

Total No. of Questions : 8]

SEAT No. :

PE-2215

[Total No. of Pages : 3

[6584]-115

B.E. (Electrical Engineering)
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) Assume suitable additional data, if necessary.
- 5) Use of a non-programmable calculator is allowed.

Q1) a) Clearly explain the following terms. [6]

- i) Physical variables,
- ii) Phase variables and
- iii) Canonical variables

b) A feedback system is characterized by the closed loop transfer function

$$\frac{Y(s)}{U(s)} = \frac{1}{s^3 + 7s^2 + 14s + 8}$$

Obtain a state space model in phase variable form. [6]

c) Determine the expression for the solution of homogeneous state equation. [6]

OR

Q2) a) Define the State transition matrix. Write its properties. [4]

b) What are the different methods to find State transition matrix? Explain any one method in detail. [6]

c) Consider a control system with state model

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

Compute the state transition matrix. Also find the solution of state. [8]

P.T.O.

- Q3)** a) Explain what is the pole placement technique with the help of transformation matrix method. [4]
- b) Define controllability. Explain with a suitable example, how the controllability of a system can be checked? [4]
- c) Consider the system $\dot{x} = Ax + Bu;$ [10]

$$y = Cx$$

$$\text{Where } A = \begin{bmatrix} 1 & 2 & 0 \\ 3 & -1 & 1 \\ 0 & 2 & 0 \end{bmatrix}; B = \begin{bmatrix} 2 \\ 1 \\ 1 \end{bmatrix}; C = [0 \ 0 \ 1];$$

Design a state observer to place the observer poles at $s = -3 + j1;$
 $s = -3 - j1$ and $s = -4.$

OR

- Q4)** a) Explain the pole placement technique with direct substitution method. [4]
- b) Discuss the effect of pole zero cancellation on the controllability and the observability of the system. [6]
- c) Examine the observability of the system [8]

$$\dot{x} = Ax + Bu;$$

$$Y = Cx$$

$$\text{Where } A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -2 \end{bmatrix}; B = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix}; C = [3 \ 4 \ 1].$$

- Q5)** a) State and explain sampling theorem. [4]
- b) Explain the stability analysis of closed loop system in z-plane using Jury's test. [6]
- c) Consider the system whose characteristic equation is $F_1(z) = 2z^4 + 7z^3 + 10z^2 + 4z + 1$ Comment on stability. [7]

OR

- Q6)** a) State and explain digital control system. Also write it's advantages and limitations. [4]
- b) Explain mapping between s-plane and z-plane. [6]
- c) Determine the range of K, using Jury's stability analysis for which sampled data control system described by polynomial [7]
- $Q(z) = z^2 + (0.368K - 1.368)z + (0.368 + 0.264K)$ is stable.

- Q7)** a) Define and explain sliding mode control. [5]
- b) Explain Gain scheduling adaptive control strategy with proper block diagram. [6]
- c) State and explain the linear quadratic regulator. problem. [6]

OR

- Q8)** a) Explain the adaptive control and its various schemes. [5]
- b) What is chattering and how it is attenuated? [6]
- c) Draw and explain Model Reference Adaptive Control. [6]
