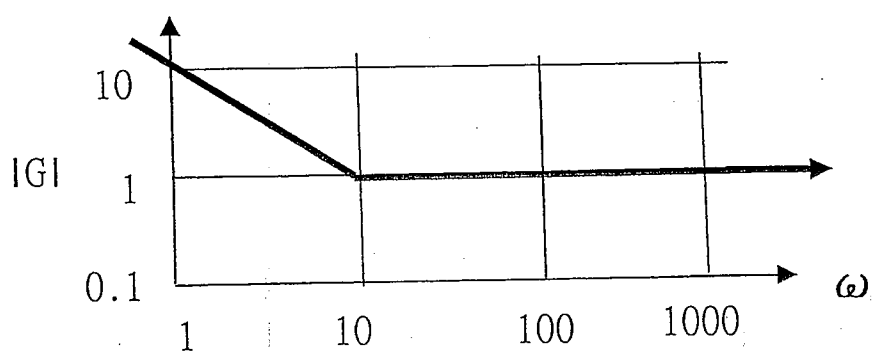

Fig. P-3

4. Consider the discrete-time system

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

where a state-feedback controller can be described as $u(k)=-[\ell_1 \quad \ell_2]x(t)$.

(a) (10%) Determine a state-feedback controller such that the closed-loop poles are in the origin (i.e., 0 and 0).

(b) (10%) Find the control sequence $u(0)$ and $u(1)$ if the discrete-time system has the initial state $\mathbf{x}(0)=[1 \quad 1]^T$.

5. Let the process be the DC motor with the state-space model

$$\frac{dx(t)}{dt}=\begin{bmatrix}-1 & 0\\ 1 & 0\end{bmatrix}x(t)+\begin{bmatrix}1\\ 0\end{bmatrix}u(t)$$

$$y(t)=[0 \quad 1]x(t)$$

(a) (10%) Describe the discrete-time state-space representation of the above continuous-time system with the sampling period h.

(b) (10%) Determine the transfer function, poles, and zeros of the above sampled-data (or discrete-time) system with the sampling period h, respectively.

6. (10%) Please distinguish five important considerations in any control system design problem.