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.

   (a) When $D(s) = 0$, find the error signal $E(s)$ in the presence of the reference input $X(s)$. (7%)

   (b) When $X(s) = 0$, find the error signal $E(s)$ in the presence of the disturbance input $D(s)$. (7%)

   (c) When $X(s)$ is a unit step and $D(s) = 0$, calculate the steady-state error of the system. (7%)

   (d) When $D(s)$ is a unit ramp and $X(s) = 0$, calculate the steady-state error of the system. (7%)

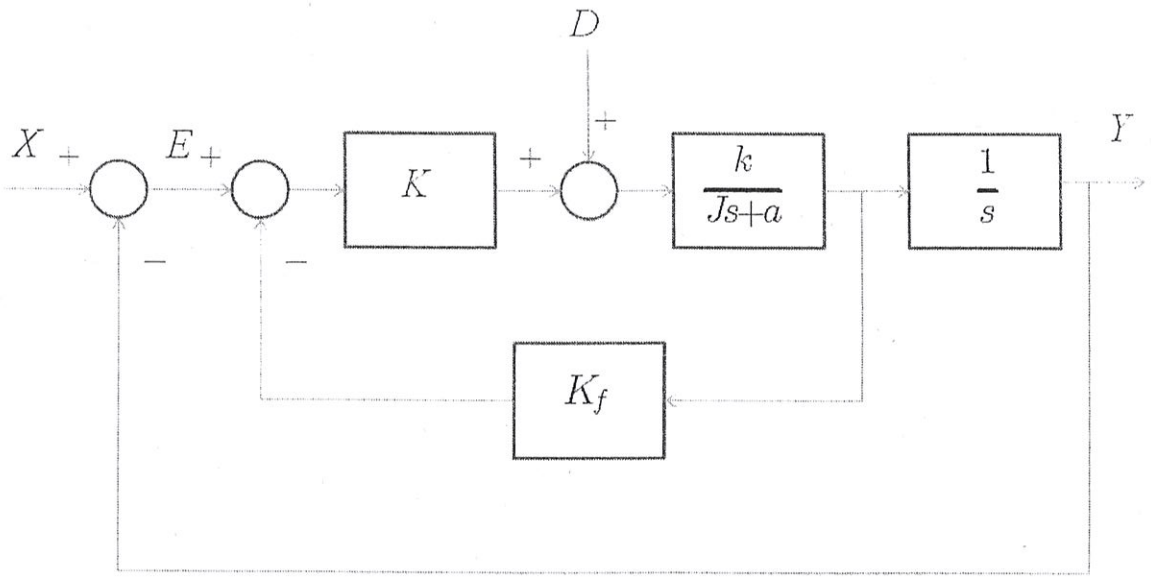

Figure 1

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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:

$s^4+2s^3+10s^2+20s+5=0$. (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)

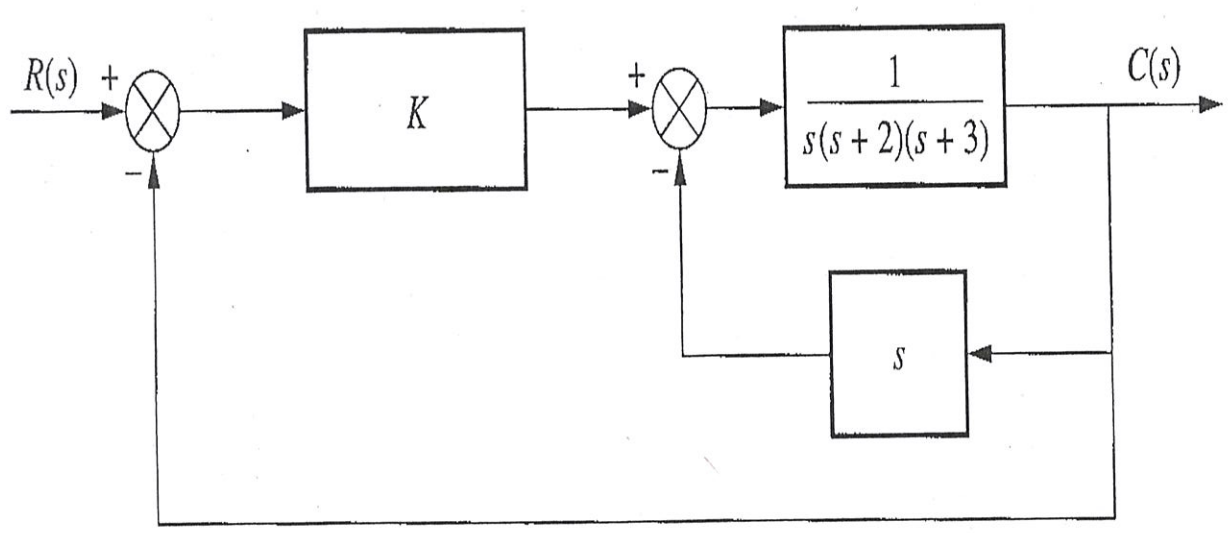

Figure 2

(a) (5%) What type is the system?

(b) (5%) Please find the corresponding error constant.

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6. Given the following Bode plot (figure 3) for a system $KG(s)$ with K=1.

(a) (5%) Please estimate the phase margin of the system.

(b) (5%) For what range of K value the system will be stable?

(c) (10%) Please write an approximate transfer function for $G(s)$.

Be sure to state how you get those numbers.

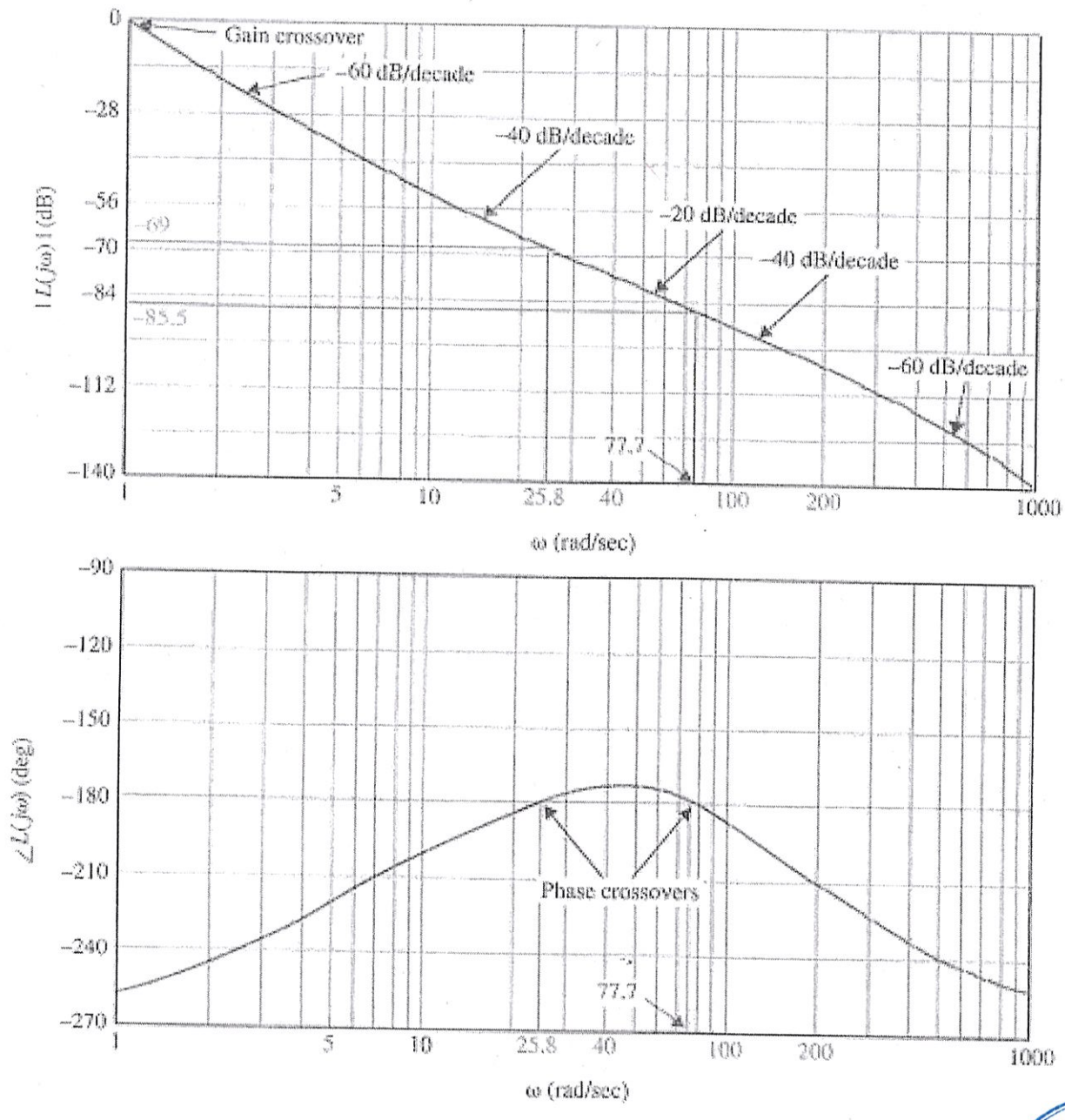

Figure 3.