Total No. of Questions : 8]

SEAT No. :

**P3317**

[Total No. of Pages : 3

**[5461]-573**

**B.E. (Electrical)**

**CONTROL SYSTEM - II**

**(2015 Pattern) (Semester-I)**

*Time : 2½ Hours]* *[Max. Marks : 70*

***Instructions to the candidates:***

1) *Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6, Q.7 or Q.8.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right indicate full marks.*
4) *Assume suitable data, if necessary.*

***Q1)*** a) Explain in detail ZOH and FOH operation. Draw suitable diagrams. **[6]**

b) Obtain inverse z transform using partial fraction method. Given that

$$X(Z)=\frac{1+3z^{-1}}{1+3z^{-1}+2z^{-2}} \quad |z|>2.$$ **[6]**

c) Using Jury stability test comment on the stability of the system described by the characteristic equation. **[8]**

$z^4 + 3.5z^3 + 5z^2 + 2z + 0.5 = 0$

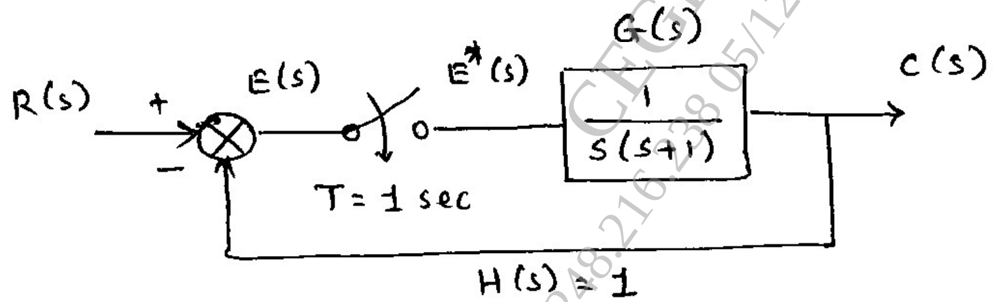
OR

***Q2)*** a) State and explain Shannon's Sampling theorem. Also discuss aliasing effect. **[6]**

b) Explain with neat diagrams direct digital programming and standard digital programming. **[6]**

c) Obtain the Z-transfer function for the following closed loop system using the relation **[8]**

$$\frac{C(Z)}{R(Z)}=\frac{G(Z)}{1+GH(Z)}$$



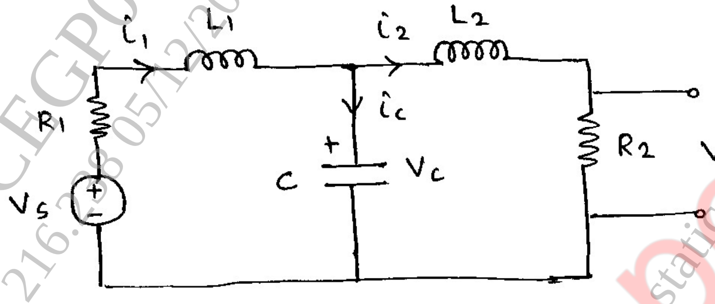

*P.T.O.*

*Q3)* a) State advantages of state space representation over transfer function approach. **[4]**

b) With block diagram representation and writing down necessary equations, obtain state model in phase variable form for following transfer function.

$$\frac{Y(s)}{U(s)} = \frac{25}{(s+1)(s+4)(s+5)}$$ **[6]**

c) Obtain the state model for following electrical network. Choose $i_1$, $i_2$ and $V_c$ as state variables. **[8]**




OR

*Q4)* a) Convert the given state model into transfer function. **[4]**

$$\dot{X} = \begin{bmatrix} -4 & -1.5 \\ 4 & 0 \end{bmatrix} X + \begin{bmatrix} 2 \\ 0 \end{bmatrix} u \ and \ \ y = [1.5 \quad 0.625]\, X$$

b) Define the terms **[6]**

i) state ii) state variables

iii) state vector iv) state space

c) Explain in detail canonical and Jordan canonical form of state space representation. Also draw suitable diagrams. **[8]**

*Q5)* a) Obtain state transition matrix (STM) using cayley Hamilton theorem.

Given that $A = \begin{bmatrix} 0 & 1 \\ -8 & -6 \end{bmatrix}$ **[6]**

b) Diagonalize following system using modal matrix and obtain $\overline{A}$ *and* $\overline{B}$. **[10]**

$$\dot{X} = \begin{bmatrix} 0 & 1 & -1 \\ -6 & -11 & -6 \\ -6 & -11 & 5 \end{bmatrix} X + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

OR

*Q6)* a) State and derive properties of state Transition Matrix. **[6]**

b) Obtain state response and output response for the system represented by the homogeneous state equation. **[10]**

$$X = \begin{bmatrix} 0 & 1 \\ -6 & -5 \end{bmatrix} X \ and \ y = [1 \quad 1]\ X \ Take \ X0 = [1 \quad 1]^T.$$

*Q7)* a) What is Gilbert's test for observability? Explain the same for following cases – **[8]**

i) Distinct eigenvalues

ii) Repeated eigenvalues

iii) MIMO system

b) Design a state feedback grain matrix K for the following system using Ackermann's formula if it is desired to place the poles at $-3 \pm j2$. **[8]**

$$\dot{X} = \begin{bmatrix} -1 & 0 \\ 1 & -2 \end{bmatrix} X + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

OR

*Q8)* a) Explain with proof Duality property. Write a state model for dual system of following **[8]**

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -12 & -7 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$y = [1 - 2]x$

b) Using suitable diagram explain the need and concept of state Observer. **[8]**

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