

國立臺北科技大學

九十四學年度電機工程系碩士班入學考試

控制系統試題

填准考證號碼

第一頁 共二頁

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注意事項：

1. 本試題共五題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. Consider the ideal OP-amp circuit realization shown in Fig. 1.
 - (a) Find the transfer function. (15%)
 - (b) Verify the possible types of the controller. (5%)

2. Consider the unity negative feedback system with the open loop transfer function $G(s) = \frac{K}{s(s+5)}$.
 - (a) Sketch the Nyquist plot corresponding to the Nyquist path shown in Fig. 2. (10%)
 - (b) Determine the closed-loop system stability by using Nyquist stability criterion for positive K . (10%)

3. Consider a unity feedback system with the plant $G(s) = K/s^2(1+0.1s)$ and the controller $D(s)$, where $D(s) = \frac{(aTs+1)}{(Ts+1)}$ and $a > 1$.
 - (a) Justify the type of compensation. (5%)
 - (b) Find the value of K such that the steady-state error to a unit parabolic-function input is equal to 1/5. (5%)
 - (c) If the phase provided by controller is 30° , please find the value of a .

(5%)

(d) If $\omega = 5.2$ rad/sec is the required cross-over frequency, calculate T . (5%)

4. For the system

$$\dot{x} = \begin{bmatrix} -5 & -6 \\ 1 & 0 \end{bmatrix} x + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$y = [1 \quad 1] x$$

- (a) Determine the observability and controllability of the given system. (5%)
- (b) Design a state feedback law $u = -Kx + r$ such that the closed loop system is unobservable. (10%)
- (c) Is it possible to design a state feedback law such that the closed loop system is uncontrollable? Justify your answer. (5%)

5. For the discrete-equivalent rule $s = (z-1)/T$ where s and z represent the differential and difference operators respectively, and T is the sampling period, show that the dynamic system

$$\begin{cases} \dot{x}(t) = Ax(t) + Be(t) \\ y(t) = Cx(t) + De(t) \end{cases}$$

can be digitized equivalently in the form of

$$\begin{cases} x(k+1) = \Phi x(k) + \Gamma e(k) \\ y(k) = Hx(k) + J e(k) \end{cases}$$

where $\Phi = I + AT$, $\Gamma = BT$, $H = C$, $J = D$. (20%)

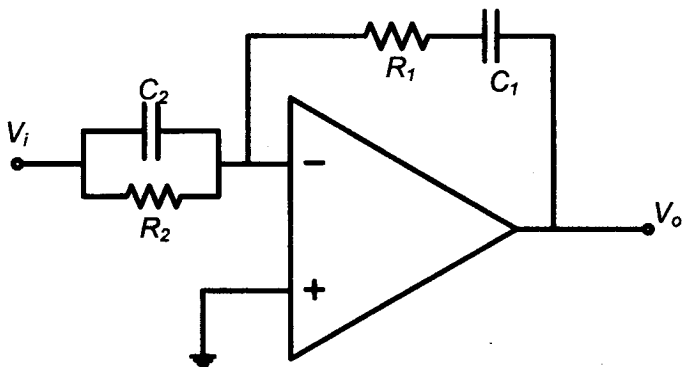


Fig. 1 OP-amp Circuit realization for Problem 1.

注意：背面尚有試題

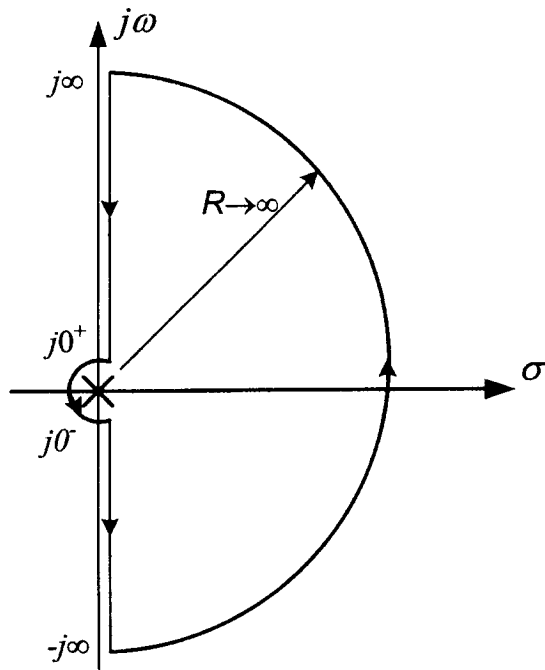


Fig. 2 Nyquist path for the system in Problem 2.