PVP 17

Code: **17EEPC1T2**

I M.Tech-I Semester-Regular Examinations-February 2018

MODERN CONTROL THEORY
(POWER SYSTEM & CONTROL)

Duration: 3 hours Max. Marks: 60

Answer the following questions.

1. a) What are the advantages and disadvantages of state space analysis over classical design methods and explain 7 M
(i) Eigen values (ii) Eigen vectors (iii) state of a system.

b) Develop the state model for the system which is described by the following differential equation 8 M

$$\dddot{y} + 6\ddot{y} + 11\dot{y} + 6y = \ddot{u} + 8\ddot{u} + 17\dot{u} + 8u$$

(OR)

2. a) Obtain the eigen values, eigen vectors, of the matrix 7 M

$$\begin{bmatrix} -4 & 1 & 0 \\ 0 & -3 & 1 \\ 0 & 0 & -2 \end{bmatrix}$$

b) Obtain the state model for the system whose transfer function is given by $G(s) = \frac{s+3}{s(s^2+3s+2)}$. From the state model, explain again how to get transfer function? 8 M

3. Determine controllability and observability of the system described by the state modal 15 M

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \\ \dot{x}_3 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -6 & -11 & -6 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} u$$

$$Y = \begin{bmatrix} 4 & 5 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

(OR)

4. a) Derive the solution of homogeneous and non-homogeneous state equations. 10 M

   b) Define state transition matrix. Derive its equation. 5 M

5. Explain in detail about the behavior of nonlinear system and classification of Non-linearities. 15 M

(OR)

6. a) Define Lyapunov's stability. Explain Lyapunov's direct method. 7 M

   b) Check the stability of the Equilibrium state of the system described by the following state equation using Lyapunov's method2. $\dot{x}_1 = x_2$; $\dot{x}_2 = -x_1 - x_1^2 . x_2$ 8 M

7. Find optimal control law u^x(t) for the system

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ -10 & 0 \end{bmatrix} x + \begin{bmatrix} 0 \\ 10 \end{bmatrix} u$$

Which minimize the performance index $j = \frac{1}{2}\int_0^2 u^2 dt$

15 M

(OR)

8. Find the extremal of the function

$J(x) = \frac{1}{2}\int_0^{\pi/2}[\dot{x_1}^2 + 2x_1x_2 + \dot{x_2}^2]\, dt$. Boundary conditions are $x_1(0) = 0, x_2(0) = 0\ , \dot{x_1}\left(\frac{\pi}{2}\right)\ is\ free\ ,$ $x_2\left(\frac{\pi}{2}\right) = -1$

15 M