國立臺灣海洋大學 101 學年度研究所碩士班暨碩士在職專班入學考試試題

考試科目：控制系統

系所名稱：通訊與導航工程學系碩士班控制組　　* 可使用計算器

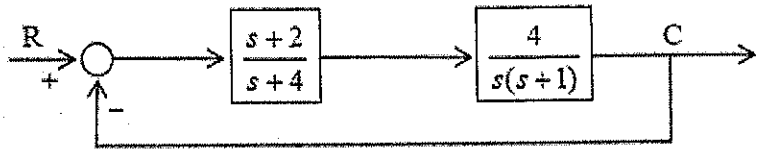
1.答案以橫式由左至右書寫。2.請依題號順序作答。

1. (20%) Consider a single-loop feedback control system has the loop transfer function

$$L(s) = G(s)H(s) = \frac{K}{s(s+2)(s+10)}.$$

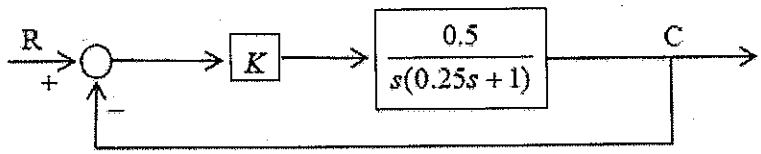
(a) Draw the Nyquist plot of $L(s)/K$ for $\omega = \infty$ to $\omega = 0$.
(b) Find the range of K such that the system is stable.

2. (20%) A unit feedback system is given as follow:



Find the steady-state error when the input is:
(a) unit-step function
(b) unit-ramp function
(c) unit-parabolic function

3. (20%) Consider a servo motor position control system as follow:



(a) Find the range of K such that the system is stable.
(b) For a unit-step input, find the value of K such that the system has critical-damped response.
(c) Continue from part (b). Find the critical-damped response and steady-state value of the system.

4. (20%) Consider the system with

$$G(s) = \frac{K}{(T_1 s+1)(T_2 s+1)};\ \text{where } T_1 = 1,\ T_2 = 0.5.$$

(a) Construct root loci for $K \geq 0$.
(b) Locate the roots for K=0, 0.125, and ∞.
(c) If we add a zero at −5, draw the new root locus and describe the effect on system stability.
(d) If we add a pole instead of a zero at −5, draw the new root locus and describe the effect.

5. (20%) Consider a system with following dynamic equations:

$$\dot{X}(t) = AX(t) + Bu(t),\ \ y(t) = CX(t) + Du(t)$$

where $X(t) = \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix}$, $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, $C = \begin{bmatrix} 1 & 0 \end{bmatrix}$, $D = [0]$.

(a) Assume that the initial conditions of x_1 and x_2 are $x_1(0) = 1$ and $x_2(0) = 1$, respectively. Find the output $y(t)$ for $t \geq 0$, where $u(t)$ is the input of the system and is a unit-step function.
(b) Is this system stable with step function input? Explain why.