83-1

淡江大學97學年度碩士班招生考試試題

系別：航空太空工程學系　　　　科目：自 動 控 制

准帶項目請打「V」	
V	簡單型計算機

本試題共 3 頁，7 大題 P1.

1. (10%) Explain why a feedback system is usually used in control system design. (Discuss the effect of feedback on system gain, stability, external disturbance/noise, system sensitivity on process parameter variations, etc.,)

2. (15%) For the unity feedback control system as shown in Figure 1, determine the range of the plant parameters K and p so that the poles of the closed-loop system are located in the areas enclosed by $ABCD$ and $EFGH$ as shown in Figure 2. Arcs $\widehat{CD}$ and $\widehat{GH}$ are part of a circle centered at the origin O with a radius of 3; arcs $\widehat{AB}$ and $\widehat{EF}$ are part of another circle centered at the origin O with a radius of 5. That is, $\overline{OC}=\overline{OD}=\overline{OG}=\overline{OH}=3$, $\overline{OA}=\overline{OB}=\overline{OE}=\overline{OF}=5$.

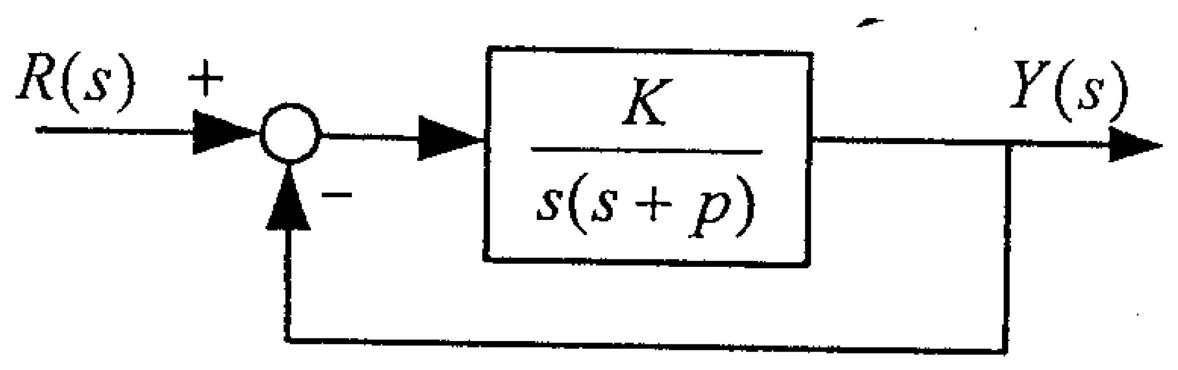

Figure 1

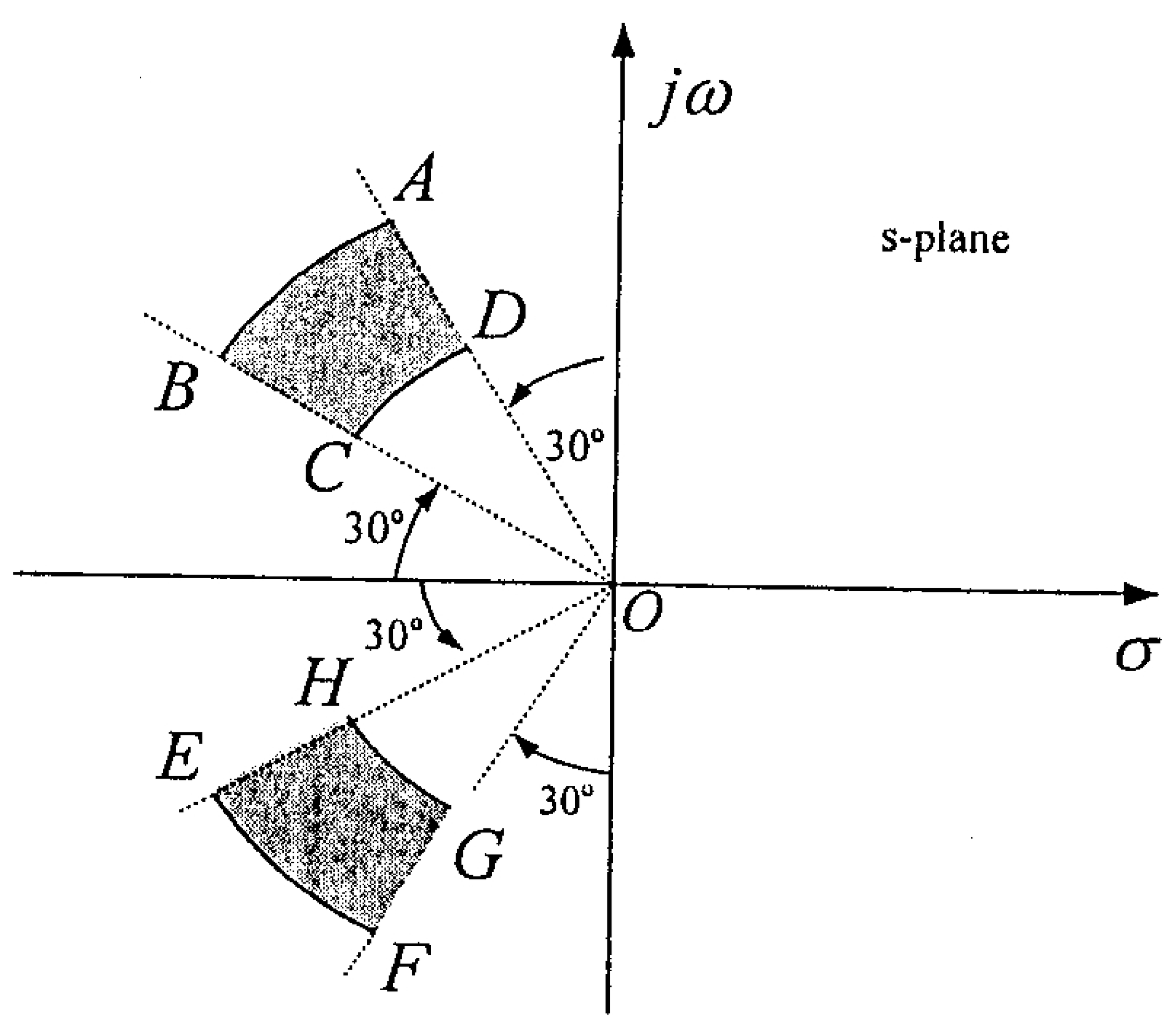

Figure 2

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3. (10%) Given the feedback control system in Figure 3. Determine the constant feedback control gains k_1 and k_2, so that the poles of the closed-loop system are placed at $-1\pm i$.

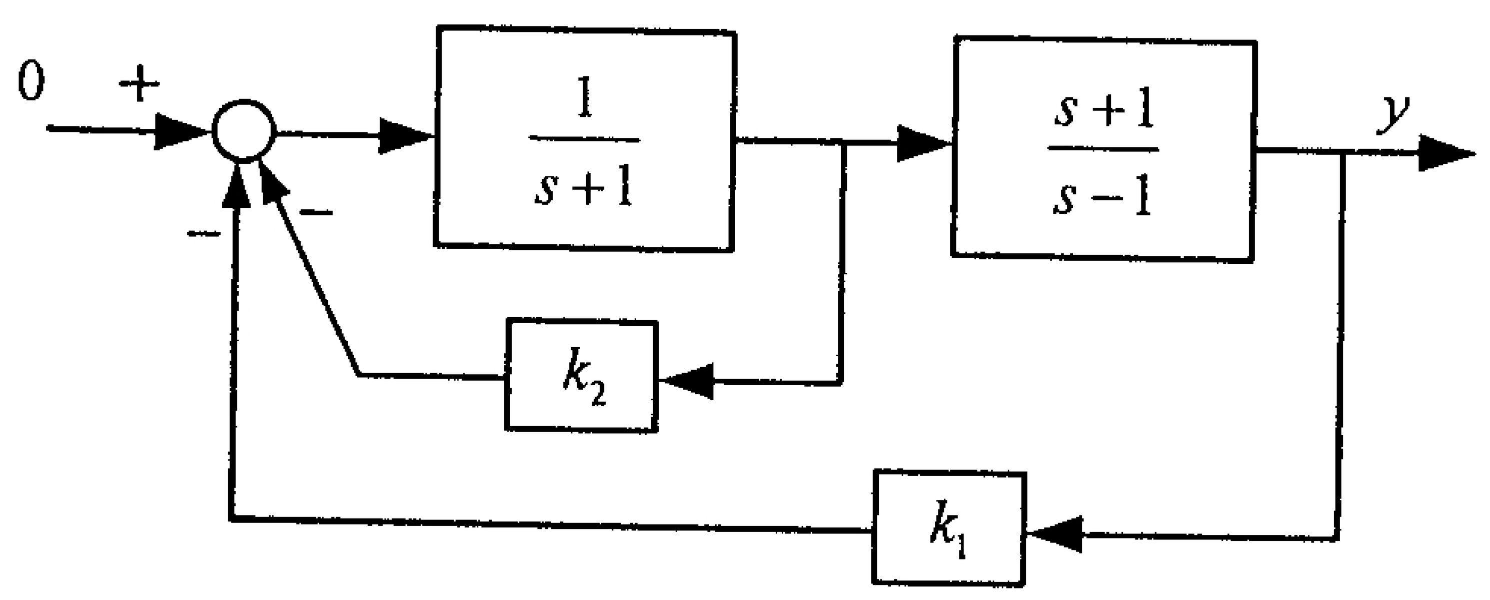

Figure 3

4. (10%) Consider a feedback control system with loop transfer function

$$G(s)H(s)=K\frac{s+8}{s(s^2+8s+20)}$$

Is it possible to place a closed-loop system pole at $s=-2+2i$ through proper selection of K? (Detailed justifications are required.)

◀注意背面尚有試題▶

5. (25%) Given a linear dynamical system with a state space realization

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}1 & -2\\ 0 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}\alpha\\ 1\end{bmatrix}u$$

$$y=\begin{bmatrix}0 & \beta\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

(a). (5%) Determine the values of α so that the system will be controllable.

(b). (5%) Determine the values of β so that the system will be observable.

(c). (5%) Find the transfer function of the system from input u to output y.

(d). (10%) Find a state space representation of the transfer function that you obtained in (c). Is it similar to the original system? If the result is different to the original system, provide an explanation for the differences.

6. (15%) Consider the feedback control system in Figure 4 with a controlled plant $P(s)$ and a controller $K(s)$.

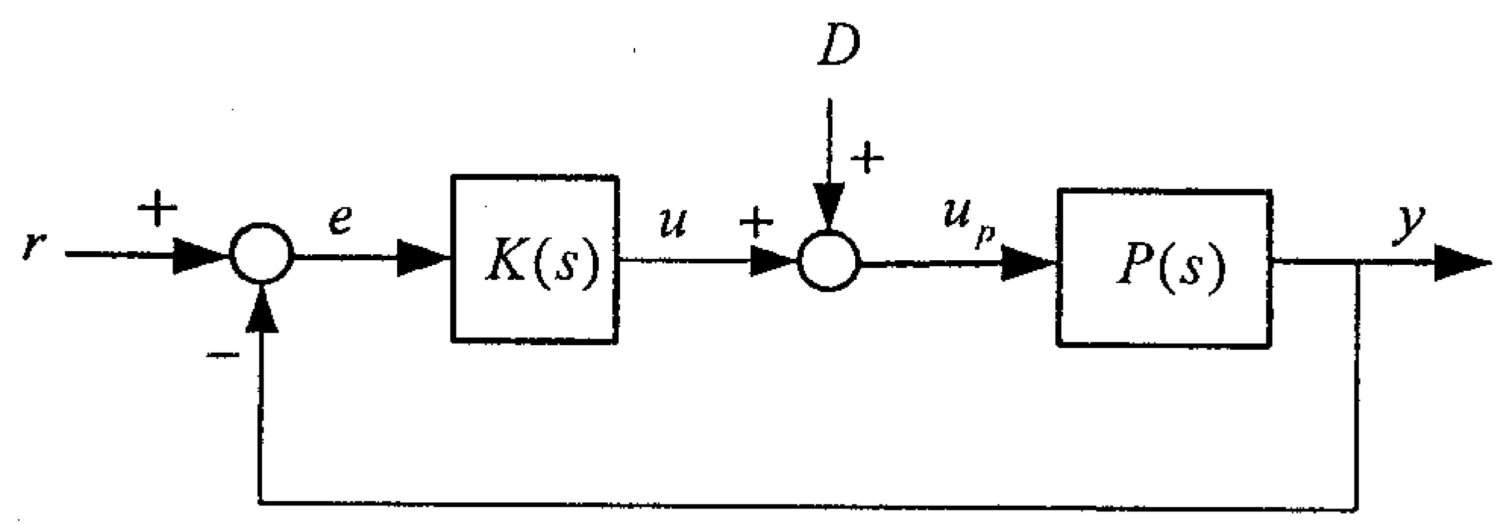

Figure 4

(a). (2%) Derive the transfer function from the reference input r to the output y.

(b). (3%) Derive the transfer function from the disturbance D to the output y.

(c). (10%) Assume the dynamical equation of the controlled plant is

$$\frac{dy(t)}{dt}+0.2y(t)=u_p(t)$$

and a PI controller $u(t)=K_P e(t)+K_I\int_0^t e(\tau)d\tau$ is adopted for regulation design. Choose the parameters K_P and K_I so that a constant disturbance D will not produce steady state error to the system and the closed-loop system will has the characteristic polynomial s^2+2s+2.

7. (15%) For the unity-feedback system as shown in Figure 5, with

$$G(s) = \frac{10K}{s(s+4)(s+5)}$$

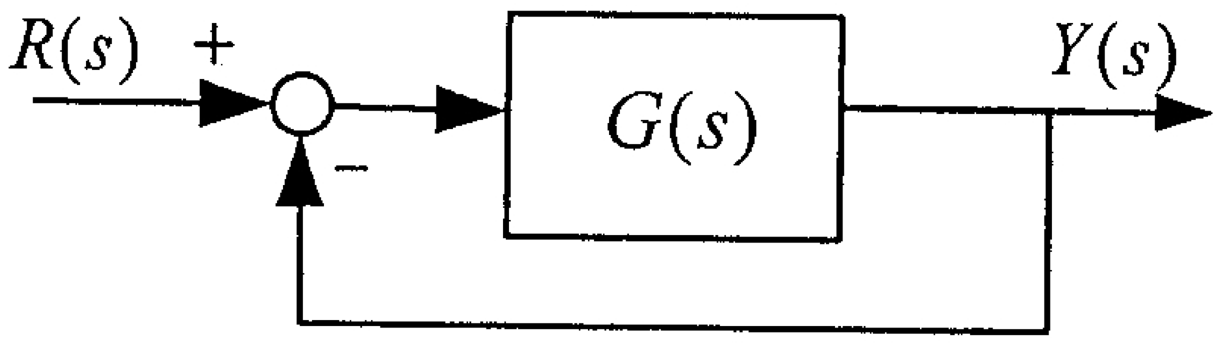

Figure 5.

(a) (4%) Find the range on K so that the closed-loop system is stable.

(b) (3%) Find the value of K so that the closed-loop will be marginally stable.

(c) (8%) Find the range on K so that all the poles of the closed-loop system are in the left of $s=-1$.