

# 國立中正大學

## 112 學年度碩士班招生考試

# 試題

### [第 1 節]

科目名稱	控制系統
系所組別	電機工程學系-電力與電能處理甲組

#### —作答注意事項—

※作答前請先核對「試題」、「試卷」與「准考證」之系所組別、科目名稱是否相符。

1. 預備鈴響時即可入場，但至考試開始鈴響前，不得翻閱試題，並不得書寫、畫記、作答。
2. 考試開始鈴響時，即可開始作答；考試結束鈴響畢，應即停止作答。
3. 入場後於考試開始 40 分鐘內不得離場。
4. 全部答題均須在試卷（答案卷）作答區內完成。
5. 試卷作答限用藍色或黑色筆（含鉛筆）書寫。
6. 試題須隨試卷繳還。

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系所組別：電機工程學系-電力與電能處理甲組

1. (20 %) The block diagram of a feedback control system is shown in Fig. 1.

(a) The controller with the transfer function  $H(s)$  is for the reduction of the effect of the noise  $N(s)$ . Find  $H(s)$  so that the output  $Y(s)$  is totally independent of  $N(s)$ .

(b) If the maximum overshoot of the unit-step input and the peak time are 10 % and 0.1 sec, respectively. Find the gains  $F_1$  and  $F_2$  when  $H(s)$  is as determined in part (a).

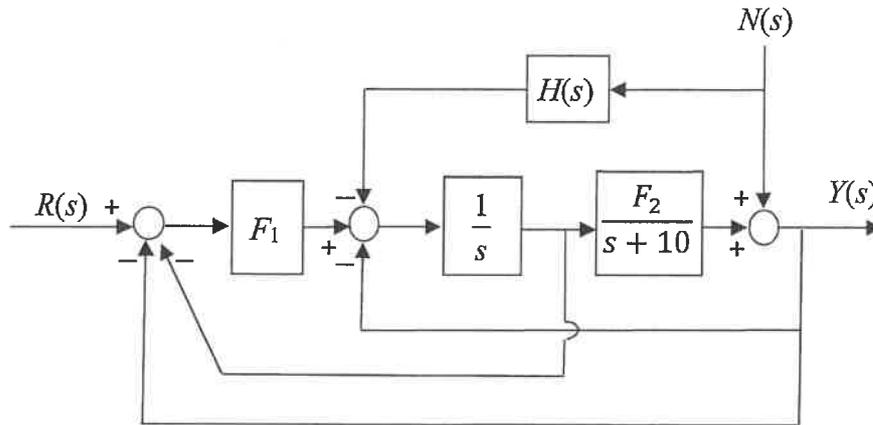


Fig. 1

2. (40 %) The transfer function of a unity feedback control system is

$$G(s) = \frac{F}{s(s+1)(s+5)}$$

(a) Using the Routh-Hurwitz criterion, determine how many roots of the characteristic equation are to the left of the line  $s = -1$  in the  $s$ -plane for  $F = 10$ .

(b) Determine if the point  $s = -7$  is a point on the loci of roots of the characteristic equation for  $F \geq 0$ . Use the angle criterion to test this point. If it is a point on a root locus, determine the value of  $F$  at this point by using the magnitude criterion.

(c) Using the Nyquist criterion only, find the number of poles of the closed-loop transfer function in the right half-plane, if  $F = 5$ .

(d) Find the value of  $F$  so that the phase margin of the system is  $45^\circ$ .

3. (40%) Given the system  $\frac{dx(t)}{dt} = Ax(t) + Bu(t)$ ,  $y(t) = Cx(t)$

where  $A = \begin{bmatrix} -1 & 5 \\ -6 & 0 \end{bmatrix}$ ,  $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$ ,  $C = [1 \ 0]$ .

(a) Determine the controllability and observability of the system.

(b) Let  $u(t) = r(t) - Fx(t)$ , where  $F = [F_1 \ F_2]$  and  $r(t)$  is the reference input. Determine if and how controllability and observability of the closed-loop system are affected by the elements of  $F$ .

(c) Find the value of  $F_1$  and  $F_2$  such that  $\xi = 0.707$  and  $\omega_n = 10$  rad/sec.

(d) Find the locus in the  $F_1$ -versus- $F_2$  plane ( $F_1 =$  vertical axis) on which the steady-state error due to a unit-step input is zero.