國立臺北科技大學

九十七學年第一學期電機系博士班資格考試

數位控制理論與應用試題

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 %) Briefly explain the following terminologies:

a. Bilinear transformation;

b. Deadbeat response;

c. Jury stability test;

d. Reachability;

e. Bounded-input-bounded-output stability.

(2) (20 %) Consider a zero-order hold preceded by a sampler. Let x(t) be the input to the sampler and y(t) the output of the zero-order hold. Supposed that the input-output relationship is expressed by

$$y(t) = x(0)[1(t) - 1(t-T)] + x(T)[1(t-T) - 1(t-2T)] + x(2T)[1(t-2T) - 1(t-3T)] + x(3T)[1(t-3T) - 1(t-4T)] + \ldots..$$

where $x(0)=3$, $x(T)=4$, $x(2T)=7$, $x(3T)=6$, $x(4T)=5$.

a. Draw possible curves for input x(t) and y(t);

b. Find Y(s);

c. Find the transfer function of the zero-order hold.

(3) (20 %) Consider the discrete-time system

$$x(k+1) = A\,x(k)$$

Choose the Lyapunov function for this system is V(x(k))=x*(k)Px(k) ('*' means 'transpose').

a. Derive the Lyapunov equation A*PA-P=-Q, which can determine the stability of the system;

b. If $A=\begin{bmatrix} 0 & 1 \\ -0.5 & -1 \end{bmatrix}$, find the matrix P and determine the stability of the system.

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

where $A=\begin{bmatrix} 0 & 1 \\ -0.2 & -1 \end{bmatrix}$ $B=\begin{bmatrix} 0 \\ 1 \end{bmatrix}$

Determine a suitable state feedback gain matrix such that the closed-loop system will have the poles at z= 0.5+j0.5 and z=0.5-j0.5.

(5) (20 %) Consider a system with transfer function given by $Y(s) = \dfrac{1}{s(s+1)}U(s)$.

a. Let x1=y and x2=dy/dt. Find the state space representation;

b. Let the sampling interval be T. Find its sampled data system;

c. Find the transfer function of the sampled data system.