國立中正大學
113學年度碩士班招生考試
試 題

[第2節]

科目名稱	自動控制
系所組別	機械工程學系-乙組
	機械工程學系光機電整合工程

—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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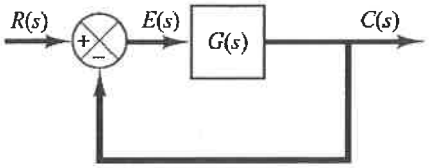
科目名稱：自動控制　　本科目共 2 頁 第 1 頁

系所組別：機械工程學系-乙組

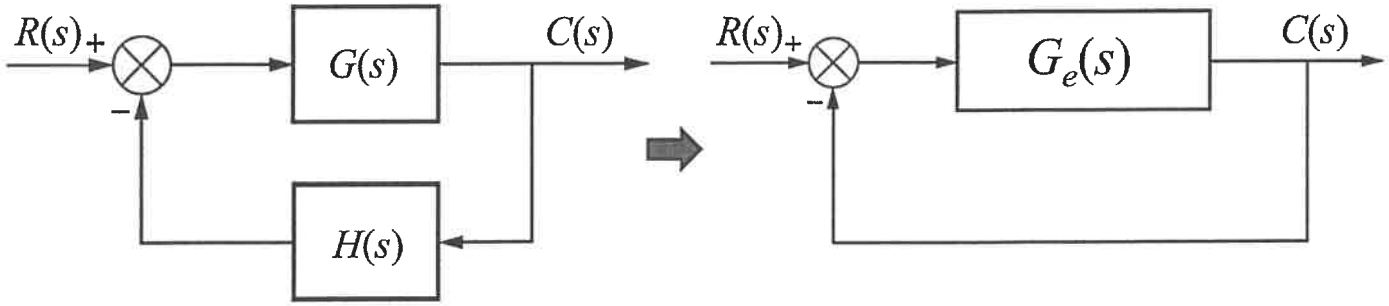
機械工程學系光機電整合工程

1. (10%) Given the following system, please report its natural frequency and damping ratio.

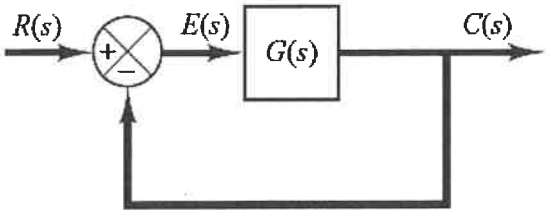


$$G(s) = \frac{4}{s(s+1)}$$

2. (20%) If the following two systems are equivalent, please derive the transfer function of $G_e(s)$.



3. (20%) Please derive the function of $E(s)$ in terms of $R(s)$ and $G(s)$. Please also use final value theorem to proof the following equations of steady state error with unit step, ramp, and parabolic inputs for the given open loop transfer function $G(s)$ with negative unity-feedback.



$$e_{step}(\infty) = \frac{1}{1+\lim_{s\to 0} G(s)} \qquad e_{ramp}(\infty) = \frac{1}{\lim_{s\to 0} sG(s)} \qquad e_{parabola}(\infty) = \frac{1}{\lim_{s\to 0} s^2 G(s)}$$

4. (25%) Consider a linear dynamics G, the transfer function of which is

$$G(s) = \frac{10s}{s^3 + 6s^2 + 11s + 6}.$$

It is found that the gain margin of G is infinite.

(a) (10%) Show this fact via Root Locus.

(b) (15%) Show this fact with Nyquist Criterion.

5. (25%) Consider a linear dynamic operator G, the transfer function of which is

$$G(s) = \frac{-s+1}{s(s+1)}.$$

(a) (15%) How much is the gain margin of G? Get the answer in frequency domain.

Let φ be a Relay operator defined by

$$\varphi(u) \equiv \begin{cases} 1 & \text{for } u \geq 0 \\ -1 & \text{for } u < 0 \end{cases}.$$

Then consider a new operator $\hat{G}$, defined by the composite of G and φ, that is

$$\hat{G} \equiv G\varphi .$$

(b) (10%) What is the gain margin of $\hat{G}$? Get the answer by Root Locus.