

國立臺灣科技大學103學年度碩士班招生試題
系所組別： 自動化及控制研究所碩士班乙組
科目： 控制系統

(總分為100分)

1. A block diagram of a servomotor with tachometer feedback is shown as Figure 1.
- When $D(s) = 0$, find the error signal $E(s)$ in the presence of the reference input $X(s)$. (7%)
 - When $X(s) = 0$, find the error signal $E(s)$ in the presence of the disturbance input $D(s)$. (7%)
 - When $X(s)$ is a unit step and $D(s) = 0$, calculate the steady-state error of the system. (7%)
 - When $D(s)$ is a unit ramp and $X(s) = 0$, calculate the steady-state error of the system. (7%)

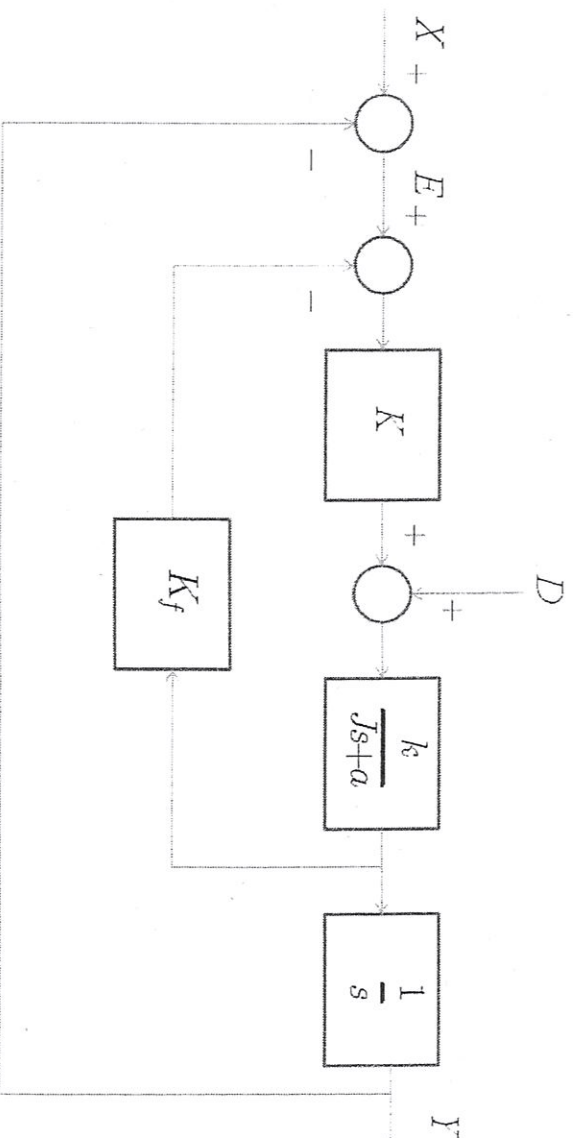
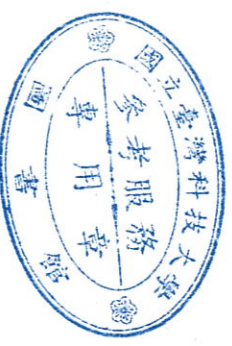


Figure 1



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2.

(a) Consider the characteristic equation of a linear time-invariant closed-loop system: $s^3 + (k_3 + 3)s^2 + (k_2 + 4)s + k_1 = 0$, where k_1, k_2 , and k_3 are real constants. Using Routh-Hurwitz criterion, determine the constraints for k_1, k_2 , and k_3 so that the closed-loop system is stable. (7%)

(b) Using Routh-Hurwitz criterion, determine the stability of the closed-loop system that has the characteristic equation:

$$s^4 + 2s^3 + 10s^2 + 20s + 5 = 0. \quad (7\%)$$

3. (8%) A unity feedback control system has the open-loop transfer function:

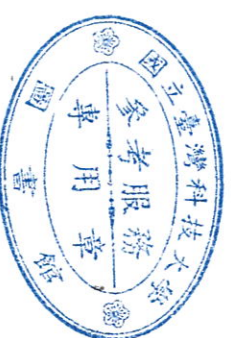
$$G(s) = \frac{A}{s(s+a)}.$$

Compute the sensitivity of the closed-loop transfer function to changes in the parameter A .

4. Consider a system as $\dot{x} = \begin{bmatrix} -3 & -2 \\ 0 & 1 \end{bmatrix} x + \begin{bmatrix} 2 \\ 1 \end{bmatrix} u$ and $y = \begin{bmatrix} 1 & 1 \end{bmatrix} x$.

(a) (10%) Find the transfer function of the system.

(b) (10%) Find $x_1(t)$ and $x_2(t)$ when $u(t)=0$ for $t \geq 0$, $x_1(0)=1$ and $x_2(0)=2$.



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5. Consider a stable control system with unity feedback as follows (figure 2)

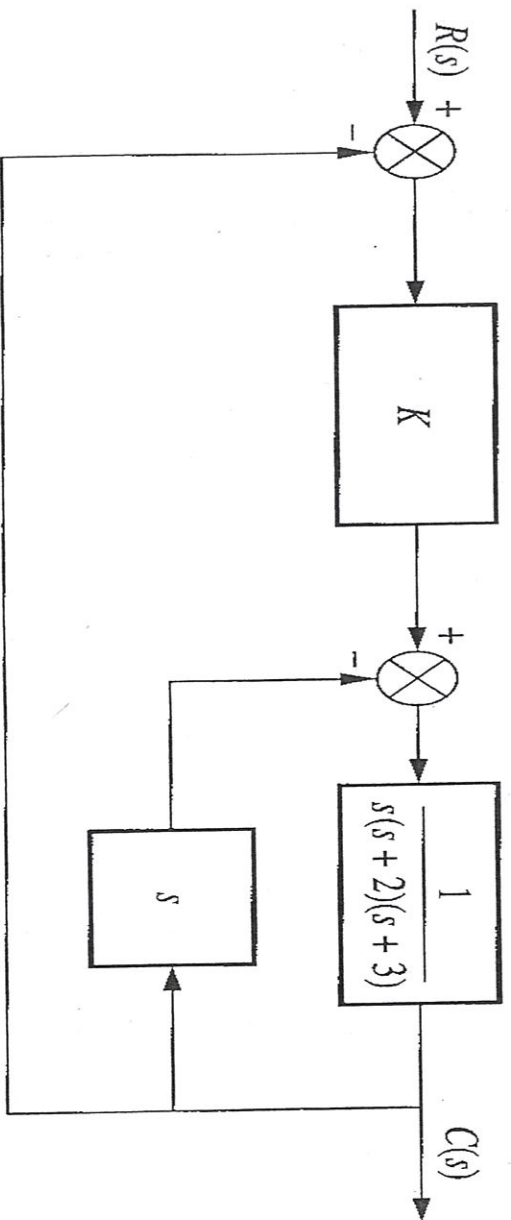


Figure 2

- (a) (5%) What type is the system?
 (b) (5%) Please find the corresponding error constant.

