國立中正大學
109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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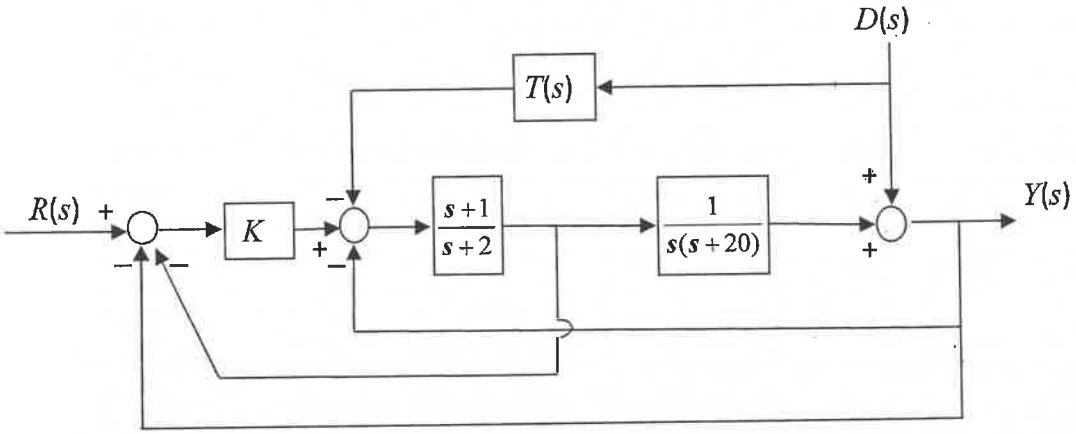
1. (30%) The block diagram of a feedback control system is shown in the figure.

(a) Derive the following transfer functions: $\left.\frac{Y(s)}{R(s)}\right|_{D=0}$ $\left.\frac{Y(s)}{D(s)}\right|_{R=0}$.

(b) Find $T(s)$ such that the output $Y(s)$ is totally independent of $D(s)$.

(c) Find the value of K so that the steady-state error is zero when the input is $r(t)=u_s(t)$ and $T(s)$ is as determined in part (b).



2. (50%) The characteristic equation of a unity-feedback control system is given in the following equation:

$$s^3+6s^2+5s+K=0$$

(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 K =10.

(b) Find the value of K that makes the relative damping ratio of the closed-loop system (measured by the dominant complex characteristic equation roots) equal to 0.707.

(c) Apply the Nyquist criterion to determine the values of K for system stability.

(d) Find the value of K so that the gain margin of the system is 40 dB.

(e) Design a phase-lag compensator such that the steady-state error to unit ramp input is less than 5 % and the phase margin is greater than 70°.

3 (20%) Figure shows a circuit where the $v(t)$ is an input, the voltage of the R_2 is output, and the capacitor voltage and the inductor current are the state variables.

(a) Write the dynamic equations (state equations and output equations) and the characteristic equation.

(b) Determine the conditions that the system is controllable and observable.