110ME04

國立臺北科技大學 110 學年度碩士班招生考試

系所組別：1112 機械工程系機電整合碩士班甲組

第二節　自動控制　試題（選考）

注意事項：

1. 本試題共 5 題，每題 20 分，共 100 分。
2. 不必抄題，作答時請將試題題號及答案依照順序寫在答案卷上。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

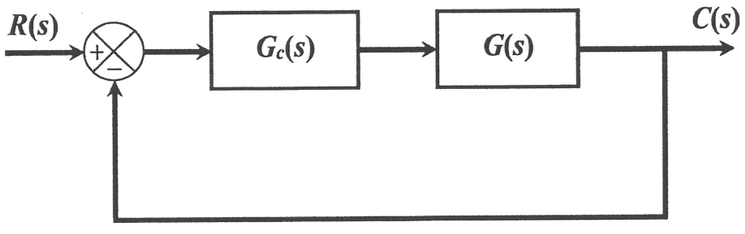
1. Consider a unity feedback control system given below, where the transfer function of the plant $G(s) = (s+3)/(s+1)(s+2)$, and the transfer function of the controller $G_c(s)$,

   (a). Assume $G_c(s) = 1$ in the beginning, if the reference input $r(t) = 1$, find the transient response and the steady-state response of system output $c(t)$. (8%)

   (b). According to the results in (a), find the steady-state error if it exists. (2%)

   (c). The steady-state error in (b) can be removed by designing the controller $G_c(s) = K/s$, please prove it. (8%)

   (d). According to (c), determine the range of K, so that the unity feedback control system is stable. (2%)



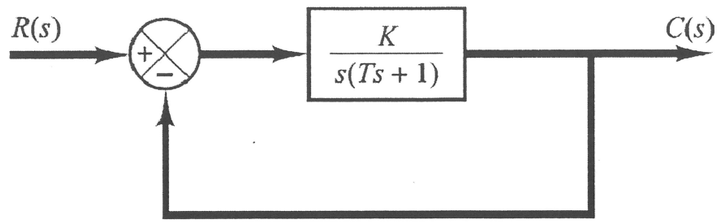
2. Consider the following closed-loop control system in Figure (a), where the unit step response is given in Figure (b),

   (a). Find the closed-loop transfer function $C(s)/R(s)$. (4%)

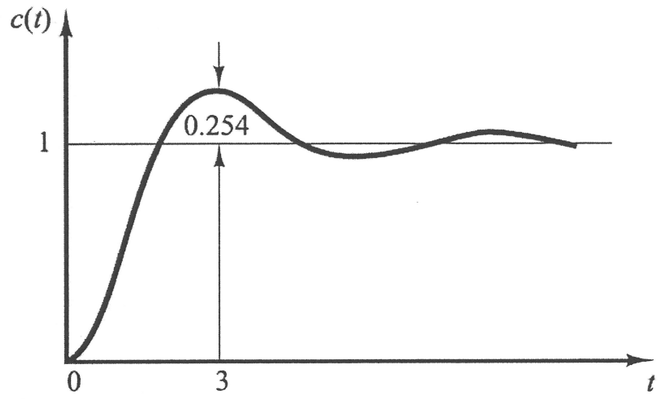
   (b). Try to find the damping ratio ζ of this system. (5%)

   (c). Try to find the undamped natural frequency ω_n of this system. (5%)

   (d). Try to decide K and T. (6%)



(a)



(b)

3. Consider a feedback control system given below, where the transfer function of the plant $G(s) = 2(s-1)/(s+2)^2(s^2+2s+2)$, and the transfer function of the controller $G_c(s)$, If $G_c(s) = K$,

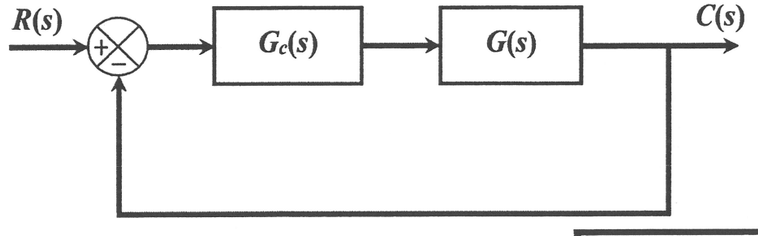
   (a). Determine the range of K, so that the unit-feedback control system is stable. (4%)

   (b). Determine the range of K, so that there is only one unstable pole in the system. (4%)

   (c). Determine all the root locus crossing points on the imaginary axis. (4%)

   (d). Determine the departure angle of its root locus at the complex poles. (4%)

   (e). If $G_c(s) = K/(s+a)$, and a pair of the system poles are located at $-1 \pm 1.5j$, please determine K and a. (4%)

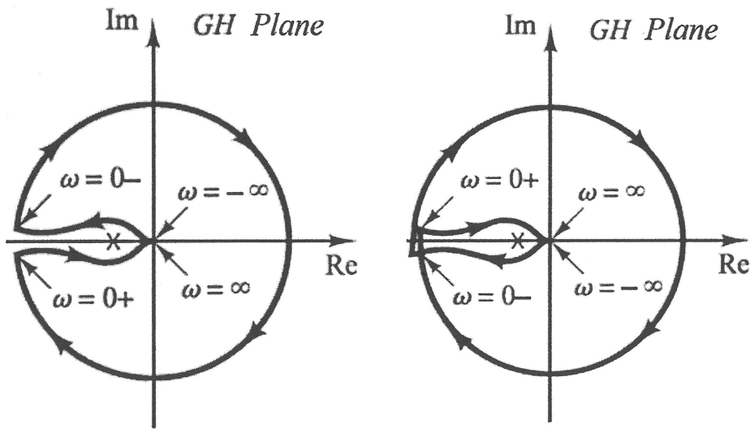


注意：背面尚有試題

4. Consider a negative feedback control system with loop transfer function $GH(s) = 2(T_2s+1)/s^2(T_1s+1)$, where T_1 and T_2 are positive, their related Nyquist plots of $GH(s)$ are given below,

   (a). For Figure ***(a)***, what's the relation of T_1 and T_2? Also, determine the stability of this negative feedback control system by applying Nyquist stability criterion. (10%)

   (b). For Figure ***(b)***, what's the relation of T_1 and T_2? Also, determine the stability of this negative feedback control system by applying Nyquist stability criterion. (10%)



(*a*)

(*b*)

5. Consider the following closed-loop control system, where the phase margin is designed to be 50°,

   (a). Determine the gain crossover frequency ω_c. (10%)

   (b). Determine the value of K, so that the phase margin is 50°. (10%)