Total No. of Questions : 8]

SEAT No. :

PA-924

[Total No. of Pages : 3

[5927]-356
B.E. (Electrical)
ADVANCED CONTROL SYSTEM
(2019 Pattern) (Semester - VII) (403142)

Time : 2½ Hours] *[Max. Marks : 70*

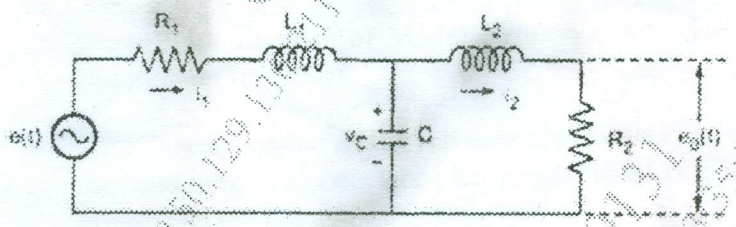
Instructions to the candidates:

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

Q1) a) Derive the formula to get transfer function from the state model. **[6]**

b) Determine state transition matrix for the system give below by using Lapalce transformation technique $\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}$ **[6]**

c) Write a set of state equations for the circuit given below. **[6]**



OR

Q2) a) Obtain the state model of the following differential equation (phase variable representation) $4\dddot{y}+3\ddot{y}+\dot{y}+2y=5u$ **[6]**

b) What is state transition matrix? List the properties of sate transition matrix. **[6]**

c) Define state, state variable, state vector, state equation and output equation. Draw state diagram. **[6]**

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Q3) a) Check the observability of the state model given below usingKalman's Test **[6]**

$$X = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -9 & -11 & -6 \end{bmatrix} x + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$Y = \begin{bmatrix} -10 & -10 & 5 \end{bmatrix} x$$

b) Explain the effect of pole zero cancellation. **[6]**

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

OR

Q4) a) What is controllability? How to investigate controllability of a system using Gilbert's test for **[6]**

i) Distinct eigenvalues and

ii) Repeated eigenvalues

b) Determine state feedback gain matrix for the system given below to place the closed loop poles at $s_1 = -1.8 + j2.4$ and $s_2 = -1.8 - j2.4$ by matrix transformation technique. **[6]**

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 20.6 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

c) Explain the principle of duality. **[6]**

Q5) a) State and explain Shannon's Sampling theorem. How to select the sampling period? **[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 $z^3 + 2.1\ z^2 + 1.44z + 0.32 = 0$. **[5]**

OR

Q6) a) Explain the concept of Zero Order Hold and First Order Hold operations. Derive the transfer function of ZOH. **[6]**

b) Draw block diagram of the digital control system. State function of each block. **[6]**

c) Determine the stability by using Bilinear transformation for sampled data control system having polynomial **[5]**

$$z^3 - 4z^2 + 5z - 2 = 0$$

Q7) a) Define adaptive control. Explain the need of adaptive control. What is adaption mechanism? **[6]**

b) If the system is given by $\dot{x} = Ax + Bu$ and sliding surface is given by $s = Sx$, prove that the closed loop system obtained by applying the equivalent control is $\dot{x} = \left(I_n - B(SB)^{-1}S\right)Ax$. **[6]**

c) State and explain the linear quadratic regulator problem. **[5]**

OR

Q8) a) Draw block diagram of Model Reference Adaptive Control scheme and explain it. **[6]**

b) 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]**

c) What is optimal control? Write down the steps in linear quadratic regulator problem. **[5]**

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