Total No. of Questions : 12] **SEAT No. :**

P1846 **[Total No. of Pages : 3**

[5059]-145

B.E. (Electrical)

DIGITAL CONTROL SYSTEMS

(2008 Pattern) (Elective - IV) (Semester - II)

Time : 3 Hours] ***[Max. Marks : 100***

Instructions to the candidates:

1) ***Answer any one question from each pair of questions : Q.1 & Q.2, Q.3 & Q.4, Q.5 & Q.6, Q.7 & Q.8, Q.9 & Q.10, Q.11 & Q.12.***
2) ***Answers to the two sections must be written in separate answer books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***
5) ***Use of Calculator is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Discuss the advantages and limitations of Digital Control System. **[8]**

b) Check whether the following systems are **[8]**

i) Static or Dynamic

ii) Linear or Non linear

iii) Time variant or Time invariant

iv) Causal or Non causal

1) $Y(n) = X(n) + n\,X(n+1)$

2) $Y(n) = nX^2(n)$

OR

Q2) a) Which are the standard discrete input test signals? Explain them with diagrams. **[8]**

b) Explain the sampling and reconstruction process, state the sampling theorem and give its importance. **[8]**

P.T.O.

Q3) a) State and prove important properties of Z-transform. **[6]**

b) Find the Z-transform of the sequence:

i) $X(t) = e^{-at} \sin \omega t$

ii) $F(k) = (1/2)^k$, for k = 0, 1, 2 .... **[12]**

OR

Q4) a) Expain different methods of obtaining Inverse Z-transform. **[6]**

b) Determine Inverse Z-transform of the following : **[12]**

i) $X(z) = \dfrac{z-4}{(z-1)(z-2)^2}$ by partial fraction expansion.

ii) $X(z) = \dfrac{4z}{(z+0.5)^2}$ for IZI > 0.5

Q5) a) Show with proper diagrams mapping of Left half of S-plane into Z-plane. **[8]**

b) Examine the stability of system by Jury's test. **[8]**

$F(z) = Z^3 + 3Z^2 + 2Z - 3 = 0$

OR

Q6) a) Explain the effect of sampling period on the transient response and on the stability of discrete time system. **[8]**

b) Describe the general rules for constructing the Root Loci in designing LTI discrete time control system. **[8]**

SECTION - II

Q7) a) Explain discretization of continuous-time state space equation. **[8]**

$X^o = Ax + Bu; \quad Y = Cx + Du$

b) Obtain STM of the following difference equation **[8]**

$X(k + 1) = GX(k) + Hu(k)$

where $G = \begin{bmatrix} 0 & 1 \\ -0.2 & -1 \end{bmatrix}$; $H = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$

OR

Q8) a) Explain clearly with neat diagrams, the Direct, Cascade and Parallel decompositions of Discrete Time Pulse Transfer Function. **[8]**

b) By using any one method, determine the discrete time state space model for a system having pulse transfer function **[8]**

$$\frac{Y(Z)}{R(Z)} = \frac{Z + 0.1}{(Z-1)(Z-0.8)}$$

Q9) a) What is the principle of duality? Also explain effect of pole zero cancellation on the system with suitable example. **[8]**

b) Consider a system with matrices **[8]**

$$G = \begin{bmatrix} 0 & 1 \\ 0.16 & -1 \end{bmatrix};\ H = \begin{bmatrix} 0 \\ 1 \end{bmatrix}.$$

Determine a suitable state feedback gain matrix K such that a system will have closed loop poles at Z = 0.5 + j0.5 and Z = 0.5 – j0.5

OR

Q10) a) What is Full order observer? With the help of a block diagram expain it. **[8]**

b) For the system X (K + 1) = GX (k) + H U(K) ; Y (k) = C X (k) where

$$G = \begin{bmatrix} 0 & 20.6 \\ 1 & 0 \end{bmatrix},\ H = \begin{bmatrix} 1 \\ 0 \end{bmatrix} \text{ and } C = [1\ 0].$$ **[8]**

Design a full order state observer for the desired eigen values of observer matrix.

As $Z_1 = -1.8 + j2.4$ & $Z_2 = -1.8 - j2.4$

Q11) a) Draw neat diagram of Digital temperature control scheme and explain it. **[8]**

b) Consider the pulse transfer function of discrete time system given as

$$\frac{Y(Z)}{U(Z)} = \frac{b_0 Z^n + b_1 Z^{n-1} + b_2 Z^{n-2} + ... + b_n}{Z^n + a_1 Z^{n-1} + a_2 Z^{n-2} + ... + a_n}$$

Determine its Controllable canonical form & Observable canonical form. **[10]**

OR

Q12) a) Explain stepper motor with proper block diagram. **[8]**

b) Consider the system defined by $G(z) = \frac{z^3 + 8z^2 + 17z + 8}{(z+1)(z+2)(z+3)}$.

Obtain the space representation for this system in Jordan canonical form. **[10]**