

國立臺北科技大學

九十七學年第二學期電機系博士班資格考試

數位控制理論與應用試題(公告用)

第一頁 共一頁

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注意事項：

1. 本試題共【5】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。

(1) (20 %)

- a. What are the definitions for the reachability and the controllability of a discrete system?
- b. Given an example to show the difference.

(2) (20 %) Consider the difference equation

$$y(k+2) - 5y(k+1) + 6y(k) = u(k)$$

where $y(0)=1$ and $y(1)=0$ and $u(k)$ the discrete impulse function.

- a. Find the Z-transform $Y(z)=?$
- b. Find $y(k)=?$

(3) (10 %) Consider $z^2 + a_1z + a_2 = 0$. Determine the stable region in the $a_1 - a_2$ plane.

(4) (20 %) Consider the system $x(k+1) = A x(k) + B u(k)$

$$\text{where } A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \quad B = \begin{bmatrix} \frac{1}{2} \\ 1 \end{bmatrix}$$

Determine a linear feedback such that the characteristic equation of the closed-loop system is $z^2 + p_1 z + p_2 = 0$.

(5) (30 %) Consider a system with a state equation $\dot{x} = Ax + Bu$.

Assume the control is applied from the computer by a Zero-Order hold, i.e.,

$$u(\tau) = u(kT), \quad kT \leq \tau < kT + T$$

where T is the sampling interval. Then, we have an exact discrete representation as given by,

$$x(k+1) = \Phi x(k) + \Gamma u(k).$$

a. Derive the general form of the matrices $\Phi = ?$ $\Gamma = ?$

b. Let $A = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix}$ and $B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$. Then, $\Phi = ?$ $\Gamma = ?$

c. Let $y = [1 \ 0]x$. Find the transfer function $Y(z)/U(z) = ?$