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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 an 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)