

國立臺北科技大學九十六學年度碩士班招生考試

系所組別：1512 自動化科技研究所甲組

第二節 自動控制 (選考) 試題

第一頁 共一頁

**注意事項：**

1. 本試題共 6 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. (15%) Consider a system

$$\dot{x} = \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 0 \\ 0 & 1 & 1 \end{bmatrix} x + \begin{bmatrix} 0 & 1 \\ 1 & 0 \\ 0 & 1 \end{bmatrix} u, \quad y = [1 \ 1 \ 1]x.$$

Is it controllable? If  $x = [x_1 \ x_2 \ x_3]^T$ , find the reduced and controllable equation

$$\dot{\bar{x}}_c = \bar{A}_c \bar{x}_c + \bar{B}_c u, \quad y = \bar{C}_c \bar{x}_c \quad \text{and the vector of controllable states, i.e. } \bar{x}_c.$$

2. (15%) There is a system described by the state variable equations

$$\dot{x} = \begin{bmatrix} -1 & 1 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -2 \end{bmatrix} x + \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} u,$$

$$y = [1 \ 1 \ 1]x.$$

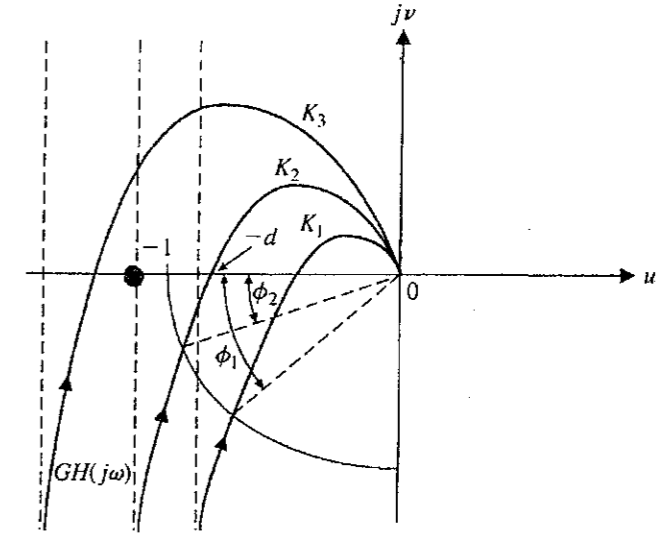
Determine the transfer function  $G(s) = Y(s)/U(s)$ .

3. (10%) A system has a transfer function

$$G(s) = \frac{4(1+s/3)}{s(1+2s)(1+s/7+s^2/49)}.$$

Show that the phase margin is approximately  $30^\circ$  and that the gain margin is approximately 16 dB.

4. (15%) How can you obtain the **gain margin** and the **phase margin** of each system using the following Nyquist plot (polar plot)? There are three systems,  $K_1$ ,  $K_2$ , and  $K_3$ , in the plot.



5. (20%) Give a system in Fig. 1, where

$$\dot{x} = \begin{bmatrix} 2 & 1 \\ -1 & 1 \end{bmatrix} x + \begin{bmatrix} 1 \\ 2 \end{bmatrix} u, \quad y = [1 \ 1]x.$$

Find the state feedback gain  $k$  using **two different methods**, so that the state feedback system has  $-1$  and  $-2$  as its eigenvalues.

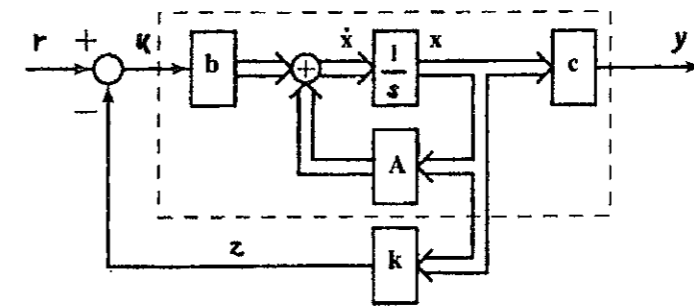


Figure 1

6. (25%) Consider various dynamic systems including linear systems, nonlinear systems, time invariant systems and time varying systems. How do you define and determine their controllability, observability, and stability of the systems, respectively? Please explain your answers.