

KAMARAJ COLLEGE (Autonomous)
Accredited with A+ Grade by NAAC
(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)
THOOTHUKUDI – 628 003

(6 Pages)

Reg. No:

Question. Code No : 25E03303

Sub Code : 24PEPH22

PG Degree - End Semester Examinations, April 2025

Second Semester

M.Sc. PHYSICS

Elective - Non Linear Dynamics

(For those who joined in July 2024 onwards)

Time : 3 Hours

Maximum : 75 Marks

PART – A ($10 \times 1 = 10$ Marks)

Answer ALL Questions

Choose the correct answer :

1. Which of the following is an example of an autonomous system?
 - (a) Driven damped harmonic oscillator
 - (b) Duffing oscillator with periodic driving force

- (c) Driven linear oscillator
 - (d) Kepler problem
2. Which method is commonly used for numerically solving ODEs?
- (a) Separation of variables
 - (b) Euler's method
 - (c) Fourier series
 - (d) Laplace transform
3. Which of the following methods is associated with obtaining N-soliton solutions for soliton equations?
- (a) Painlevé analysis
 - (b) Hirota's bilinearization method
 - (c) Perturbation method
 - (d) All of the above
4. The AKNS method is primarily used to
- (a) Obtain soliton solutions of integrable nonlinear PDEs
 - (b) Perform statistical analysis of wave functions
 - (c) Analyze quantum field interactions
 - (d) Solve linear differential equations
5. Which one is the second step to the quasiperiodic route to chaos?
- (a) Chaotic orbit
 - (b) Quasiperiodic orbit
 - (c) Stable limit cycle
 - (d) Stable equilibrium point

6. The term strange attractor was coined by
- (a) Lorentz (b) David Ruelle
- (c) Henon (d) Feigenbaum
7. The fractal dimension of Sierpinski triangle is
- (a) 1.385 (b) 1.585
- (c) 1.485 (d) 1.685
8. The mathematical construction exhibiting _____ structure include Koch curve and snow flake.
- (a) Similar (b) Dissimilar
- (c) Self similar (d) Self dissimilar
9. Which of the following is an advantage of communication using chaos?
- (a) Tolerant to transmitter and receiver nonlinearities
- (b) Low sensitivity to impulsive interference
- (c) Very low sensitivity to Doppler effect
- (d) All of the above
10. What is the name of the phenomenon in which noise enhances the response of a nonlinear system that is driven weakly, either periodically or non-periodically?
- (a) Resonance (b) Stochastic resonance
- (c) Nonlinear damping (d) Thermal fluctuation

PART – B (5 X 5 = 25 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 250 words.

11. (a) What are linear oscillator? Explain damped oscillations with phase trajectories of the system.

(OR)

- (b) Write a note on nonlinear waves.

12. (a) Derive the expression for linear dispersive wave propagation.

(OR)

- (b) Write any four applications of solitons.

13. (a) What are limit cycles? Distinguish between stable limit cycle and semistable limit cycle.

(OR)

- (b) Write a note logistic map in the discrete dynamic system.

14. (a) Write a note on fractal dimension.

(OR)

- (b) Write the applications of fractals

15. (a) Explain Soliton based communication systems.

(OR)

- (b) Write a note on chaos based communication.

PART - C (5 X 8 = 40 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 600 words.

16. (a) Explain the various linear oscillators.

(OR)

(b) Derive general criteria for stability in the classification of equilibrium points.

17. (a) Starting from KdV equation explain solitary wave and cnoidal wave.

(OR)

(b) Explain soliton in optical fibres with the neat schematic diagram of fibre optic communication system.

18. (a) Explain the occurrence of pitch force and transcritical bifurcation in the system.

(OR)

(b) What is strange attractor? Explain self similar structure.

19. (a) Explain the construction and properties of Middle third cantor set and Koch curve.

(OR)

(b) Explain the construction and properties of Julia set and Mandelbrot set.

20. (a) Explain the elementary chaotic Cryptographic system.

(OR)

(b) Explain time series analysis. Estimate time delay and embedding dimension.