國立中央大學103學年度碩士班考試入學試題卷

所別：機械工程學系碩士班　丁組(系統)(一般生)　　　　　科目：自動控制　共 2 頁　第 1 頁
　　　機械工程學系光機電工程碩士班　甲組(機電系統控制)(一般生)
　　　機械工程學系光機電工程碩士班　乙組(光機)(一般生)
本科考試可使用計算器，廠牌、功能不拘　　　　　　　　　　　＊請在試卷答案卷（卡）內作答

1. (25 points) Consider the second order system shown in Figure 1, where ζ is a parameter of the system.

   (a) (3%) Please find the closed-loop transfer function $G(s) = \frac{Y(s)}{R(s)}$.

   (b) (5%) The closed-loop frequency response is expressed as $\frac{Y(j\omega)}{R(j\omega)} = Me^{j\emptyset}$.

   Please find M and $\emptyset$ (in term of ω).

   (c) (7%) Please find the critical damping ratio ζ_c.　When $0 \leq \zeta \leq \zeta_c$, there exists the resonant phenomenon.

   (d) (10%) When $\zeta = 0.5$, the maximum value of M_{max} occurs at the frequency ω_{max}. Please find M_{max} and ω_{max}.
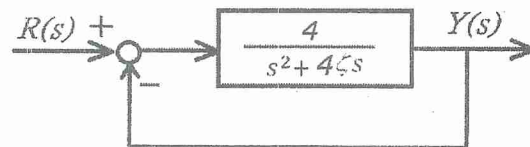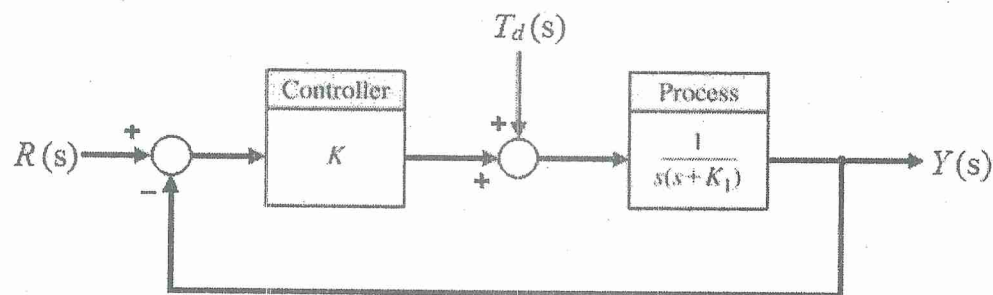

Figure 1.　A second order system

2. (25 points) Consider the unity feedback system shown in the Figure. The system has two parameters, the controller gain K and the constant K_1 in the process,

   (a) (13 %) Calculate the sensitivity of the closed-loop transfer function to changes in K_1.

   (b) (12 %) How would you select a value for K to minimize the effects of external disturbances $T_d(s)$

注意：背面有試題

3. (25 pt) Consider the system.
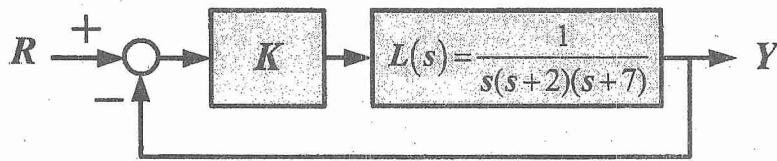
a. (6 pt) Please use Routh array to determine the range of K over which the system is stable.

d. (7 pt) Please sketch the root locus of the system. Also find the asymptotes and break-away points.

c. (6 pt) On the root locus, find the location and the gain, K, of the imaginary-axis crossing location.

d. (6 pt) Please find the steady state error if input, R, is a ramp function (that is, $r(t) = t$ for $t \geq 0$).

4. 已知系統轉移函數如下

$$G(s) = \frac{K}{s^2 + as + b}, \quad K, a, b > 0$$

(a) (5 points) 常數 K 對根軌跡(Root locus)有何影響？

(b) (10 points) 常數 K 對波特(大小與相角)圖(Bode magnitude and phase)各有何影響？

(c) (5 points) 常數 K 對奈氏圖(Nyquist)有何影響？

(d) (5 points) 轉移函數從何而來，代表什麼，它的優點為何？

注意：背面有試題