國立臺灣科技大學

八十九學年度碩士班招生考試試題

系所組別：電機工程系乙一組、電機工程系乙二組

科　目：控制系統

共六題，滿分爲一百分

Problem 1. (20%)

A control system is shown in Fig. P. 1.

(a) Find $Y_2(s)/R_1(s)$.

(b) Determine a relationship for the system that will make $Y_2(s)$ independent of $R_1(s)$.

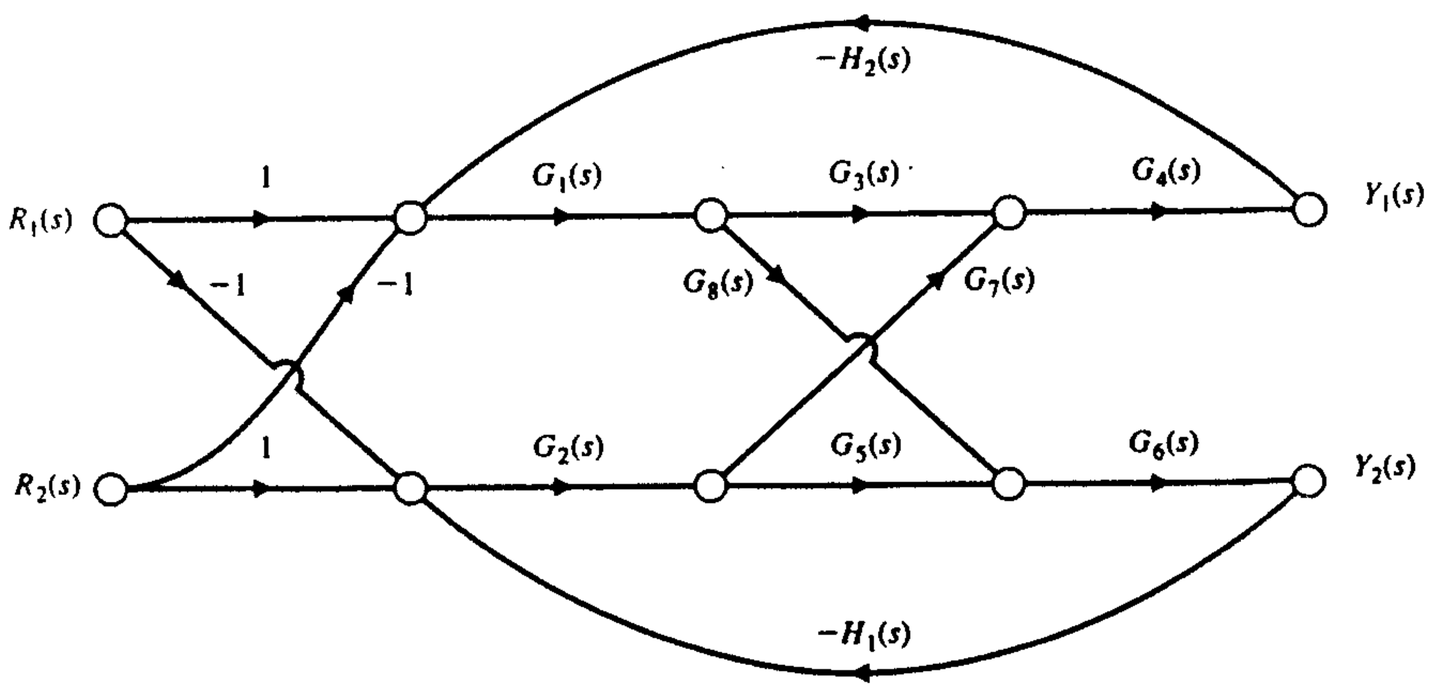

Fig. P. 1.

Problem 2. (10%)

The block diagram of a motor control system with tachometer feedback is shown in Fig. P. 2.

(a) Find the natural frequency of the system.

(b) Find the value of the tachometer constant K_t so that the damping is critical ($\xi = 1.0$).

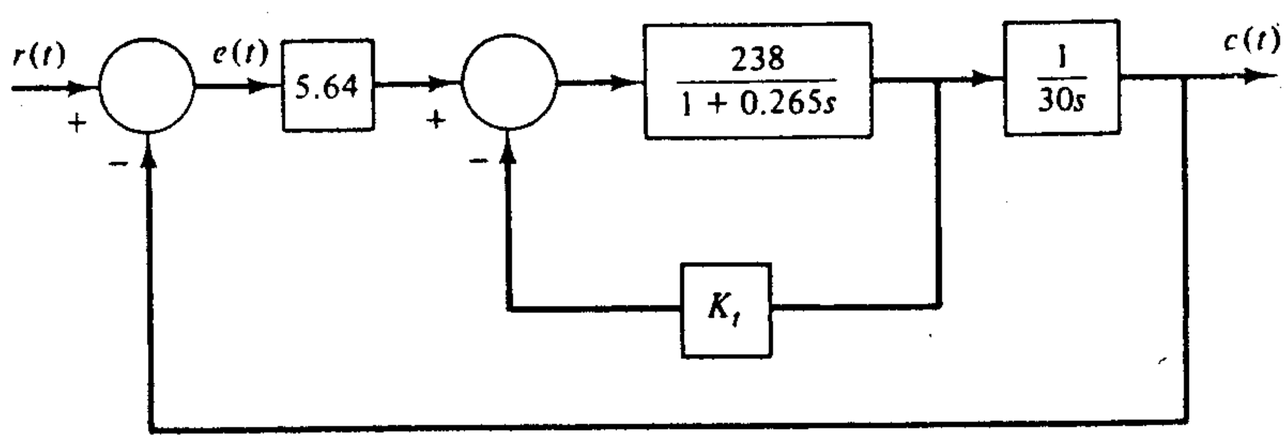

Fig. P. 2.

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Problem 3. (20%)

The block diagram of a feedback control system is shown in Fig. P. 3.

(a) Find the transfer function of the feedback control system.

(b) Construct a parameter plane of K_P versus K_D (K_P on the vertical axis and K_D on the horizontal axis), and show the region in which the system is overdamped (damping ratio > 1.0).

(c) Construct a parameter plane of K_P versus K_D (K_P on the vertical axis and K_D on the horizontal axis), and show the trajectory on which the natural undamped frequency ω_n is 40 rad/sec.

(d) Construct a parameter plane of K_P versus K_D (K_P on the vertical axis and K_D on the horizontal axis), and show the trajectory on which the parabolic error constant K_a is 40 $\sec^{-2}$.

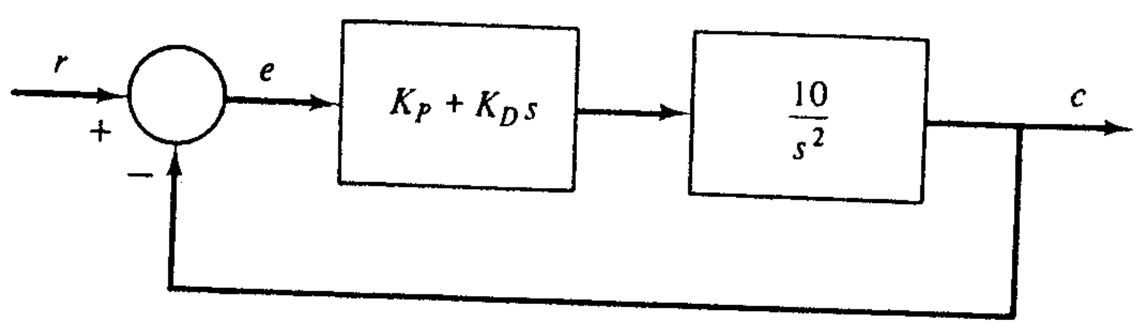

Fig. P. 3.

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Problem 4. (10%)

Determine the number of roots of the following equations that are in the right-half s-plane.

(a) $s^4 + 2s^3 + 10s^2 + 20s + 5 = 0$

(b) $s^6 + 2s^5 + 8s^4 + 15s^3 + 20s^2 + 16s + 16 = 0$

Problem 5. (20%)

A unity negative feedback system has the following open-loop transfer function

$$G(s) = \frac{K(s+1)}{s(s-3)} \quad , \quad K > 0$$

Sketch the root locus and determine the range of K so that the system is stable.

Problem 6. (20%)

For a unity negative feedback system with the following open-loop transfer function

$$G(s) = \frac{K(s-2)}{(s+1)^2} \quad , \quad K > 0$$

(a) Sketch the Nyquist plot of the system for a gain $K = 1$ and give your comments on the system stability in this case.

(b) Find the range of K for stability with the Nyquist stability criterion.