國立成功大學

110學年度碩士班招生考試試題

編　　號：169

系　　所：電機工程學系

科　　目：控制系統

日　　期：0202

節　　次：第 2 節

備　　註：不可使用計算機

※ 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 a closed-loop system described in Figure 1, where $C(s) = K\dfrac{s+a}{s+b}$, $G(s) = \dfrac{1}{s^2 + 4\zeta s + 4}$, and $0 < \zeta < 1$.

   (a) What are the constraints placed on K, a, and b so that the system is both stable and Type 1?　(12%)

   (b) What are the constraints on a and b so that the system is both Type 1 and remains stable for every positive value for K?　(12%)
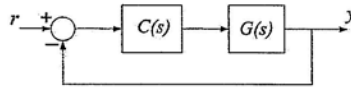

Figure 1

2. Consider the plant described by $\dot{\mathrm{X}} = \begin{bmatrix} 0 & 1 \\ 5 & -4 \end{bmatrix}\mathrm{X} + \begin{bmatrix} 1 \\ 2 \end{bmatrix}u$ and $y = \begin{bmatrix} 2 & 1 \end{bmatrix}\mathrm{X}$.

   (a) Find the transfer function using matrix algebra.　(10%)

   (b) Suppose state feedback $u = \begin{bmatrix} k_1 & k_2 \end{bmatrix}\mathrm{X}$, determine the constraints on k_1 and k_2 so that the closed-loop system is stable.　(8%)

   (c) Suppose output feedback $u = k_3 y$, determine the constraints on k_3 so that the closed-loop system is stable.　(8%)

3. The unity-feedback system with an open-loop transfer function $G(s) = \dfrac{K(s+\alpha)}{(s+\beta)^2}$, is to be designed to meet the following specifications: steady-state error for a unit step input $e_{ss} = 0.1$; damping ratio $\zeta = 0.6$; natural frequency $\omega_n = \sqrt{10}$ rad/sec. Find the values of K, α, and β.　(25%)

4. The system shown in Figure 2 has $G_1(s) = \dfrac{1}{s(s+2)(s+4)}$. Use the Routh-Hurwitz criterion to find the values of K_1 and K_2 for which the system oscillates at a frequency of 2 rad/sec.　(25%)
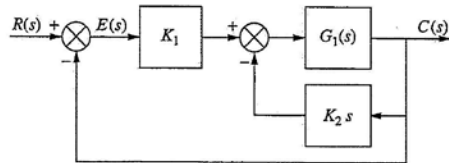

Figure 2