國立臺北科技大學九十九學年度碩士班招生考試

系所組別：1320 車輛工程系碩士班乙組

第一節　自動控制　試題

注意事項：

1. 本試題共 5 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
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. (20%) For the system shown in Fig. 1, a mass m is connected to a cart with a spring (spring constant K) and a damper (damping coefficient C). The displacement u of the cart and displacement y of the mass are considered as input and output for the system, respectively. Determine (a) the differential equation (5%), (b) the transfer function (5%), (c) the state equations (5%), and (d) the effects on system time response if K is varied (5%).

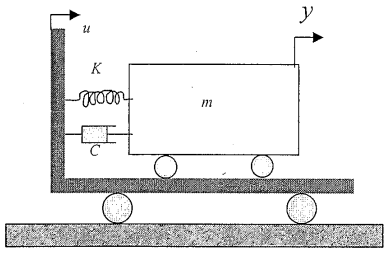

Fig.1

2. (20%) For the system shown in Fig. 2, the input is a unit step input. Prove
   (a) if the system $G(s)$ is a type 0 system, the system exists a steady-state error. Also determine the steady-state error. (10%)
   (b) if the system $G(s)$ is a type 1 system, the system exists no steady-state error. (10%)

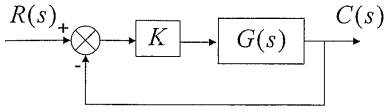

Fig. 2

3. (20%) For a 2nd-order system under a unit step input, the time response of this system is

$$y(t) = 1 - e^{-\sigma t}\left(\cos\omega_d t + \frac{\sigma}{\omega_d}\sin\omega_d t\right)$$

   (a). mention the definition of settling time in text and figure; (6%)
   (b) which system parameters can affect the settling time T_s? (4%)
   (c) If the system has its root locus shown in Fig. 3, and some data of the root locus is in Table 1. Now a proportional controller with parameter K is added to the system to make the resulted feedback control system approximately having settling time <2.3 sec and overshoot < 4.32%. Determine the approximate range of K. (10%)

(p.s. $\%overshoot = e^{-(\xi\pi/\sqrt{1-\xi^2})} \times 100$)

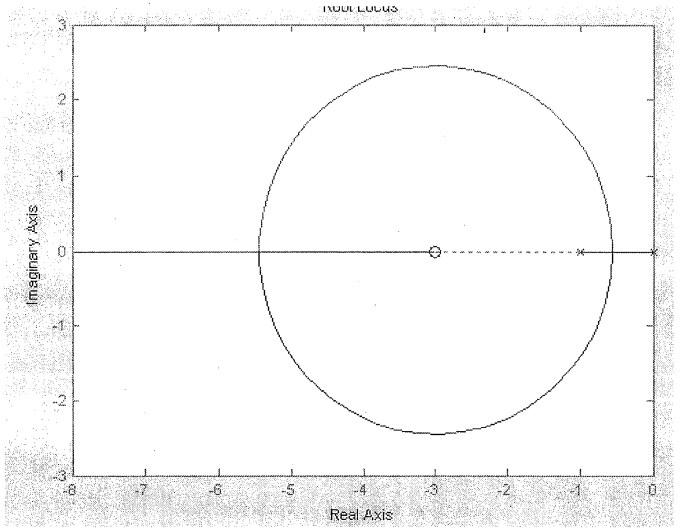

Fig. 3

Table 1

pole location	K	pole location	K	pole location	K
-0.75+0.95i	0.487	-1.4+1.86i	1.8	-2.4+2.37i	3.8
-0.803+1.08i	0.605	-1.6+2i	2.19	-2.6+2.41i	4.19
-0.902+1.26i	0.797	-1.8+2.13i	2.6	-2.81+2.44i	4.61
-1+1.41i	0.999	-2+2.23i	2.99	-3.01+2.45i	5.02
-1.2+1.64i	1.38	-2.2+2.31i	3.39		

注意：背面尚有試題

4. (20%) (a) For the following systems, roughly draw the corresponding root-loci. (12%)

(a.1) $G(s)=\dfrac{K}{s(s+2)}$;　(a.2) $G(s)=\dfrac{K(s+6)}{s(s+2)}$;　(a.3) $G(s)=\dfrac{K}{s(s+2)(s+8)}$;

(a.4) $G(s)=\dfrac{K(s+6)}{s(s+2)(s+8)}$;　(a.5) $G(s)=\dfrac{K(s+2.05)}{s(s+2)(s+8)}$;

(b) When the value of K becomes very large ($K\to\infty$), which system will become an unstable system? (8%)

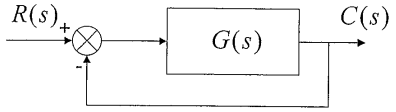

Fig. 4

5. (20%) Fig. 5 shows a Bode diagram of a transfer function *G(s)*.

(a) determine the gain margin, phase margin, and bandwidth of this system. (6%)

(b) Explain the stability of this system based on the plot in Fig.5. (4%)

(c) Determine this transfer function. (10%)

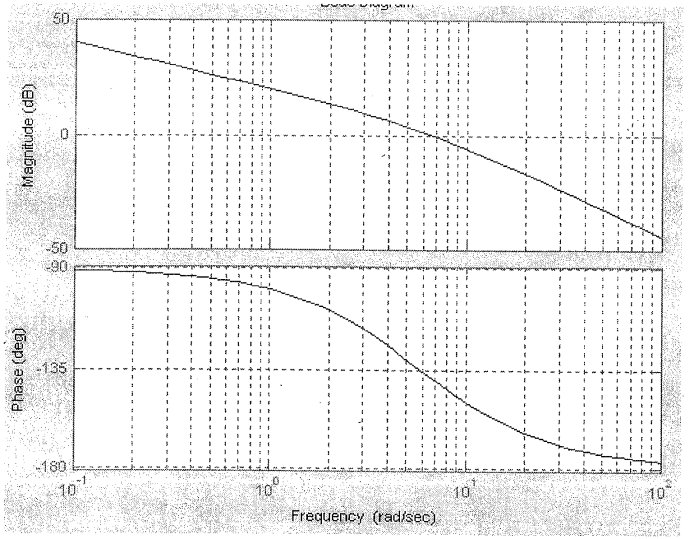

Fig. 5