國立成功大學

113學年度碩士班招生考試試題

編　號：167

系　所：電機工程學系

科　目：控制系統

日　期：0201

節　次：第 2 節

備　註：不可使用計算機

國立成功大學 113 學年度碩士班招生考試試題

系　　所：電機工程學系

考試科目：控制系統

考試日期：0201，節次：2

※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Consider the Op-amp circuit shown in Figure 1, if $R_a = R$, $R_d = R_1$ and $R_b = R_c = \infty$. If the transfer function $\frac{V_{out}}{V_{in}} = \frac{ds^2 + es + f}{as^2 + bs + c}$, please determine *a, b, c, d, e,* and *f.* **(18%)**

2. Consider a closed-loop system described in Figure 2, where $C(s) = K$ and $G(s) = \frac{(s+2)^2}{s(s-2)^2}$. (a) Give a **Nyquist path,** sketch the **Nyquist plot**, figure out the real axis and imaginary axis crossing points in this plot, and determine the range of K such that the closed-loop system is stable. (b) Determine the gain margin of this system suppose $K = 8$. **(14%, 4%)**

3. A LTI SISO system is described by $\dot{\mathbf{x}} = \mathbf{A}\mathbf{x} + \mathbf{b}u$ and $y = \mathbf{c}\mathbf{x} + \mathrm{d}u$. Please derive and show that the transfer function is $\frac{y(s)}{u(s)} = G(s) = \frac{\det\begin{bmatrix} s\mathbf{I} - \mathbf{A} & -\mathbf{b} \\ \mathbf{c} & d \end{bmatrix}}{\det(s\mathbf{I} - \mathbf{A})}$. **(14%)**

4. An autonomous system is described as $m\frac{d^2v}{dt^2} + c\frac{dv}{dt} - av + bv^3 = 0$ for some positive a, b, c, and m. Find the equilibrium points of the system and evaluate the local stability at each equilibrium point. **(20%)**

5. Consider the system in Figure 2 in which $C(s) = k$. Obtain the condition on positive k and τ so that the closed-loop system is stable for the following $G(s)$.

   (a) When $G(s) = \frac{1}{s}e^{-s\tau}$.

   (b) When $G(s) = \frac{1}{s(\tau s + 1)}$.

   (c) When $G(s) = \frac{1}{s(\tau s + 1)^2}$. **(30%)**

國立成功大學113學年度碩士班招生考試試題

系　　所：電機工程學系

考試科目：控制系統

考試日期：0201，節次：2

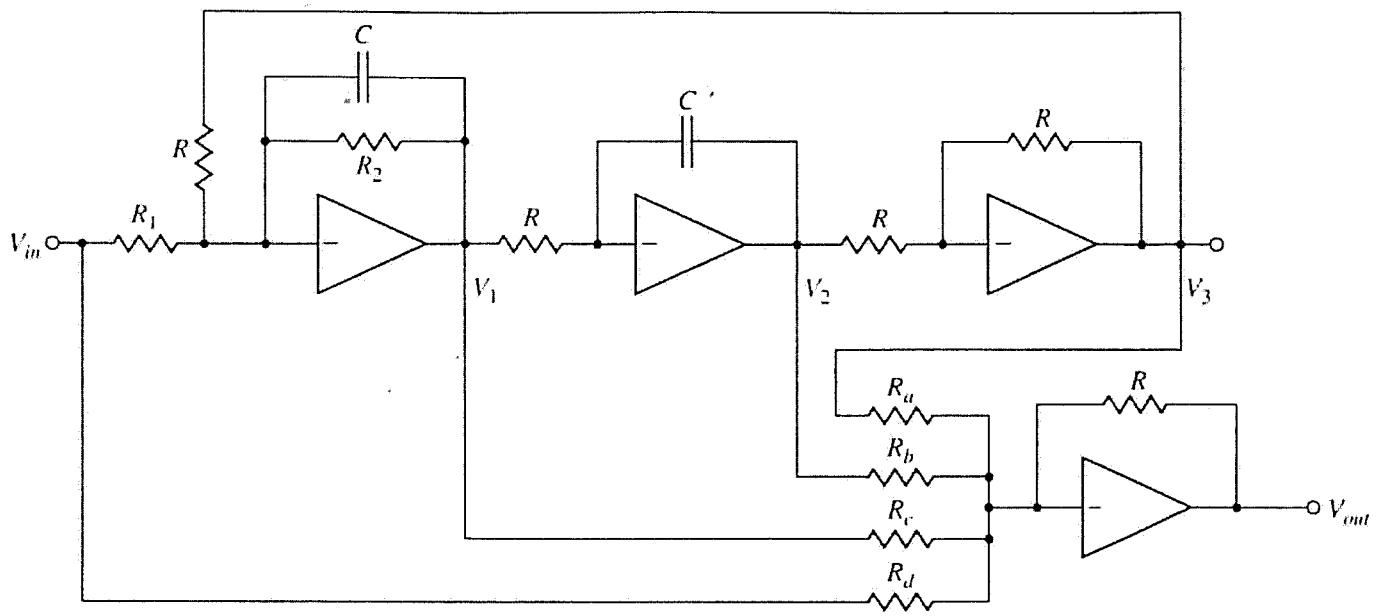

Figure 1

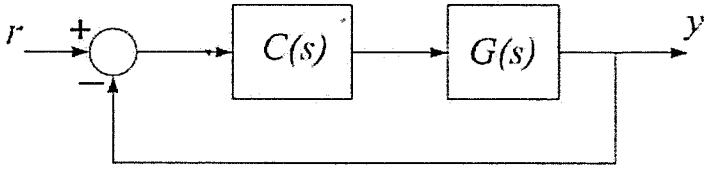

Figure 2