

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)**

- What is a dynamical system?
- What is a Strange Attractor?
- What are simple experiments to demonstrate chaos?
- What is a Cantor set?
- What is an attractor?
- How do I know if my data are deterministic?
- What is quantum chaos?
- What are cellular automata?
- What are solitons?
- What is spatio-temporal chaos?

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

- State and explain Liapunov's theorems on (i) stability, (ii) asymptotic stability (iii) global asymptotic stability and (iv) instability.
- 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.

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

SECTION-C**Attempt any two of the following:****(15×2=30)****3. For $\dot{x} = x^4 - x^2 + \alpha$,**

- Sketch the phase portrait for $\alpha = 0$.
- How many bifurcations are taking place in this system as a function of α .
- In each case, determine the type of bifurcation by reducing to normal form
- Draw the bifurcation diagram.

4. for the nonlinear system given by: $\dot{x} = \sin y$, $\dot{y} = x(1 - x^2)$,

Answer the following questions:

- How many fixed points does it have. Determine the fixed points of this system.
- Determine the Jacobian matrix for this system for any arbitrary fixed point (x^*, y^*) .
- For the fixed points on $x = 0$ line, determine the type of fixed points.
- 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?