

6. A state model for a linear system is given by

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -18 & -21 & -8 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u(t)$$
$$y(t) = \begin{bmatrix} 4 & 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

If the initial state vector is  $X(0) = \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$ , find

the zero input response, zero state response and the total response due to a unit step input.

**15**

#### Unit IV

7. Define controllability of a system. Explain the Gilbert's test and Kalman's test for assessing the controllability of a system.

**15**

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**M. Tech. EXAMINATION, May 2018**

(First Semester)

(B. Scheme) (Re-appear Only)

EE(I&C)

MIC501B

MODERN CONTROL SYSTEMS

Time : 3 Hours]

[Maximum Marks : 75

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Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

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**Note :** Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

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P.T.O.

### Unit I

1. Describe the limitations of classical control theory and explain how these are overcome in modern control theory. Differentiate between eigen values and eigen vectors. Explain the concept of vector space. **15**
2. Define and explain the following : **15**
  - (i) Matrix norm
  - (ii) Definite and semi-definite matrices
  - (iii) Linear operator and its matrix representation
  - (iv) Rank and nullity of a matrix, and
  - (v) Vector norm.

### Unit II

3. Define the terms state, state vector and state model of a control system. Explain the concept of drawing the state diagrams for linear time invariant continuous time and discrete time systems. **15**

4. Discuss the state space representation using canonical variables.

The transfer function of a system is :

$$\frac{Y(s)}{R(s)} = \frac{(2s+5)}{(s+1)^2}$$

Obtain a state model in the Jordan canonical form and draw the state diagram. **15**

### Unit III

5. (a) What do you mean by state transition matrix ? What are various methods available for the computation of state transition matrix ? Explain Cayley Hamilton theorem approach for computation of state transition matrix for LTI systems with example. **10**
- (b) How do we derive the transfer function of a linear time invariant system from its state model ? **5**

8. Check by using Gilbert's test the complete controllability and complete observability of the state model : **15**

$$\dot{X} = \begin{bmatrix} -1 & 0 \\ 1 & 1 \end{bmatrix} X + \begin{bmatrix} -2 \\ 1 \end{bmatrix} u(t)$$
$$Y = [1 \quad 2] X$$

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