大同大學96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-1.** Let $T_1(s) = Y(s)/R(s)|_{N(s)=0}$ and $T_2(s) = Y(s)/N(s)|_{R(s)=0}$ denote the transfer functions.

   (1) (8%) Derive the transfer functions $T_1(s)$ and $T_2(s)$.

   (2) (8%) Find the output response $y(t)$ when $N(s)=0$ and $r(t)=u_s(t)$ ($u_s(t)$ is a unit step function).

   (3) (10%) Find the values of a and b such that when $n(t)=u_s(t)$ and $r(t)=0$, the system is stable and the steady-state value of $y(t)$ is equal to zero.

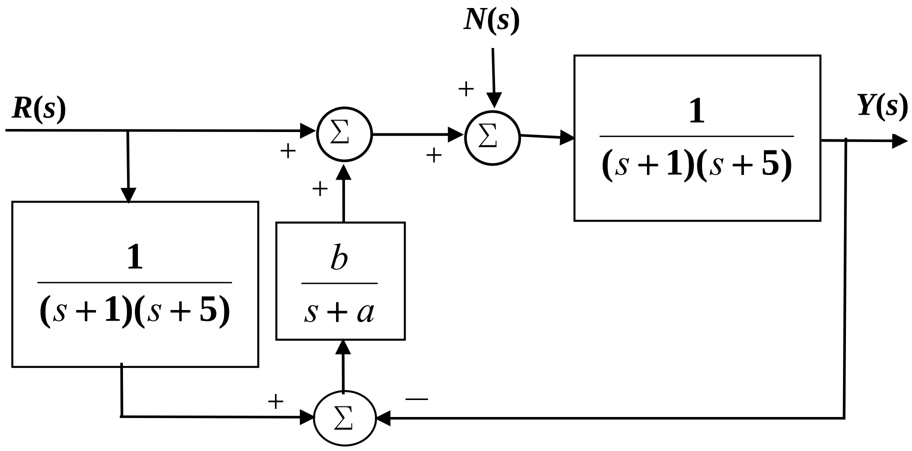

Fig. P-1

2. (8%) Consider the following closed-loop characteristic equation

$$s^2+(3+K)s+4+2K=0$$

   Find those values of K for which all poles have a real part less than -1.

3. Consider the following transfer function, which is the product of two first-order transfer functions.

$$\frac{Y(s)}{U(s)} = \left(\frac{s+2}{s+1}\right)\left(\frac{s+4}{s+3}\right)$$

   (1) (8%) Draw the state diagram of the transfer function by direct decomposition. Assign the sate variables from right to left for $x_1, x_2, \ldots$.

   (2) (8%) Write the dynamic equations from the state diagram and show that the equations are in CCF (controllability canonical form).

TO BE CONTINUED

4. Consider the continuous-time system

$$\dot{\mathbf{x}}(t) = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \mathbf{x}(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t-\tau)$$
$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix}.$$

Assume that the system is sampled with the sampled period $h = 1$, where $0 \leqq \tau < h$.

(1) (10%) Determine the transfer function, poles, and zeros of the sampled-data system (or discrete-time) with a time delay $\tau = 0$, respectively.

(2) (10%) Determine the transfer function, poles, and zeros of the sampled-data system (or discrete-time) with a time delay $\tau = 0.5$, respectively.

5. (15%) Consider the discrete-time system with the transfer function

$$H(z) = \frac{z^{-1}(1-2z^{-1})}{1-3z^{-1}}$$

Please determine the controller $u(k)$ so that all the poles of the closed-loop system (as shown in **Fig. P-2)** are at the origin and the steady-state error is zero if the reference input signal $r(k)$ is a unit step.

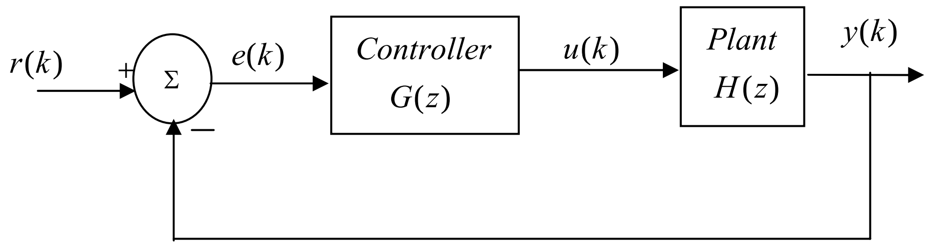

Fig. P-2

6. Suppose that the mathematical model of a discrete-time system can be represented as the following difference equation

$$y(k+2) - 2y(k+1) + y(k) = 0.5u(k+1) + 0.5u(k)$$

(1) (8%) Describe the state space representation of the above discrete-time system.

(2) (7%) Using the result of (1), please determine a state-feedback controller such that the desired characteristic equation of the closed-loop system is $z^2 + p_1 z + p_2$ (in terms of p_1 and p_2).

THE END