25% 1. Consider a feedback control system shown by the block diagram in Figure 1.

a. Find the range of K for the system to be stable.(10%)

b. If input is a step function r(t)=1 and no initial condition, write the time domain response of y(t) when K=1/2.(12%)

c. From the input and the output, what can you tell about this control system?(3%)

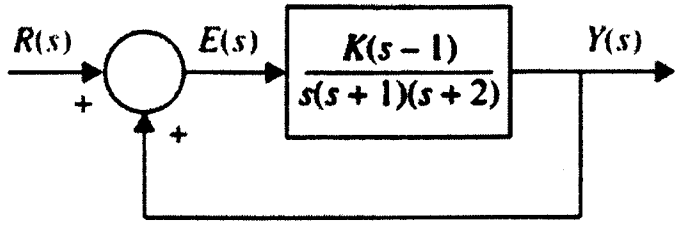

Figure 1

25% 2. A controlled process is modeled by the following set of differential equations

$$\dot{x}_1(t) = x_1(t) + 2x_2(t), \qquad \dot{x}_2(t) = -10x_1(t) + u(t).$$

The feedback control has the form of

$$u(t) = -K_1x_1(t) - K_2x_2(t) + r(t),$$

where K_1 and K_2 are constants and $r(t)$ is a linear function of time.

a. Draw a graph diagram representing the control system.(10%)

b. Determine the area in the K_2 vs K_1 plane where the closed-loop system is asymptotically stable. Let K_1 be the horizontal and K_2 be the vertical axis.(15%)

(背面仍有題目,請繼續作答)

3.

(a). 利用根軌跡法，求出 K 使下面系統的共軛極點阻尼比爲 $\zeta = 1/\sqrt{2}$ 。(13%)

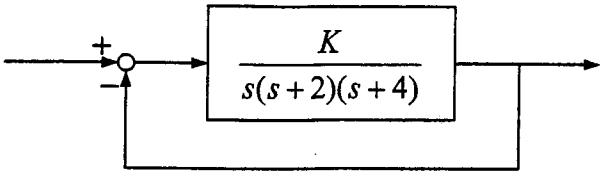

圖 3.a

(b). 利用根軌跡法，求閉迴路系統爲欠阻尼(underdamped)的 K 值範圍。(12%)

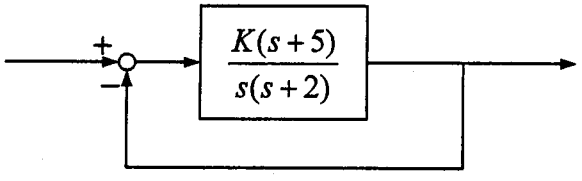

圖 3.b

4. 考慮圖 4 之系統， $G(s) = \dfrac{5}{s(s+3)(s+10)}$ ，且 $C(s) = \dfrac{k(s+3)}{(s+p)}$.

（1）. 繪出 G(s)之奈氏圖(Nyquist plot) 。(7%)

（2）. 求 $\angle G(s)\big|_{s=-2+2j}$ 之值。(3%)

（3）. 決定 p 之值使得 $\angle G(s)C(s)\big|_{s=-2+2j} = -180°$ 。(6%)

（4）. 決定 k 之值使得閉迴路極點落於 $-2 \pm 2j$ ，並求出另外兩個系統極點。(4%)

（5）. 求此已補償系統之相位裕度與增益裕度。(5%)

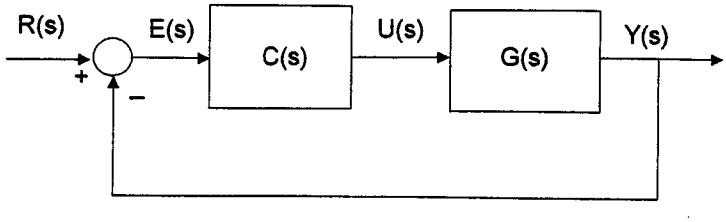

圖 4