Reg. No. :

Code No.: 6525 Sub. Code: ZPHM 14

M.Sc. (CBCS) DEGREE EXAMINATION, NOVEMBER 2021

First Semester

Physics -Core

NONLINEAR DYNAMICS

(For those who joined in July 2021 onwards)

Time : Three hours Maximum : 75 marks

PART A — $(10 \times 1 = 10 \text{ marks})$

Answer ALL questions.

Choose the correct answer :

- 1. If a system is given unbounded input then the system is
 - (a) stable (b) unstable
 - (c) not defined (d) linear
- 2. Linear mathematical model applies to
 - (a) Linear systems (b) Stable systems
 - (c) Unstable systems (d) All of the mentioned

(6 pages)

- 3. In non–linear systems forced and free responses are;
 - (a) Related (b) Not related
 - (c) Contemporary (d) None of the above
- 4. If X (t) approaches near the origin as t tends to infinity then the system is
 - (a) Stable
 - (b) Unstable
 - (c) Asymptotically stable
 - (d) Asymptotically stable in the large
- 5. In an automatic control system which of the following elements is not used?
 - (a) Error detector (b) oscillator
 - (c) sensor (d) Control element
- 6. A simple piecewise- linear circuit exhibiting chaotic dynamics, namely the ______ oscillator
 - (a) Colpitt's (b) Hartely
 - (c) Tuned collector (d) Wien's bridge
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- 7. The sierpinski triangle is another fractal introduced by the <u>mathematician</u>
 - (a) Polish (b) german
 - (c) Both (a) and (b) (d) none of the above
- 8. Snowflake is composed of three congruent parts, each of which is a <u>curve</u>
 - (a) Julia (b) Koch
 - (c) Mandelbrot (d) Cantor
- 9. Examples for nonlinear dispersive systems
 - (a) Cyclonic waves (b) Tsunami waves
 - (c) Tidal waves (d) All the above
- 10. When a radio station broadcasts its signals , the ______energy from its transmitter radiates outward in an identical fashion.
 - (a) Electromagnetic (b) UV
 - (c) Microwave (d) None of the above

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PART B — $(5 \times 5 = 25 \text{ marks})$

Answer ALL questions, choosing either (a) or (b). Each answer should not exceed 250 words.

11. (a) Define non- linearity Give any two examples for linear and nonlinear differential equations.

Or

- (b) State and explain linear superposition principle.
- 12. (a) Explain the transcritical bifurcation.

 \mathbf{Or}

- (b) Discuss in detail discrete dynamical systems.
- 13. (a) Explain linear and non-linear circuit elements.

Or

- (b) With a neat circuit diagram explain Hunt's nonlinear oscillator.
- 14. (a) Explain the contor set fractals.

 \mathbf{Or}

(b) Discuss the Julia set.

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[P.T.O.]

15. (a) Explain the linear non dispersive wave propagation.

 \mathbf{Or}

PART C — $(5 \times 8 = 40 \text{ marks})$

- Answer ALL questions, choosing either (a) or (b) Each answer should not exceed 600 words.
- 16. (a) Explain the effect of nonlinearity.

 \mathbf{Or}

- (b) Explain damped and driven nonlinear oscillators.
- 17. (a) With examples explain dynamical systems as coupled first— order differential equations

Or

- (b) Discuss the general criteria for stability in two dimensional case.
- 18. (a) Explain bifurcations and chaos.

Or

(b) With a neat circuit diagram explain the Chaotic dynamic of MLC circuit.

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19. (a) Explain the fractal dimension.

 \mathbf{Or}

- (b) List out the applications of fractals.
- 20. (a) Explain linear dispersive wave propagation.

 \mathbf{Or}

(b) Derive Korteweg — de vries equation and the solitaty waves and cnoidal waves.

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