

Total No. of Questions : 12]

SEAT No. :

P1157

[Total No. of Pages : 4

[4659] - 84

B.E. (Electrical)

DIGITAL CONTROL SYSTEMS

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

Time : 3 Hours]

[Max. Marks : 100

Instructions to the candidates :

- 1) *Answers to the two sections should be written in separate answer books.*
- 2) *Solve Q.1 or Q.2 Q.3 or Q.4 Q.5 or Q.6, Q.7 or Q.8, Q.9 or Q.10, Q.11 or Q.12.*
- 3) *Figures to the right side indicate full marks.*
- 4) *Use of calculator is allowed.*
- 5) *Assume suitable data, if necessary.*

SECTION - I

- Q1)** a) Discuss the advantages and limitations of Digital control system. [8]
- b) A discrete system is given as: [8]
- $$Y(n) = x(n) + 3u(n+1);$$
- with proper justification determine whether the system is
- i) Static or Dynamic
 - ii) Linear or Nonlinear
 - iii) Shift invariant or shift variant
 - iv) Stable or Unstable

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]
- Q3)** a) Derive the Z - transform of: i) Unit impulse; ii) Delayed unit impulse and iii) Unit ramp. [8]
- b) Determine the Z-transform and ROC of the following signals. [8]
- i) $X(n) = [3(4)^n - 5(3)^n] u(n)$, using Linearity property
 - ii) $X(n) = (\cos \omega_0 n) u(n)$ ----- use Euler's identity

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OR

- Q4)** a) Explain different methods of obtaining inverse Z - Transform [8]
 b) Determine inverse Z-transform of the following. [8]

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

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

- Q5)** a) Show with proper diagrams mapping of Left Half of the S-plane is into Z-plane. [9]
 b) Examine the stability of the system by Jury's test, whose characteristic equation is: [9]

$$F(z) = Z^4 - 1.2Z^3 + 0.07Z^2 + 0.3Z - 0.08 = 0$$

OR

- Q6)** a) Describe the general rules for constructing the Root Loci in designing LTI discrete time control system. [9]
 b) The characteristic equation of discrete time unity feedback control system is given by : [9]

$$Z^3 + (3K)Z^2 + (K+2)Z + 4 = 0$$

Determine the range of gain K for stability of the system by use of Jury's stability test.

SECTION - II

- Q7)** a) Discuss the various methods used for computation of state transition matrix (STM) from the given state difference equation $x(k+1) = Gx(k) + Hu(k)$. [8]
 b) Evaluate the pulse transfer function $\frac{Y(z)}{U(z)}$ from the state variable model of a discrete time system with usual notation. [8]

$$x(k+1) = \begin{bmatrix} 0.8 & 1 \\ 0 & 0.5 \end{bmatrix} x(k) + \begin{bmatrix} 1 \\ 0.5 \end{bmatrix} u(k)$$

$$y(k) = \begin{bmatrix} 1 & 0 \end{bmatrix} x(k)$$

OR

Q8) a) Explain clearly with neat diagrams, the direct, cascade and parallel decompositions of discrete time pulse transfer function. [8]

b) Obtain STM & its solution of the difference equation $x(k+1) = Gx(k)$
Where [8]

$$G = \begin{bmatrix} 0 & 1 \\ -0.2 & -1 \end{bmatrix}; X(0) = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

Q9) a) What is principle of duality? Explain the effect of pole - zero cancellation on controllability & observability. [8]

b) Given

$$x(k+1) = \begin{bmatrix} 0.1 & 0.1 & 0 \\ 0.3 & -0.1 & -0.2 \\ 0 & 0 & -0.3 \end{bmatrix} x(k) + \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix} u(k)$$

$$\& y(k) = \begin{bmatrix} 1 & 0 & 1 \end{bmatrix} x(k)$$

Determine controllability and observability of the system. [8]

OR

Q10)a) Explain full order observer with proper block diagram. [8]

b) Design a full state observer for the system having [8]

$$G = \begin{pmatrix} 0 & 20.6 \\ 1 & 0 \end{pmatrix}; H = \begin{pmatrix} 1 \\ 0 \end{pmatrix}; C = [0 \ 1]$$

Desired eigen values of observer matrix are $Z = -1.8 + j2.4$, and $Z = -1.8 - j2.4$.

Q11)a) Draw a neat block diagram of digital position control scheme and Explain the function of each block. **[8]**

b) Consider the pulse transfer function of discrete time system given as **[10]**

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

Determine its controllable canonical form & observable canonical form.

OR

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

b) Consider the system defined by **[10]**

$$\frac{Y(z)}{U(z)} = \frac{4z^2 - 3z + 0.5}{z^3 + z^2 - z - 0.75}$$

Determine state space representation in controllable canonical form.

