(6 pages) **Reg. No. :** .....

Code No. : 6381 **Sub. Code : HPHE 21**

M.Sc. (CBCS) DEGREE EXAMINATION, APRIL 2016.

Second Semester

Physics

Elective II — NONLINEAR DYNAMICS AND CHAOS

(For those who joined in July 2012 onwards)

Time : Three hours Maximum : 75 marks

PART A — (10 × 1 = 10 marks)

Answer ALL questions.

Choose the correct answer :

1. The physical system subjected to linear forces as

   (a) linear dynamic system

   (b) non linear dynamic system

   (c) linear static system

   (d) non linear static system

2. Which of the following is non autonomous system

   (a) damped harmonic oscillator

   (b) exponential oscillator

   (c) duffing oscillator

   (d) atmospheric conversion

3. The sudden qualitative changes in the nature of the motion, occur at critical control parameter values is

   (a) fractals (b) bifurcations

   (c) chaos (d) saddle node

4. The bifurcations associated with the stability determining quantity crossing the value equal to –1 are called

   (a) flip (b) hopf

   (c) saddle node (d) pitch fork

5. Chaotic trajectories develop from the motion of non linear system which is

   (a) periodic (b) non periodic

   (c) regular (d) linear

6. Chua's circuit exhibits a chaotic attractor is called

(a) double scroll Chua's attractor

(b) single scroll Chua's attractor

(c) multi sproll Chua's attractor

(d) non symmetric spiral attractor

7. The multi fractal is characterized by generalized

(a) coordinate (b) momentum

(c) dimension (d) velocity

8. Contor set is a fractal with a non integer dimension

(a) $D_F = 2.06$ (b) $D_F = 1.585$

(c) $D_F = 1.11$ (d) $D_F = 0.631$

9. In this equation $f(\xi) = \alpha_3 - (\alpha_3 - \alpha_2)sn^2 \left[\sqrt{\alpha_3 - \alpha_1}(x - ct), m\right]$ if $m = 1$ means

(a) solitary wave (b) cnoidal wave

(c) harmonic wave (d) unharmonic wave

10. The dispersion relation of Cnoidal waves is ———— dependent

(a) frequency (b) amplitude

(c) phase (d) pulse

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Distinguish autonomous and non-autonomous systems with a few illustrations.

Or

(b) Explain the sub harmonic and super harmonic resonances.

12. (a) Discuss Hopf bifurcation and prove Hopf theorem.

Or

(b) Explain the period doubling phenomenon.

13. (a) Explain about linear and nonlinear circuit elements.

Or

(b) Discuss about modified Chua's circuit and Colpitt's oscillator with circuit diagram.

14. (a) Explain the concept of fractal with an example and define fractal dimension.

Or

(b) Explain the construction of Koch curve.

15. (a) Explain about linear waves with example.

Or

(b) Discuss about solitary and cnoidal waves

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Discuss the free, damped and Forced oscillations of linear oscillators.

Or

(b) Explain about dissipative and conservative systems with example.

17. (a) Explain about equilibrium points and their stability.

Or

(b) Explain the dynamic behavior of logistic map using Lyapunov exponent.

18. (a) Discuss the stability analysis and analytical solutions of MLC circuit.

Or

(b) Discuss the behavior of electronic analog simulator with circuit diagram.

19. (a) Discuss the construction and characteristic properties of middle one third cantor set and Julia set.

Or

(b) Explain the construction, similarity and difference between Sierpinski triangle and Mandelbrot set.

20. (a) Discuss about non linear dispersive systems with examples.

Or

(b) Explain Scott Russell phenomenon and derive the standard form of Kdv equation.

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