Q.P. Code: 18EE0223 **R18**

Reg. No: | | | | | | | | | | |

SIDDHARTH INSTITUTE OF ENGINEERING & TECHNOLOGY:: PUTTUR

(AUTONOMOUS)

B.Tech III Year II Semester Regular Examinations July-2021

MODERN CONTROL THEORY

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 60

PART-A

(Answer all the Questions **5 x 2 = 10** Marks)

1	**a**	Write any two properties of state transition matrix.	**L1**	**2M**
	b	What is controllability?	**L1**	**2M**
	c	Define state observer.	**L1**	**2M**
	d	Write the Classification of Nonlinearities.	**L2**	**2M**
	e	State Lyapunov instability theorem.	**L5**	**2M**

PART-B

(Answer all Five Units 5 x 10 = 50 Marks)

UNIT-I

2 **a** Derive a solution of homogeneous state equation. **L3** **5M**

b Obtain the state transition matrix of **L1** **5M**

$$A = \begin{bmatrix} -6 & 1 & 0 \\ -11 & 0 & 1 \\ -6 & 0 & 0 \end{bmatrix}$$

OR

3 **a** Explain state space representation of the system. **L1** **5M**

b Obtain state transition matrix for the following system: **L1** **5M**

$$\begin{bmatrix} \dot{x1} \\ \dot{x2} \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \end{bmatrix}$$

UNIT-II

4 The state model of a system is given by **L2** **10M**

$$\begin{bmatrix} \dot{x1} \\ \dot{x2} \\ \dot{x3} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ -2 & -3 & 0 \\ 0 & 2 & -3 \end{bmatrix} \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix} + \begin{bmatrix} 0 \\ 2 \\ 0 \end{bmatrix} u, \quad Y = [1\ 0\ 0] \begin{bmatrix} x1 \\ x2 \\ x3 \end{bmatrix}$$

Convert the state model to canonical form.

OR

5 a Define Observability. What are the tests to find the Observability of a given system? **L1** **5M**

b The state equation is given by **L4** **5M**

$$\begin{bmatrix}\dot{X1}\\ \dot{X2}\\ \dot{X3}\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ 0 & 0 & 1\\ 0 & 2 & -3\end{bmatrix}\begin{bmatrix}x1\\ x2\\ x3\end{bmatrix}+\begin{bmatrix}0\\ 0\\ 10\end{bmatrix}u.$$

Test for controllability.

UNIT-III

6 Explain the design of pole placement controller using state feedback. **L1** **10M**

OR

7 The state model is given by **L2** **10M**

$$\begin{bmatrix}\dot{X1}\\ \dot{X2}\\ \dot{X3}\end{bmatrix}=\begin{bmatrix}0 & 0 & 1\\ -2 & -3 & 0\\ 0 & 2 & -3\end{bmatrix}\begin{bmatrix}x1\\ x2\\ x3\end{bmatrix}+\begin{bmatrix}0\\ 2\\ 0\end{bmatrix}u, \quad Y=[1\ 0\ 0]\begin{bmatrix}x1\\ x2\\ x3\end{bmatrix}$$

Convert the state model to controllable phase variable form.

UNIT-IV

8 Derive the describing function of backlash nonlinearities. **L6** **10M**

OR

9 Derive the describing function of saturation nonlinearities. **L6** **10M**

UNIT-V

10 a State and prove Lyapunov stability theorem. **L5** **5M**

b Show the graphical representation of stability, asymptotic stability and instability. **L1** **5M**

OR

11 Consider the non-linear system: $\dot{x}_1 = x_2, \dot{x}_2 = -x_1 - x_1^2 x_2$. investigate the stability of this non-linear system around its equilibrium point at origin. **L1** **10M**

END