淡江大學 99 學年度碩士班招生考試試題

系別：電機工程學系控制晶片與系統組　　　科目：控制系統
　　　電機工程學系機器人工程碩士班

準帶項目請打「V」	
V	簡易型計算機

本試題共　1 頁，4 大 題

1. Consider the electrical circuit in Figure 1.

   (i) Find the transfer function from the input voltage $v(t)$ to the capacitor voltage. (10%)

   (ii) Assume $L = 1H$ and $C = 10^{-4}F$, compute the range of the resistance within which the electrical circuit is under-damped and the settling time of the capacitor voltage subject to unit step input voltage is less than 0.1 second. (10%)

2. Consider a 2nd-order system $\dfrac{a_3}{s^2 + a_1 s + a_2}$, where a_1, a_2, and a_3 are unknown constants. Suppose that the transient response of the system subject to the input $\sin(t)$ is of the form $be^{-t} - 2e^{-2t}$, where $b \neq 0$. What are the values of $a_i, i = 1,2,3$. (20%)

3. Consider the unity feedback system as shown in Figure 2. Let $r(t)$, $e(t)$, and $c(t)$ be the inverse Laplace transform of $R(s)$, $E(s)$, and $C(s)$, respectively. Assume that G has the following state-space representation:

$$\dot{x}(t) = \begin{bmatrix} -3 & -1 \\ 1 & 0 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} e(t), \quad c(t) = \begin{bmatrix} 0 & 1 \end{bmatrix} x(t)$$

with initial condition $x(0)$.

   (i) Find a state-space realization for the closed-loop system from $r(t)$ to $c(t)$. (10%)

   (ii) Assume $x(0) = [1 \ \ 0]^T$, and $r(t)$ is a unit step, find the output $c(t)$. (10%)

   (iii) Find a state-space realization for the closed-loop system from $r(t)$ to $[e(t) \ \ c(t)]^T$. (10%)

4. Consider the unity feedback system in Figure 2 where $G(s) = \dfrac{K(5s+2)}{s^n(s+4)}$. Let $r(t)$, $e(t)$, and $c(t)$ be the inverse Laplace transform of $R(s)$, $E(s)$, and $C(s)$, respectively.

   (i) Assume $n = 1$, $K = 1$, and $r(t)$ is a unit step, find the steady-state values of $e(t)$ and $c(t)$. (10%)

   (ii) Assume $n = 2$, find the range of K to make the feedback system stable, e.g., all the closed-loop poles are in the open left half complex plane. (10%)

   (iii) Find the values of n and $K \in [10, 20]$ so that the steady-state value of $e(t)$ subject to unit ramp input $r(t)$ is zero; furthermore, the steady-state value of $e(t)$ subject to the input $r(t) = t^2, t \geq 0$ is minimized. (10%)

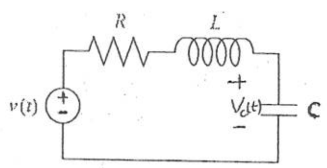

Figure 1

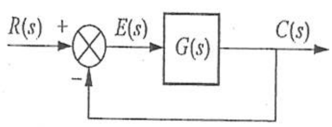

Figure 2