國立高雄應用科技大學
100 學年度碩士班招生考試
電機工程系（乙組）

准考證號碼□□□□□□□□□□ （考生必須填寫）

控制系統

試題　共 2 頁，第 1 頁

注意：a. 本試題共 6 題，每題　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. (15%) An unity feedback system with loop transfer function:

$$G(s)H(s)=\frac{k_1 s+k_2}{s^2+2s-1}$$

Determine the $[k_1,k_2]$ pair so that the following condition hold:

(a) Steady state error for step input $e_{ss}|_{\frac{1}{s}} \le 0.1$

(b) Maximum overshoot $po \le 5\%$

(c) Settling time $t_s < 1.5\text{sec}$

2. (15%) An unity feedback system formed by open loop transfer function:

$$G(s)=\frac{ks(s+2)}{(s^2-4s+8)(s+3)}$$

(a) Find the range of k for stability

(b) Find the frequency of oscillation when the system is marginally stable

(c) What do you expect about the system's stability when the zero at $s_z=0$ is removed

3. (15%) A system is described by the following state space equations:

$$\dot{x}(t)=\begin{bmatrix}0 & 1\\ -(a+k) & -(a+1)\end{bmatrix}x(t)+\begin{bmatrix}0\\1\end{bmatrix}u(t) \qquad y(t)=\begin{bmatrix}k & 0\end{bmatrix}x(t)$$

where a and k are the uncertain constants

(a) Find its steady state error e_{ss} for an unit step input

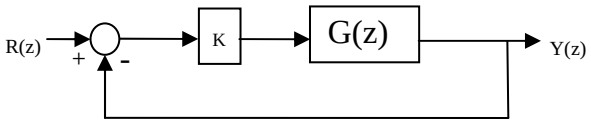
(b) Find the sensitivity of e_{ss} to a and k

4. (15%) Given the Plant:

$$\dot{x}(t)=\begin{bmatrix}0 & 1\\ -3 & 5\end{bmatrix}x(t)+\begin{bmatrix}0\\ 1\end{bmatrix}u(t) \qquad y(t)=\begin{bmatrix}178 & 0\end{bmatrix}x(t)$$

Use pole placement method to design a state feedback controller $u(t)=-kx(t)$ in order to stabilize it and yield 10% overshoot , 0.5sec settling time for a step input.

5. (15%) A discrete control system is shown as on the diagram below:



$$G(z)=\frac{k(z+0.8)}{(z-1)(z-0.6)}$$

(a) Draw the root locus of the system for $k=0\sim\infty$
(b) Find the range of k such that the system remains stable

6. (25%) Briefly answer the following questions:(可用中文回答)

(a) Why a Bode plot can't be used for stability analysis for a non-minimum phase transfer function?
(b) If a system's transfer function can be minimal realized to lower order, what can you tell about its controllability and observability?
(c) By adding a zero to open loop transfer function, what are the effects on the system's stability and bandwidth?
(d) For linear time invariant system: $\dot{x}(t)=Ax(t)$ where A is non-singular
  (i) Define the equilibrium state
  (ii) Describe the Lyapunov stability theorem for the system.
(e) For the above system in (d), find its state transition matrix and explain how this matrix influences the initial states if it is a stable system.