

國立高雄應用科技大學
101 學年度碩士班招生考試
電機工程系

准考證號碼 (考生必須填寫)

控制系統 (乙組)

試題 共 2 頁，第 1 頁

- 注意：a. 本試題共 5 題，每題 20 分，共 100 分。
b. 作答時不必抄題。
c. 考生作答前請詳閱答案卷之考生注意事項。

1. For a controlled unity feedback system with forward transfer function:

$$G_c(s)G_p(s) = \frac{k(s+2)}{s+20} \frac{1}{s(s-1)}$$

Sketch its root locus and find the range of k for which the system is stable.

2. For the system described by the equation:

$$\dot{x}(t) = \begin{bmatrix} 0 & 1 \\ -8 & -4 \end{bmatrix} x(t) + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t)$$

Design a state feedback gain matrix $u(t) = -kx(t)$ so that:

- (a) New system has the closed-loop poles with damping coefficient $\xi = 0.707$
(b) Its step response peak time $t_p \leq 3.14$ sec

3. For a discrete control system as follow:

$$x(k+1) = \begin{bmatrix} 0 & 1 \\ -0.16 & -1 \end{bmatrix} x(k) + \begin{bmatrix} 1 \\ 1 \end{bmatrix} u(k)$$

$$y(k) = [1 \quad 0] x(k) \quad x(0) = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$$

- (a) Prove that the system is stable
(b) Find its state transition matrix
(c) If $u(k) = 0$, find its steady state output $y(\infty)$

4. Assume the transfer function of a linear control system is:

$$\frac{Y(s)}{R(s)} = \frac{s + \alpha}{s^3 + 7s^2 + 14s + 8}$$

- Determine α so that the system is either uncontrollable or unobservable
- With the value of α found in (a), define the system state variable and write its state equation so that one of the states is uncontrollable

5. A negative unity feedback system has the forward path transfer function:

$$G(s) = \frac{100e^{-T_d s}}{s(s^2 + 10s + 100)} \quad \text{where } T_d \text{ is the time delay in sec}$$

- If $T_d = 0$, what is the phase margin(PM) of this system
- If $T_d \neq 0$, determine the maximum time delay T_d allowed for the closed loop system to be stable