國立臺灣科技大學
九十四學年度碩士班招生考試試題
系所組別：電機工程系碩士班乙二組
科　　目：控制系統

「 總分 100 分 」

Problem 1. (10%)

Use the properties of impulse function $\delta(t)$ to prove $x(t)=\int_{-\infty}^{\infty} x(\tau)\delta(t-\tau)d\tau$ mathematically.

Problem 2. (10%)

Consider a system transfer function $T(s)=\dfrac{Y(s)}{R(s)}=\dfrac{10}{s(s+5)^2}$, find the steady-state response $y_{ss}(t)$ of the system for input $r(t)=\cos(5t),\ t>0$.

Problem 3. (10%)

Consider a control system as shown in Figure P.3, find the system transfer functions $T_1(s)=\dfrac{Y_1(s)}{R(s)}$ and $T_2(s)=\dfrac{Y_2(s)}{R(s)}$.

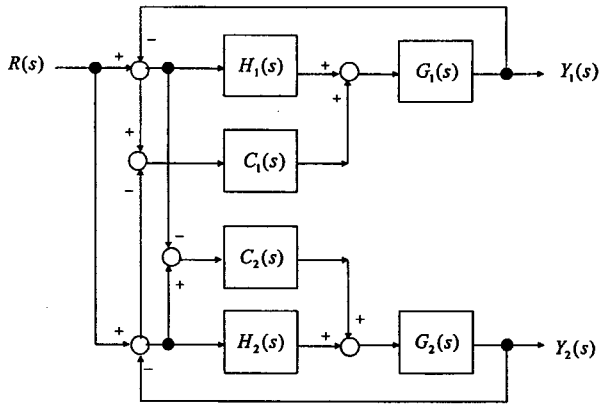

Figure P.3.

Problem 4. (20%)

Consider a closed-loop control system as shown in Figure P.4, when a unit step input $r(t)=u(t)$ is applied to the system, it is found that the output step response $y(t)$ has zero steady-state error and a maximum overshoot $M_p=50\%$ at peak time $t_p=0.5$ seconds, determine the plant parameters K and a.

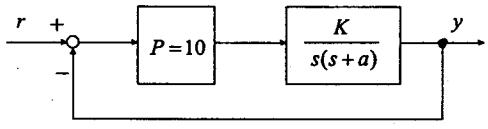

Figure P.4.

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Problem 5. (10%)

A unity-feedback control system has the open-loop transfer function as $G(s)=\frac{K(s^2-1)(s+2)}{s(s^2+2s+2)}$. Sketch the root loci of the characteristic equation. Label all important points and information on the loci.

Problem 6. (20%)

Consider the control system shown in Fig. P. 6.

(a) Find the open-loop transfer function, which is $G(s)=\frac{C(s)}{E(s)}$ (5%).

(b) Sketch the Nyquist plot of G(s). Please clearly explain the details of each step for your Nyquist plot (10%).

(c) Use the Nyquist plot to determine the stability criterion of the system (5%).

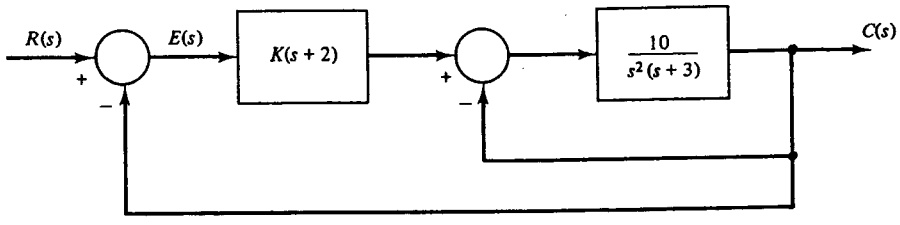

Fig. P. 6.

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Problem 7. (20%)

The Bode diagram of the open-loop transfer function $G(s)$ of a unity feedback control system is shown in Fig. P. 7.

(a) Find the gain margin and phase margin of the system (5%).

(b) If the open-loop transfer function is changed to $e^{-Ts}G(s)$, find the value of T so that the phase margin of the system is 45 degrees (5%).

(c) If the open-loop transfer function is changed to $e^{-Ts}G(s)$, find the value of T so that the gain margin of the system is 20 dB (5%).

(d) What is the ramp error constant of the system in part (b) (5%).

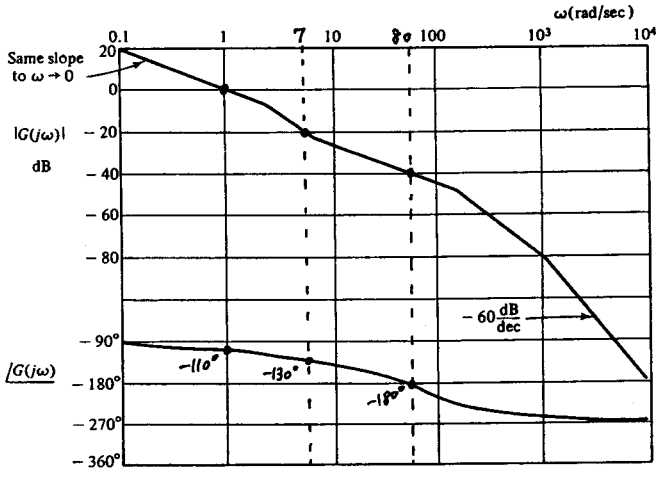

Fig. P. 7.

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