

國立台灣科技大學九十八學年度碩士班招生試題

系所組別： 高分子工程系碩士班乙組

科 目： 控制系統

控制系統；共四大題，總分 100 分；請於答案卷內依序作答

一、選擇題：共 6 題，8 分／題，總計 48 分。每題皆為四選一之選擇題，空白者零分計算，選錯一題則倒扣 2 分。請將選擇題答案書寫於答案卷內，於試題作答不予計分。

1. Closed-loop transfer function of a unity-feedback system is given by $\frac{Y(s)}{R(s)} = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$. Steady-state error to unit-ramp input is (8%)
 (A) ∞ (B) $2\zeta/\omega_n$ (C) 1 (D) $4/\zeta\omega_n$
2. Dead-time model $e^{-s\tau_D}$ may be approximated by the transfer function (8%)
 (A) $(1 - \tau_D s)$ (B) $(1 + \tau_D s)$
 (C) $(1 + \tau_D s)/(1 - \tau_D s)$ (D) $(1 - \tau_D s)/(1 + \tau_D s)$
3. The characteristic equation of a feedback control system is $s^3 + \alpha_1 s^2 + \alpha_2 s + K\alpha_2 = 0$; $\alpha_1, \alpha_2 > 0$, where K is a variable positive scalar parameter. The system is stable for all values of K given by (8%)
 (A) $K > \alpha_2$ (B) $K < \alpha_2$ (C) $K > \alpha_1$ (D) $K < \alpha_1$
4. The system model equation is $\ddot{x} + 7\dot{x} + 6x = 10$, How long it will take to reach steady-state? (8%)
 (A) 7s (B) 6s (C) 5s (D) 4s
5. A unity feedback system has open-loop transfer function (8%)
 $G(s) = K(s+1)(s+2)/[s(s+3)(s+4)]$. For $K=10$, the closed-loop poles are
 (A) all real and distinct (B) one real and two complex conjugate
 (C) all real and repeated (D) None of the answers in (A), (B), and (C) is correct
6. Undamped natural frequency ω_n and bandwidth ω_b of a unity feedback system with open-loop transfer function $G(s) = \frac{\omega_n^2}{s(s + 2\zeta\omega_n)}$ are related as (8%)
 (A) $\omega_n = \omega_b$ (B) $\omega_n > \omega_b$ (C) $\omega_n < \omega_b$
 (D) None of the answers in (A), (B), and (C) is correct



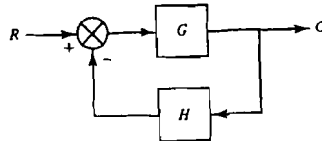
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二、 In the Figure as shown below, $G(s) = \frac{4K}{(0.5s+3)(2s^2+8s+12)}$

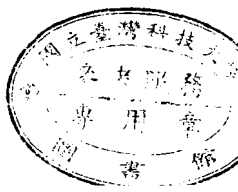
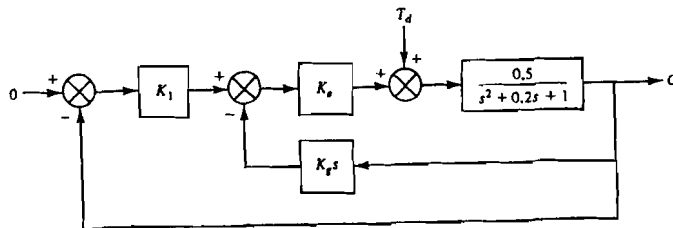
$$H(s) = \frac{0.1}{0.05s+0.4}$$



- (a) Sketch the loci of the closed-loop poles for varying K . (10 %)
- (b) Find the approximate value of K so that the damping ratio of the dominating closed-loop poles will be 0.5. (10 %)

三、 The block diagram of a roll stabilizer for a ship is shown below. Minor loop rate feedback is included because of the low damping associated with the ship dynamics.

- (a) Express the transfer function for the effect of wave disturbance torque T_d on ship roll angle C . (7 %)
- (b) Find the equations that must be satisfied by K_a , K_I , and K_g to ensure both a steady-state value of no more than 0.1 for C in response to a unit step T_d and a system damping ratio 0.5. (5 %)
- (c) Which of K_I and K_a must be adjustable to enable both specifications in part (b) to be met? (5 %)



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10. Find the transfer function, $G(s) = X_3(s)/F(s)$, for the translational mechanical system shown below. (15%)

