Roll No. | | | | | | | | | | | | | Total No. of Pages : 02

Total No. of Questions : 09

B.Tech.(EIE) (2011 & Onwards) (Sem.–5)

NON LINEAR AND SAMPLED DATA CONTROL SYSTEMS

Subject Code : EI-303

Paper ID : [A0362]

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Answer briefly :

a) What is a state transition matrix?

b) What do you mean by jump response nonlinearity?

c) Define describing function.

d) List any two methods for stability analysis of nonlinear systems.

e) What is meant by positive definite function in Lyapunov stability criteria?

f) What is adaptive control?

g) Define pulse transfer function.

h) Define equilibrium point in nonlinear systems.

i) What is a asymptotically stable system?

j) Define observability.

SECTION-B

2. What is Controllability ? Check the controllability of the following system.

$$\dot{X} = \begin{bmatrix} 0 & 1 & -2 \\ 3 & -4 & 5 \\ -6 & 7 & 8 \end{bmatrix} X + \begin{bmatrix} 0 & -1 \\ 2 & -3 \\ 4 & -5 \end{bmatrix} U$$

3. Find the Z-transform of $x(n) = cos\ (\omega_0 n)$ for $n \geq 0$.

4. Using a suitable stability method, comment upon the stability of a discrete time control system with following characteristic equation.

$$P(z) = z^4 - 1.2z^3 + 0.07z^2 + 0.3z - 0.08 = 0$$

5. Discuss Popov criterion used in stability analysis of nonlinear systems.

6. Consider the following nonlinear system

$$\frac{dz_1}{dt} = z_2(z_1 + 1)$$

$$\frac{dz_2}{dt} = z_1(z_2 + 3)$$

Draw its phase plane diagram.

SECTION-C

7. What is an adaptive control? Explain the Model Reference Adaptive Control (MRAC) approach with the help of a block diagram.

8. Derive an expression for describing function of Saturation nonlinearity.

9. Consider the following nonlinear function.

$$\dot{x}_1 = -x_1 + x_2 + x_1(x_1^2 + x_2^2)$$

$$\dot{x}_2 = -x_1 + x_2 + x_2(x_1^2 + x_2^2)$$

Using Lyapunov function as V(X) = $\frac{1}{2}x_1^2 + \frac{1}{2}x_2^2$ comment on its stability around equilibrium point (0,0)