

國立臺北科技大學九十九學年度碩士班招生考試

系所組別：1112 機電整合研究所甲組

第二節 自動控制 試題 (選考)

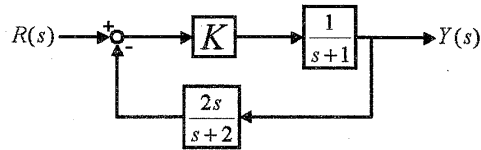
第一頁 共一頁

注意事項：

1. 本試題共 5 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

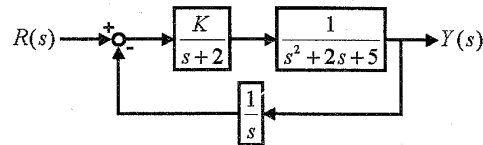
1. (10%) If the unit-step response of a system is $y(t) = [1 - e^{-at}(1 + at)] \cdot u_s(t)$, what will be the system's response to the input $u(t) = \frac{1}{a^2} e^{-at} u_s(t)$? (Here, $u_s(t)$ denotes a unit-step function.)

2. Given the system shown below:



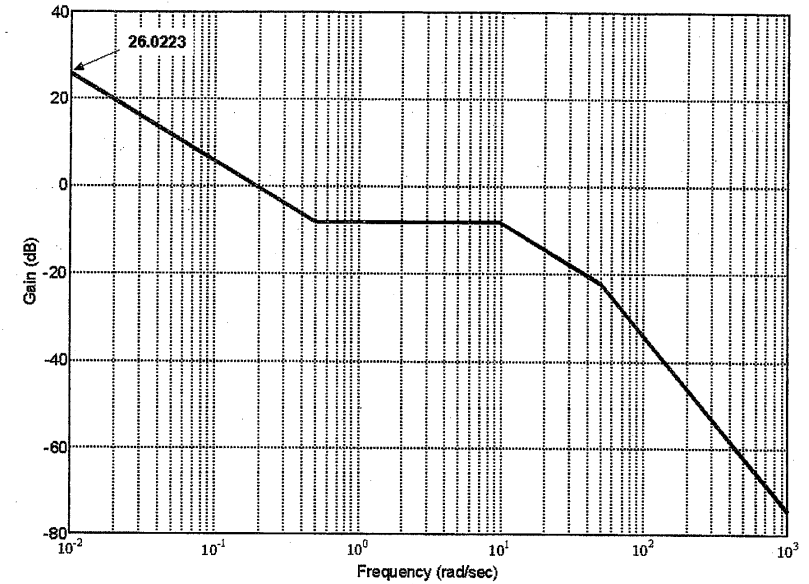
- (a) (5%) Find all the values of K that the closed-loop system is stable.
- (b) (10%) Find the steady-state error for the closed-loop system if the input is $r(t) = \frac{1}{2}(1 - e^{-2t}) \cdot u_s(t)$.

3. Draw the root-locus for the closed-loop system shown below:



- (a) (5%) Sketch the portions of the real axis corresponding to the positive root-locus.
- (b) (5%) Sketch the asymptotes for $K \rightarrow \infty$.
- (c) (5%) Estimate all departure angles.
- (d) (5%) Find all breakaway points.
- (e) (5%) Compute the crossings of the imaginary axis.
- (f) (5%) Sketch the root-locus.

4. Given the asymptotic plot of $|G(j\omega)|$ for the transfer function $G(s)$ as shown below:



- (a) (10%) Determine the transfer function $G(s)$.
- (b) (5%) Sketch the phase plot of $G(s)$.

5. Given the system,

$$\frac{dx(t)}{dt} = Ax(t) + Bu(t), \quad y(t) = Cx(t)$$

where

$$A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}, \quad C = [1 \quad 1], \quad \text{and} \quad x(0) = \begin{bmatrix} 1 \\ 0 \end{bmatrix}.$$

- (a) (10%) Find the state transition matrix.
- (b) (10%) Find the unit-step response $y(t)$.
- (c) (10%) If $u(t) = -[k_1 \quad k_2] \cdot x(t)$, where k_1 and k_2 are real constants. Select k_1 and k_2 such that the poles of the state-feedback system are relocated to $-1 \pm j$.