[06 – 4123]

IV/IV B.E. DEGREE EXAMINATION.

First Semester

Electrical and Electronics Engineering

DIGITAL CONTROL SYSTEMS

(Effective from the Admitted Batch of 2006–2007)

(Common with M.S)

Time : Three hours Maximum : 70 marks

Question No.1 is compulsory.

Answer any FOUR from the remaining questions.

All questions carry equal marks.

1. (a) State the principle of sampling theorem.

   (b) Name the various theorems of Z-transform.

   (c) Define Z-transfer function.

   (d) What is meant by multi-rate discrete data system?

   (e) Write the expression for Non-homogeneous state equation.

   (f) List the methods of deriving the state transition equations.

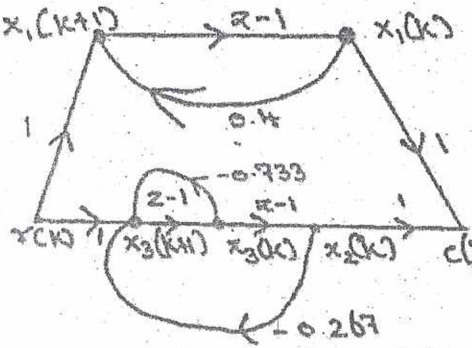
   (g) Explain the Jury's stability test.

6. Decompose the transfer functions by cascade decomposition and draw the state diagrams. Write the discrete state equations in vector matrix form.

(a) $$\frac{C(z)}{R(z)}=\frac{Z-0.1}{(Z-0.5)(Z-0.8)}$$

(b) $$\frac{C(z)}{R(z)}=\frac{Z}{(Z-0.2)(Z-1)}.$$

7. The state diagram of a digital control system is shown in figure. Determine the controllability and observability of the system.



8. The characteristic equations of Linear discrete data system are given below. Determine the values of K for the systems to be Asymptotically stable

(a) $Z^4+0.2Z^3-0.25Z^2-0.05Z+K=0$

(b) $Z^3+5Z^2-Z+5K=0$

(c) $Z^3+Z^2-Z+K=0.$

$Cp(z) = \frac{27.8(S+1)}{S(S^2+6S+48.6)}$; the sampling period.

(a) Determine the modified Z-transform of the output $C(z,m)$ for a unit step input.

(b) Find $C(z)$ by setting $m=1$ in $C(z,m)$.

(c) Find $C(KT,m)$ by means of inversion formula.

(d) Find $C(KT)$ from $C(z)$ and compare with $C(KT,m)$ for $m \neq 1$.

5. Consider the system

$$X = \begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} U$$

$$Y = [1 \quad 0] X.$$

A similarity transformation is defined by

$$X = P\overline{X} = \begin{bmatrix} 2 & -1 \\ -1 & 1 \end{bmatrix} \overline{X}.$$

(a) Express the state model in terms of the states $\overline{X}(t)$.

(b) Draw state diagrams in signal flow graph form for the state models in $X(t)$ and $\overline{X}(t)$.

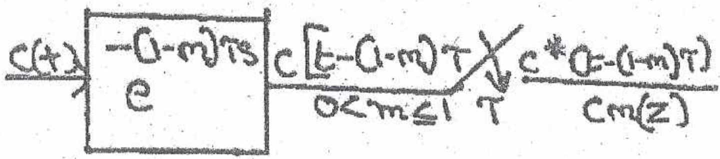
(c) Show by Mason's gain formula that the transfer functions for the two state diagrams are equal.

2. (a) Explain the block diagram representation of sample and hold operation.

(b) Define ZOH and obtain the transfer function of ZOH device.

3. (a) Given $f_1(t)=t^2 Us^{(t)}$ and $f_2(t)=e^{-2t}Us^{(t)}$, find the Z-transform of $f_1(t)$ and $f_2(t)$ by means of the partial differentiation theorem of Z-transform.

(b) Consider the sampled-data system with non-integral time delay shown in figure.



Assume that $C_{(+)}=0$ for $t<o$ and show that the Z-transform of the output is $C_m(z)=Z^{-1}\sum_{k=0}^{\infty}C[(k+m)T]Z^{-K}$.

4. The open loop transfer function of the digital control system shown in fig is