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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 $x^{\cdot} = x^4 - x^2 + \alpha$,**

a) Sketch the phase portrait for $\alpha = 0$.

b) How many bifurcations are taking place in this system as a function of α.

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: $x^{\cdot} = \sin y$, $y^{\cdot} = x(1 - x^2)$,

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 $(x^{\bullet}, y^{\bullet})$.

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?

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