國 立 臺 北 科 技 大 學

103 學年第一學期電機系博士班資格考試

控制系統(大學部) 試題

注意事項：

1. 本試題共 4 題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。
4. 考試時間:二小時。
5. 可用計算機。

1. [20%] Determine the transfer functions from R to Y for the block diagrams in Fig. 1.
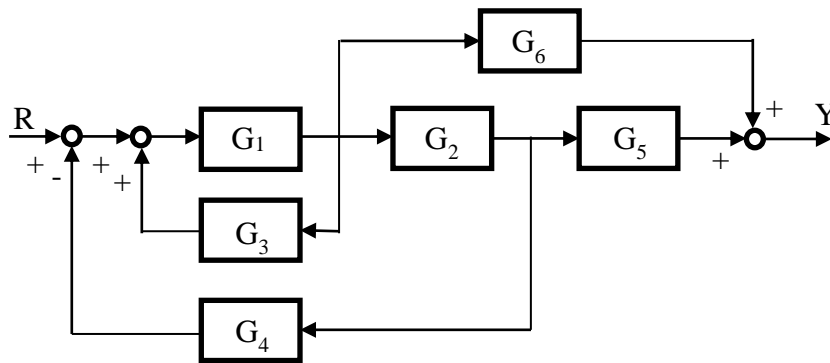

Fig. 1

2. [40%] Consider the standard second-order system.

$$G(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

(1) [20%] Determine the step response.

[Hint] : Apply inverse Laplace transform to $G(s) \cdot \dfrac{1}{s}$.

(2) [20%] Derive the peak time t_p.

[Hint] : Find the time when the step response reaches the maximum.

3. [20%] For the system in Fig. 2, sketch the root locus of the system as the parameter K varies from 0 to ∞. Be sure to give the asymptotes, arrival or departure angles, break away or break in points, and the frequency of any imaginary-axis crossing, if applicable.

$$R(s) \xrightarrow{\quad} \underset{\substack{+ \\ -}}{\bigcirc} \xrightarrow{\quad} \boxed{K} \xrightarrow{\quad} \boxed{\dfrac{1}{s^3 + 14s^2 + 98s}} \xrightarrow{\quad} Y(s)$$
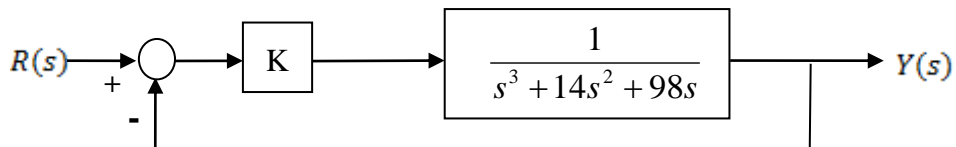
Fig. 2

4. [20%] Sketch the asymptotes of the Bode plot magnitude and phase for the following open-loop transfer function.

$$G(s) = \frac{2000s + 1000}{s^3 + 90s^2 + 1400s}$$