國立中正大學
108學年度碩士班招生考試
試 題

[第 1 節]

系所組別	電機工程學系－電力與電能處理甲組
科目名稱	控制系統

－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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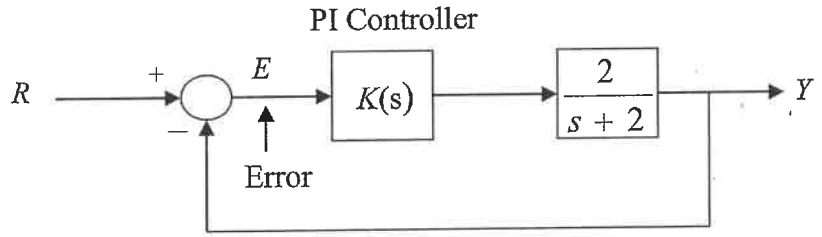
科目名稱：控制系統　　本科目共 1 頁　第 1 頁

系所組別：電機工程學系-電力與電能處理甲組

1. (20%) Design a PI controller ($K(s) = K_p + \frac{K_i}{s}$) for the system shown in the following figure such that the steady-state error with a step input is zero, the system is critically damped, and the natural undamped frequency is 4 rad/s.



2. (20%) The transfer function of a unity-feedback control system is

$$G(s) = \frac{100K}{s(s+10)(5s+10)}$$

(a) Find the value of K so that the gain margin of the system is 20 dB. (10%)

(b) Find the value of K so that the phase margin of the system is 45°. (10%)

3. (20%) Construct the root locus and the Nyquist plot for a unity-feedback control system with $K \geqq 0$

$$G(s) = \frac{K}{(s+5)^3}$$

4. (20%) Determine the condition on b_1, b_2, c_1, and c_2, so that the following system is controllable and observable.

$$\frac{dx(t)}{dt} = \begin{bmatrix} 2 & 2 \\ 0 & 2 \end{bmatrix} x(t) + \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} c_1 & c_2 \end{bmatrix} x(t)$$

5. (20%) A system is described by the differential equation:

$$\frac{d^3y(t)}{dt^3} + 3\frac{d^2y(t)}{dt^2} + 3\frac{dy(t)}{dt} + y(t) = r(t)$$

Let the state variables be defined as $x_1 = y$, $x_2 = dy/dt$, $x_3 = d^2y/dt^2$. (a) Check the stability of the system. (b) Find the state-transition matrix $\phi(t)$. (10%, 10%)