國立台灣科技大學九十七學年度碩士班招生試題

系所組別： 自動化及控制研究所碩士班乙組

科　　目： 控制系統

總分為 100 分。

題號請標示清楚，並請依序作答。

1. Find the closed-loop transfer function Y/Y_{sp} for the control system in Fig.1. (10%)

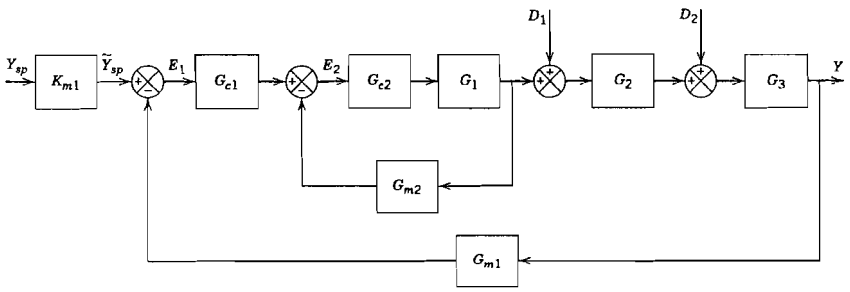

Fig. 1

2. For a second-order system with transfer function

$$G = \frac{3}{s^2 + 2s - 3}$$

determine the final value to a step input. (10%)

3. The transfer function of a plant system is given by

$$G = \frac{K(s+4)}{s[(s+0.5)(s+1)(s^2+0.4s+4)]}$$

Using Routh's stability criterion, determine the range of K for which this system is stable when the characteristic equation is $1 + G = 0$. (15%)

4. Consider the system

$$G_M = \frac{1}{s^2 + 2\xi s + 1}$$

We would like to add a transfer function of the form $G_C = K(s+a)/(s+b)$ in series with G_M in a feedback structure (as shown in Fig.2).

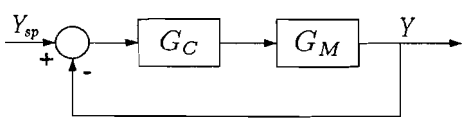

Fig. 2

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Ignoring stability, what are the constraints on $K, a,$ and b so that system type 1? (15%)

5. A plant (as shown in Fig.3) has open-loop transfer functions

$$G_M = \frac{K_M}{(\tau_0 s + 1)^2} \qquad G_L = \frac{K_L}{(\tau_0 s + 1)^2}$$

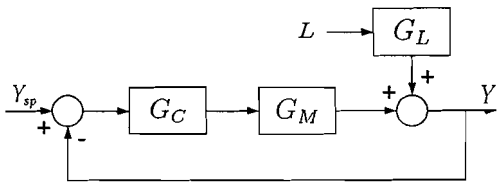

Fig.3

If a PI (Proportional-Integral) controller, $G_C = K_c\left(1 + \frac{1}{\tau_I s}\right)$, is used with τ_I set equal to τ_0, calculate

(1). The value of controller gain that gives a closed-loop damping coefficient of 0.707. (5%)

(2). The closed-loop time constant, using this value of gain. (5%)

(3). The closed-loop transfer function between the load variable L and the output variable Y. (5%)

(4). The steady-state error for a step change in the load variable L. (5%)

6. A plant (as shown in Fig.2) has the open-loop transfer function

$$G_M G_C = \frac{K_c(-3s + 1)}{(s + 1)(5s + 1)}$$

(1). Find the value of K_c that gives a phase margin of 45^0. (15%)

(2). Find the value of K_c that gives a gain margin of 2. (15%)