國立臺灣科技大學
八十八學年度碩士班招生考試試題

系所別：電機工程系碩士班　　組別：乙組　　科目：控制系統

共五題，滿分爲一百分

Problem 1. (20%)

The one-sided Laplace transform of a function $f(t)$ is defined as

$$F(s) = \int_{0^-}^{\infty} f(t)e^{-st}\,dt .$$

(a) For any pair of Laplace transform, show that $f(0^+) = \lim_{s\to\infty} sF(s)$.

(b) Let functions $u(t) = 0$ and $h(t) = 0$, for $t < 0$, show that $Y(s) = U(s)H(s)$, where

$$y(t) = \int_0^t u(\tau)\,h(t-\tau)\,d\tau = \int_0^t u(t-\tau)h(\tau)\,d\tau .$$

Problem 2. (20%)

A system transfer function, $H(s)$, has three poles at $s = -1,-2,-2$, one zero at $s = -3$, and dc gain $H(0) = 4$. Find its step response $y(t)$.

Problem 3. (20%)

Draw exactly four different signal-flow graphs to represent a linear system with following transfer function

$$H(s) = 5\frac{s+4}{s^3+6s^2+11s+6}.$$

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Problem 4. (20%)

The pole-zero configuration of $G(s)H(s)$ of a single-feedback-loop control system is shown in Fig. P.4(a). Without actually plotting, apply the angle-of-departure (and angle-of-arrival) property of the root loci to determine which one of the root-locus diagrams shown in Fig. P.4(b) to Fig. P.4(f) is the correct one. Note: Calculations of the angle-of-departure (and angle-of-arrival) are required. Give the figure number which has the correct root-locus diagram.

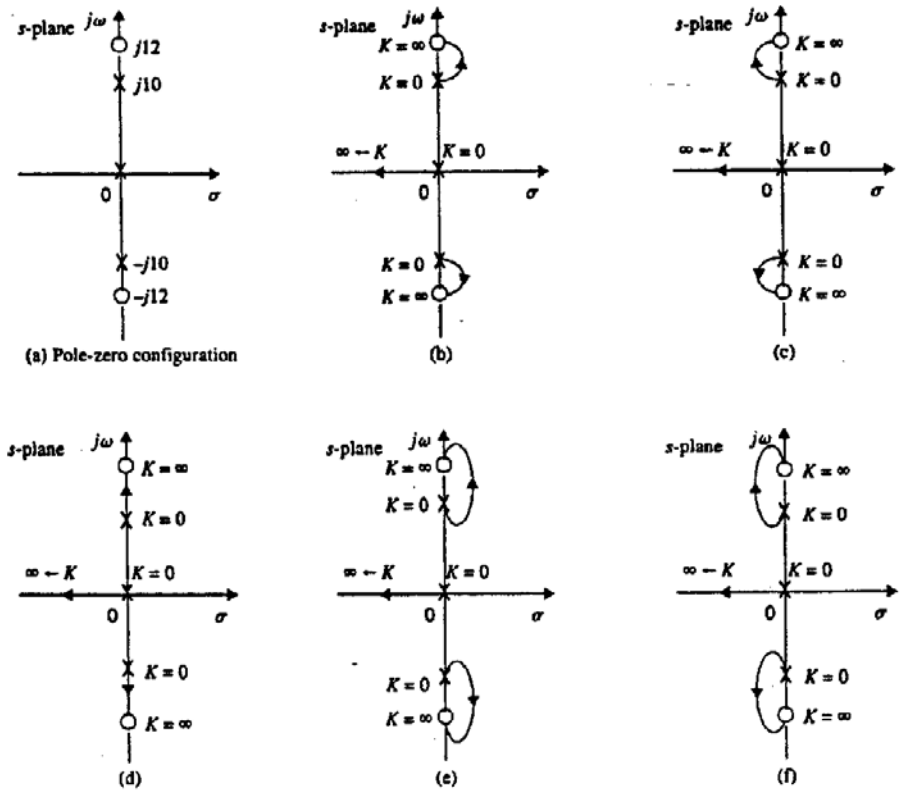

Fig. P.4. (a) The pole-zero configuration for Problem 4. (b)-(f) Possible root-locus configruations. Choose a correct one.

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Problem 5. (20%)

The Bode diagram of the forward-path transfer function of a unity-feedback control system is obtained experimentally and is shown in Fig. P.5 when the forward gain K is set at its nominal value.

(a) Find the gain and phase margins of the system from the diagram as best you can read. Find the gain and phase-crossover frequencies.

(b) Repeat part (a) if the gain is doubled from its nominal value.

(c) Repeat part (a) if the gain is 10 times its nominal value.

(d) Find out how much the gain must be changed from its nominal value if the gain margin is to be 40 dB.

(e) Find out how much the loop gain must be changed from its nominal value if the phase margin is to be 45°.

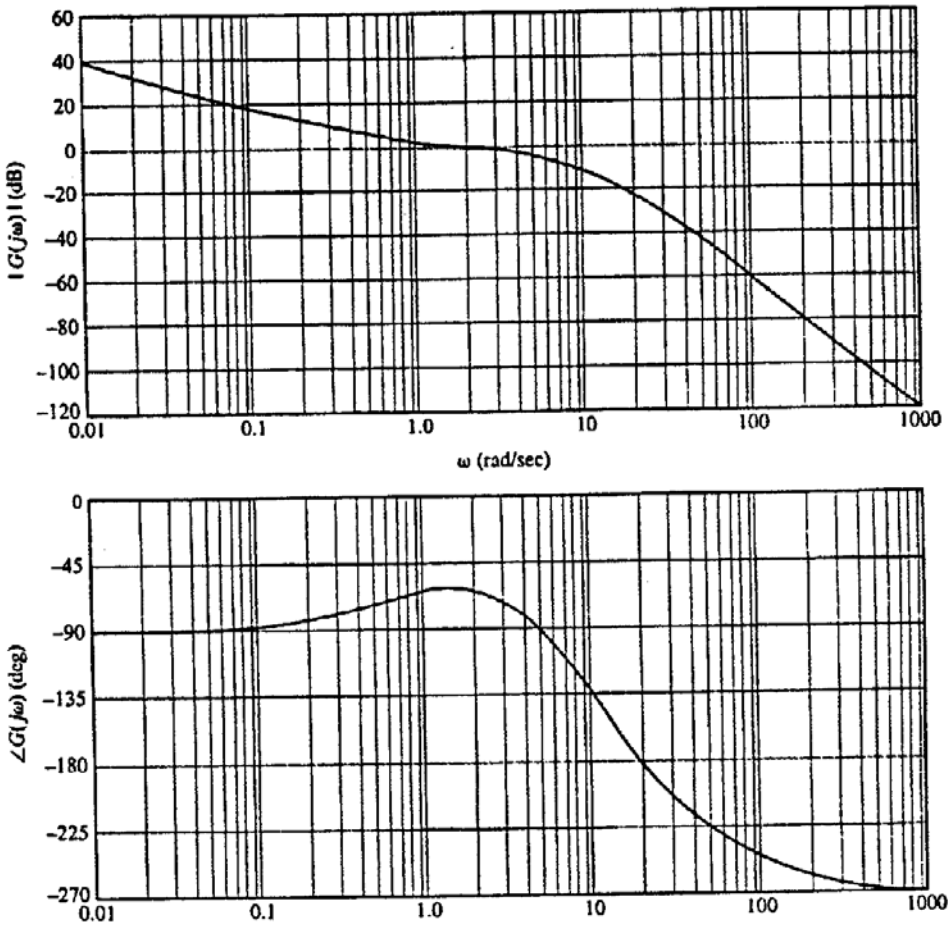

Fig. P.5. The Bode diagram for Problem 5.