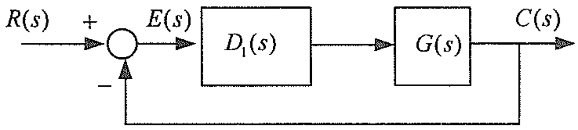
總分 100 分　　※ 注意：請於試卷內之「非選擇題作答區」依序作答，並應註明作答之部份及題號。

1. A control system is shown in Fig.1 with $D_1(s)=1,\ G(s)=\dfrac{25}{s(s+1)}$.

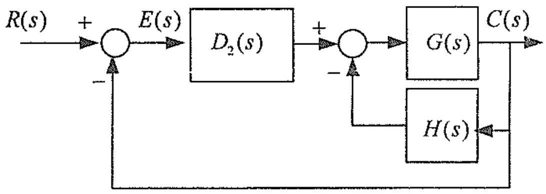
(a) Please solve the percent overshoot and the settling time of system in Fig. 1(a). **(10%)**

(b) The control performance in Fig.1(a) can be improved by the system in Fig.1(b) with

$D_2(s)=K_1,\ H(s)=K_2 s, G(s)=\dfrac{25}{s(s+1)}$. Please design K_1 and K_2 to achieve 25% overshoot and settling time 0.2 sec. **(15%)**



(a)



(b)

Fig.1

2. A root locus problem is shown in Fig.2 with plant $G(s)=\dfrac{1}{(s+1)(s+2)(s+3)(s+4)}$.

(a) Sketch the root locus as $D(s)=K$, including asymptotes and breakaway points. **(7%)**

(b) Find the range of K for stability in (a). **(4%)**

(c) In order to improve the stability, a zero is added in the controller as $D(s)=K(s+a)$ to make the root locus cross the jw-axis at $\pm j5.5$. Please find the value of a, and sketch the new root locus. **(10%)**

(d) Find the range of K for stability in (c). **(4%)**

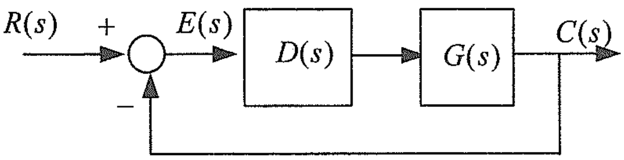


Fig.2

3. A Nyquist stability problem is shown in Fig.3,

where $D(s) = K(s+0.5)$, $H(s) = 1$, $G(s) = \dfrac{1}{s^2(s+1)}$.

(a) Please derive and sketch the Nyquist plot. **(15%.)**

(b) Find the range of K for stability by Nyquist stability criterion. **(10%.)**

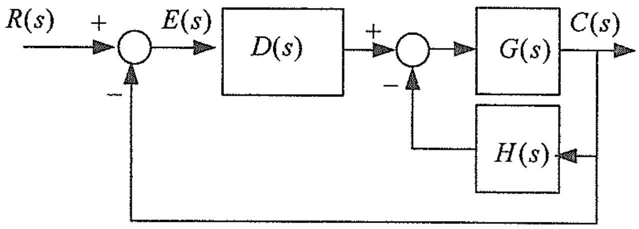


Fig.3

4. A servo control system is designed with $G_1(s) = \dfrac{10}{s+1}$, $G_2(s) = \dfrac{1}{s-2}$, and the state variable x_1 and x_2 are defined, as shown in Fig.4.

(a) Please derive the state space equation of the closed-loop control system. **(10%)**

$$\dot{\mathbf{x}} = \mathbf{A}\mathbf{x} + \mathbf{B}r$$
$$y = \mathbf{C}\mathbf{x}$$

(b) Please solve the gain K_a and K_b for the closed-loop poles located at $-2 \pm j2$. **(15%)**

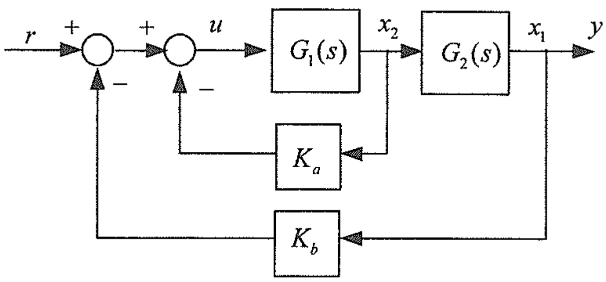


Fig.4

試題隨卷繳回