國 立 臺 北 科 技 大 學

105 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

第一頁　共一頁

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. Consider the ideal OP-amp circuit realization shown in Fig. 1.

   (a) (20%) Find the transfer function.

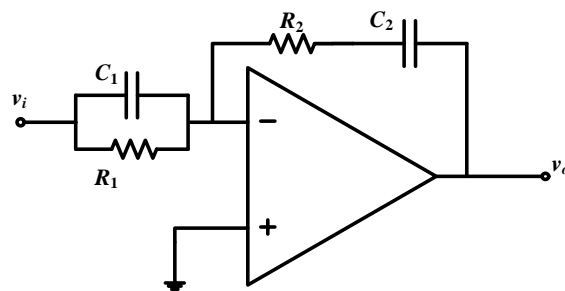   (b) (5%) Specify which kind of controller the circuit belongs to.

Fig. 1

2. Consider the polynomial $s^5 + 8s^4 + 25s^3 + 40s^2 + Ks + 12 = 0$.

   (a) (15%) Determine the range of K for system remaining stable.

   (b) (10%) Find the oscillation frequencies if there are roots on the $j\omega$ axis.

3. For the system

$$\dot{x}(t) = \begin{bmatrix} -5 & -6 \\ 1 & 0 \end{bmatrix} x(t) + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u(t), \quad x(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}.$$

$$y(t) = \begin{bmatrix} 1 & 0 \end{bmatrix} x(t)$$

(a) (5%) Write the corresponding state transition equation.
(b) (10%) Find the corresponding transition matrix.
(c) (10%) Calculate the output $y(t)$ if $u(t)$ is a unit step function.

4. (25%) Determine the controllability and observability of the following system:

$$\dot{x}(t) = \begin{bmatrix} 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 3 \end{bmatrix} x(t) + \begin{bmatrix} 0 & 0 \\ 0 & 1 \\ 1 & 1 \\ 1 & 0 \end{bmatrix} u(t)$$

$$y(t) = \begin{bmatrix} 1 & 0 & 2 & 0 \\ 1 & 0 & 0 & 3 \end{bmatrix} x(t)$$