國立臺灣科技大學
八十七學年度碩士班招生考試試題

所　別：
學程別：電子工程技術研究所　　組別：系統組　　科目：控制系統

1. For a system as shown in Fig. 1,

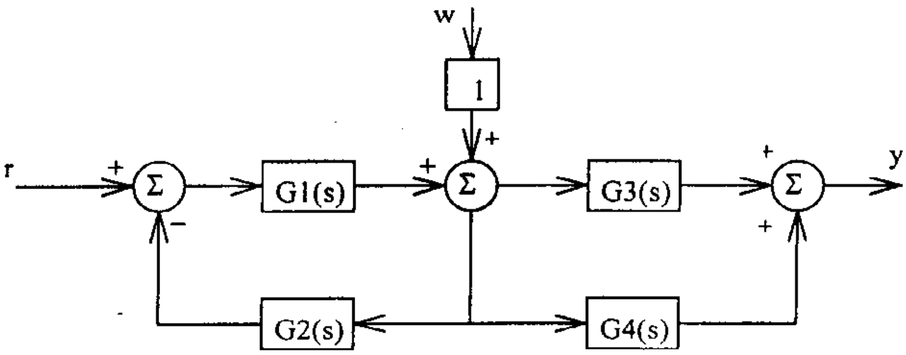

Fig. 1

(a) Find the transfer functions of $\frac{Y}{R}$ and $\frac{Y}{W}$ (You can use G instead of G(s) for simplicity). (7%)

(b) If $G1(s) = \frac{1}{s}$, $G2(s) = \frac{1}{s+2}$, $G3(s) = \frac{1}{4}$ and $G4(s) = \frac{3}{4}$, determine the system type with respect to the reference input r and the disturbance input w. (7%)

(c) From (b), if the system type with respect to r is to be raised, what value should the constant gain in G4(s) be modified to? (5%)

(d) From (b), if the system type with respect to w is to be raised, should the unity gain before entering the summing junction be changed to a differentiator or a integrator? (5%)

(e) If $r = 1 \cdot u(t)$ and $w = t \cdot u(t)$, where u(t) is the unit step function, please find the steady-state response y_{ss}. (6%)

2. For a unity feedback system as shown in Fig. 2, where $r(t) = 1 \cdot u(t)$ and $G(s) = \frac{1}{(s+1)(s+4)}$:

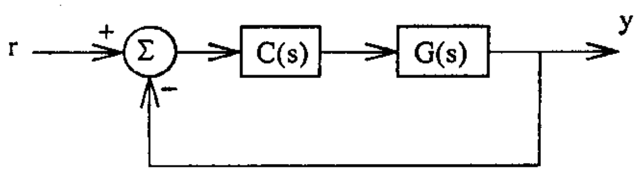

Fig. 2

(a) If C(s) is a constant K and the feedback path is broken, determine K such that the steady-state error e_{ss} is zero. (5%)

(b) From (a), reconnect the feedback path for a P control system. Please explain if there is a possibility that a damping ratio ζ larger than 0.7071 and e_{ss} smaller than 20% can be both achieved. (6%)

(c) From (b), let $C(s) = K(1+T_D s)$ for a PD control system. If the dynamic requirements of the dominant pair of poles are $\omega_n = 5$ and $\zeta = 0.8$, calculate e_{ss}. (7%)

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(d) From (b), let $C(s) = K\left(1+\frac{T_I}{s}\right)$ for a PI control system. If the dynamic requirements of the dominant pair of poles are $\omega_n = 2$ and $\zeta = 0.5$, calculate y_{ss}. Furthermore, calculate e_{ss} for a ramp input $[r(t) = t\cdot u(t)]$. (7%)

(e) Please state briefly the effects of the P, I and D control, respectively. (5%)

3. For a unity feedback system as shown in Fig. 2 with $C(s) = K$ and $G(s) = \frac{1}{s(s+1)(s+2)}$:

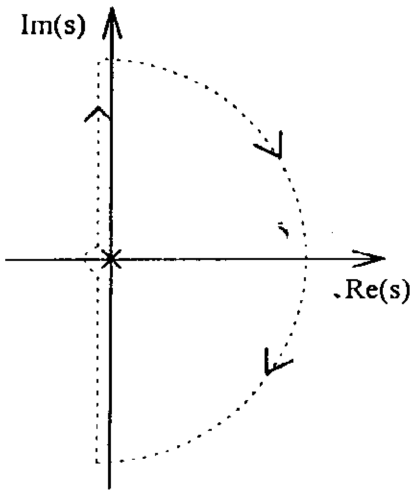

Fig. 3

(a) Determine $\angle G(j\omega)$ at $\omega = 0^+$ and $\omega \to \infty$. (5%)

(b) Determine $|\angle G(j\omega)|$ at $\angle G(j\omega) = -180^\circ$. (6%)

(c) Calculate the real part of $G(j\omega)$ at $\omega = 0^+$. (5%)

(d) For the contour as shown in Fig. 3, construct its Nyquist plot in detail. (7%)

(e) Discuss the relationship between the gain K and the system stability. (7%)

(f) Construct its Bode plot in detail and verify the stability range. (10%)