

**I M.Tech - I Semester–Supplementary Examinations December 2018****MODERN CONTROL THEORY  
(POWER SYSTEM & CONTROL)**

Duration: 3 hours

Max. Marks: 60

Answer the following questions.

1. a) Give the merits of state variable analysis and formulation of state model. 5 M

- b) Find the Eigen values and Eigen vectors of the matrix

$$A = \begin{bmatrix} 0 & 0 & 10 \\ 0 & 1 & 52 \\ -3 & -7 & 4 \end{bmatrix} \quad 10 \text{ M}$$

OR

2. a) Derive the state model for the system whose transfer function is given by

$$\frac{Y(s)}{U(s)} = \frac{3s^2 + 7s + 15}{s^3 + 7s^2 + 14s + 8} \quad 7 \text{ M}$$

- b) Develop the state model for a system characterized by the differential equation  $\ddot{y} + 7\dot{y} + 5y + u = 0$  8 M

3. a) Explain controllability and observability of a linear system using Kalman's test. 7 M

b) Obtain the transfer function from the state model. 8 M

$$\dot{X} = \begin{bmatrix} -3 & 1 \\ -2 & 0 \end{bmatrix} X + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u ; Y = [1 \quad 0] X$$

OR

4. a) Obtain state space representation for the system described by differential equation. Assume zero initial conditions. Determine State transition matrix also for this.

$$\frac{d^2 y}{dt^2} + \frac{dy}{dt} - 2y = u(t)e^{-t}$$

Where  $y(0)=0$ ,  $u(t)=$ unit step input. 10 M

b) Derive the solution of the non-homogeneous state equation. 5 M

5. What is phase plane, phase trajectory and phase portrait? Draw and explain how to determine the stable and unstable limit cycles using phase portrait? 15 M

OR

6. a) Derive the describing function for relay with deadzone non-linearity. 7 M

b) State and explain Lyapunov's stability theorem. 8 M

7. Explain in detail the fundamental theorem of the calculus of variations. 15 M

OR

8. What is optimal control? Explain how to formulate the optimal control problem? 15 M