

B. TECH.**THEORY EXAMINATION (SEM-VIII) 2016-17**
NON-LINEAR DYNAMICS SYSTEM**Time : 3 Hours****Max. Marks : 100****Note : Be precise in your answer. In case of numerical problem assume data wherever not provided.****SECTION-A****1. Attempt all parts of the following- (10×2=20)**

- a. What is a dynamical system?
- b. What is a Strange Attractor?
- c. What are simple experiments to demonstrate chaos?
- d. What is a Cantor set?
- e. What is an attractor?
- f. How do I know if my data are deterministic?
- g. What is quantum chaos?
- h. What are cellular automata?
- i. What are solitons?
- j. What is spatio-temporal chaos?

SECTION-B**2. Attempt any five of the following: (10×5=50)**

- a) State and explain Liapunov's theorems on (i) stability, (ii) asymptotic stability (iii) global asymptotic stability and (iv) instability.
- b) Consider the linear autonomous system

$$\dot{X} = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix} X$$

Using direct method of Lyapunov, determine the stability of the equilibrium state.

- c) Explain Peano's theorem?
- d) What is the normal form theory and application to non-linear system?
- e) What is a Bifurcation?
- f) What is a degree of freedom? How are maps related to flows (differential equation)?
- g) Explain the control of chaos?
- h) Describe the different types of solutions.

SECTION-C**Attempt any two of the following: (15×2=30)**

- 3. For $x' = x^4 - x^2 + a$,
 - a) Sketch the phase portrait for $a = 0$.
 - b) How many bifurcations are taking place in this system as a function of a .
 - c) In each case, determine the type of bifurcation by reducing to normal form
 - d) Draw the bifurcation diagram.
- 4. for the nonlinear system given by: $x' = \sin y, y' = x(1 - x^2)$,
Answer the following questions:
 - a) How many fixed points does it have. Determine the fixed points of this system.
 - b) Determine the Jacobian matrix for this system for any arbitrary fixed point (x^*, y^*) .
 - c) For the fixed points on $x = 0$ line, determine the type of fixed points.
 - d) Draw the phase portrait ONLY around the fixed points lying on $x = 0$ line.
- 5. What is Generic? What is the minimum phase space dimension for chaos?