Total No. of Questions : 12]

SEAT No. :

P1157

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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) + 3 u (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) $X(n) = (\cos w_o n)\, u(n)$----- 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 IZI > 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]**

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

y (k) = [[1 0] 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

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

$$\&\, y(k)=[1\ 0\ 1\ ]x(k)$$

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.

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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]**

$$\frac{Y(z)}{U(z)} = \frac{b_o z^n + b_1 z^{n-1} + b_2 z^{n-2} + \text{-------} + b_n}{z^n + a^1 z^{n-1} + a_2 z_{n-2} + \text{--------} + a_n}$$

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]**

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

Determine state space representation in controllable canonical form.