

Code No.: 52103

MR 15-2015-16 & 2016-17 Admitted Students

MALLA REDDY ENGINEERING COLLEGE (AUTONOMOUS)

(Affiliated to JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD)

Gundlapochampally (H), Maisammaguda (V), Medchal (M), Medchal-Malkajgiri (Dist), Hyderabad.

M.TECH I SEMESTER SUPPLEMENTARY EXAMINATIONS, JANUARY-2018

SUBJECT: MODERN CONTROL THEORY

Branch/Specialization: **EEE/Electrical Power Systems**

Time: 3 hours

Max. Marks: 60

PART – A

Answer All Questions

5 x 4Marks=20 Marks

1. Define the concept of state. Write the state equations for dynamic systems.
2. Derive the state space representation using phase variable for n number of state variables and draw its state diagram.
3. Discuss the describing function analysis of non linear systems.
4. Define the state observer. Deduce the expression for full order observer.
5. State and explain the principle of optimality.

Answer any five of the following questions

5 x 8 Marks= 40 Marks

1. Develop the state model of Linear system and draw the block diagram of state model. [8]
2. a) Derive the solution of Non-homogeneous state equations. [4]
b) What is a Non-linear system? What are the different types of Non-linearities? Explain each of them in detail. [4]
3. A Linear dynamical time invariant system represented by $\dot{x} = AX + BU$
Where $A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 0 & -2 & -3 \end{bmatrix}$, $B = \begin{bmatrix} 0 & 1 \\ 0 & 0 \\ 1 & 0 \end{bmatrix}$
Find if the system is completely controllable. [8]
4. a) Illustrate the generation of Lyapunov function by Krasooviski's method. [4]
b) Explain the singular points in non linear systems. [4]
5. Consider the second order system described by
$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

The equilibrium state is the origin. Determine the stability of this state. [8]
6. a) Explain the terms-stability in the sense of Liapunov, asymptotic stability and instability with graphic representation. [4]
b) State and prove the Liapunov's stability theorem for linear time invariant systems. [4]

7. a) Obtain the Hamilton Jacobi equation for the system described by $\dot{x} = u(t)$, subjected to the initial condition $x(0) = X^0$. Find the control law that minimizes $J = \frac{1}{2}x^2(t_1) + \int_0^{t_1}(x^2 + u^2)dt$, t_1 specified. [4]
- b) Explain the Linear system with full order state observer with neat block diagram. [4]
8. a) Explain the fixed end point problem and derive the Euler-Lagrange equation. [4]
- b) Explain the term-Linear quadratic regulator. [4]