

EE 5323- Exam 1

Fall 2021

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All questions require numerical calculations to arrive at the answers. To obtain full credit, show all your work. No partial credit will be given without the supporting work. This probably means you must do calculations by hand and type them up, not using MATLAB routines.

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Name: _____

Pledge of honor:

"On my honor I have neither given nor received aid on this examination."

Signature: _____

1. Equilibrium points and linearization

System is

$$\dot{x}_1 = x_2$$

$$\dot{x}_2 = -x_1 + \frac{x_1^3}{9} - x_2$$

d. Find the Jacobian

e. Find all equilibrium points

- f. Find the nature of all e.p.s. Sketch the phase plane trajectories near each e.p.

2. System is

$$\dot{x}_1 = -x_1 + 2x_1^3 + x_2$$

$$\dot{x}_2 = -x_1 - x_2$$

a. Find the Jacobian

b. Find all equilibrium points

- c. Find the nature of all e.p.s. Sketch the phase plane trajectories near each e.p.

3. Duffing's equation is interesting in that it exhibits bifurcation, or dependence of stability properties and number of equilibrium points on a parameter. The undamped Duffing equation is

$$\ddot{x} + \alpha x + x^3 = 0$$

c. Find the Jacobian

d. Let $\alpha > 0$. Find the equilibrium points and their nature. Sketch the phase plane trajectories near each e.p.

e. Let $\alpha < 0$. Find the equilibrium points and their nature. Sketch the phase plane trajectories near each e.p.