Total No. of Questions : 8]

SEAT No. :

P-7861

[Total No. of Pages : 3

[6181]-126A
B.E. (Electrical)
ADVANCED CONTROL SYSTEM
(2019 Pattern) (Semester-VII) (403142)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates :

1) *Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.*
2) *Neat diagrams must be drawn wherever necessary.*
3) *Figures to the right indicate full marks.*
4) *Use of algorithm tables slide rule and electronic pocket calculator is allowed.*
5) *Assume suitable data, if necessary.*

Q1) a) Determine State Transition matrix using Caley Hamilton method having **[6]**

$$A=\begin{bmatrix}0 & -1\\ 2 & -3\end{bmatrix}.$$

b) Define i) State ii) State Variables iii) State Space representation. **[6]**

c) Consider the state model with A as **[6]**

$$\begin{bmatrix}0 & 2 & 0\\ 4 & 0 & 1\\ -48 & -34 & -9\end{bmatrix}$$

Obtain Eigen values, Eigen vectors and Model matrix for matrix A.

OR

Q2) a) Determine transfer function Y(s)/U(s) for the state model given below **[6]**

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}-3 & -1\\ -2 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u$$

$$Y=\begin{bmatrix}1 & 0\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$$

With D=0.

b) Check controllability and Observability of the system given below. **[6]**

$$A=\begin{bmatrix}-2 & 1\\ 1 & -2\end{bmatrix}, B=\begin{bmatrix}1\\ 0\end{bmatrix}, C=\begin{bmatrix}1 & -1\end{bmatrix}, D=[0]$$

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c) Obtain the state space representation for the transfer function given below

$$\frac{Y(s)}{U(s)} = \frac{2}{s^3 + 2s^2 + 3s + 4}.$$ **[6]**

Q3) a) Explain the effect of Pole zero cancellation on the controllability and observability of the system. **[6]**

b) Determine the state feedback gain matrix k to place the closed loop poles at $s = -2 \pm j2\sqrt{3}$, using transformation matrix method. **[6]**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 4 \end{bmatrix} u$$

c) Explain full order Observer with proper block diagram. **[6]**

OR

Q4) a) Construct the State model using phase variables if the system is described by the differential equation. **[6]**

$$\dddot{y} + 6\ddot{y} + 11\dot{y} + 10y = 3u$$

b) The system is described by $\dot{x} = Ax$, $Y = Cx$, where **[6]**

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -5 & -6 \end{bmatrix} \quad B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}$$

It is desired to place the poles at $s = -1 \pm j2$, s=10. Determine state feedback gain matrix 'k' using Ackerman's formula.

c) Explain concept of effect of pole zero cancellation. **[6]**

Q5) a) State and explain Shannon's Sampling theorem. Also discuss aliasing effect. **[6]**

b) Explain mapping between s-plane and z-plane. **[6]**

c) Determine the stability of sampled data control system using Jury's stability analysis having following polynomial **[5]**

$$2z^4 + 8z^3 + 12z^2 + 5z + 1 = 0$$

OR

Q6) a) Explain in detail ZOH and FOH operation. Derive the transfer function of ZOH. **[6]**

b) Explain basic block diagram of the digital control system. **[6]**

c) Determine the stability by using Bilinear transformation for sampled data control system having polynomial $z^3 - 0.2z^2 - 0.25z + 0.05 = 0$. **[5]**

Q7) a) What is reaching law? Why is it required? Write expressions of constant rate reaching law, constant plus proportional rate reaching law and power rate reaching law. **[6]**

b) State and explain the linear quadratic regulator problem. **[6]**

c) Describe a self-tuning regulator with suitable block-diagram. **[5]**

OR

Q8) a) Derive the expression of equivalent control in sliding mode control. **[6]**

b) Describe a self-tuning regulator with suitable block-diagram. **[6]**

c) List out the properties of sliding mode control. **[5]**

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