

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:

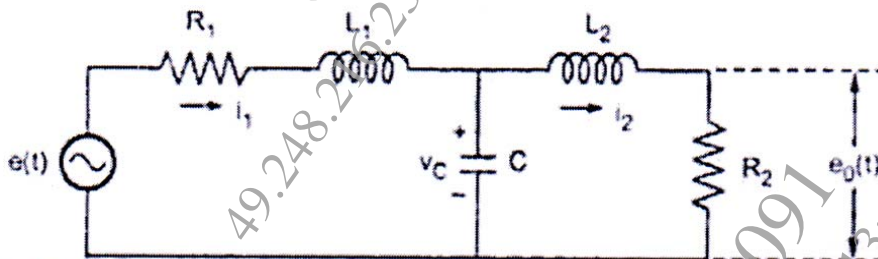
- 1) Solve Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.
- 2) Figures to the right indicate full marks.
- 3) Neat diagrams must be drawn wherever necessary.
- 4) Use of algorithmic tables slide rule, and electronic pocket calculator is allowed.
- 5) Assume suitable data if necessary.

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) $4\ddot{y} + 3\dot{y} + y + 2y = 5u$ [6]

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

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

P.T.O.

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

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

$$Y = [-10 \quad -10 \quad 5]x$$

- 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 $z^3 + 2.1z^2 + 1.44z + 0.32 = 0$. [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 $\dot{x} = (I_n - B(SB)^{-1}S)Ax$. [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]

□□□