Nonlinear Dynamics: Mathematical and Computational Approaches (Fall 2018)

3.6 Flows I: Unit test » Take unit 3 test

Instructions 1

You may use any course materials, websites, books, computer programs, calculators, etc. for this test. Just don't ask another perso answers or share your answers with other people. Be aware that simply typing the question text into google is unlikely to get you dir right answer; you're going to have to read what you find there in order to extract that answer, and the course videos are probably a fa do that.

"Experts" notes clarify situations that haven't been covered in this course, but that may introduce subtleties into the exam answers. about them unless you understand the terms and issues in those notes.

If you have questions about this test, please email us at nonlinear@complexityexplorer.org rather than posting on the forum.

Question 2

What is the solution to the ODE $\frac{d}{dt}x(t) = x(t)$ if the initial condition $x(t=0) = 1$?

- A. $x(t)$
- B. $x(t) = e^t$
- C. $x(t) = t + 1$
- D. $x(t) = t$
- E. $x(t) = e^t + 1$

Question 3

Which of these ODEs models the *damped* pendulum?

- A. $ml\theta'' + mg\sin\theta = 0$
- B. $ml\theta'' + mg\sin\theta + \beta l\theta' = 0$
- C. $ml\theta' + mg\sin\theta + \beta l\theta' = 0$
- D. $ml\theta'' + mg + \beta l\theta' = 0$

Question 4

What does it mean if there exists no analytic solution to an ODE?

- A. That ODE is linear.
- B. That ODE is for sure chaotic.
- C. That ODE could be (but might not be) nonlinear.
- D. You can find the solution to that ODE with paper and pencil.

Question 5

Why are computers such an important tool in the study of nonlinear dynamics?

- A. Because you have to solve chaotic ODEs numerically.
- B. Because they speed up calculations.
- C. Because they help us generate nice plots.
- D. Because they let us look things up on the web.

Question 6

Which one of these statements *most accurately and completely* specifies the relationship between nonlinearity and chaos?

- A. Nonlinearity =→ chaos
- B. Chaos =→ nonlinearity
- C. Chaos ←=→ nonlinearity

Question 7

Which one of these statements *most accurately and completely* specifies the relationship between nonintegrability and chaos?

- A. Nonintegrability =→ chaos
- B. Chaos =→ nonintegrability
- C. Chaos ←=→ nonintegrability

Question 8

This ODE is nonlinear:

$x' = x$

- True
- False

Question 9

This ODE is nonlinear:

$x' = \sin x$

- True
- False

Question 10

This ODE is nonlinear:

$x' = 37x$

- True
- False

Question 11

This ODE is nonlinear:

$x'' + x^2 = 0$

- True
- False

Question 12

What are the state variables of the pendulum?

- The angular velocity and the angular position of the bob.
- The mass of the bob and the distance between the bob and the anchor point.
- The angular position of the bob and the coefficient of friction that is acting on the bob as it moves.

Question 13

How many state variables does the *double* pendulum have?

- 0
- 1
- 2
- 4
- An infinite number

Question 14

How many *fixed points* does the double pendulum have?

- One, and it's stable.
- Four, three of which are unstable.
- An infinite number of both.