

ELEN 160  
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## Homework 2

**PROBLEM 1.** The system shown below

$$\begin{aligned}\dot{x}_1 &= -x_1 + x_2 - 3 \\ \dot{x}_2 &= x_1^2 + x_1x_2 - 1\end{aligned}$$

has *three* distinct equilibria.

- Compute these equilibria using Newton's method.
- Determine the stability of each equilibrium using linearization.
- Solve the equations numerically for different initial conditions, and verify the results obtained in Part b).

**PROBLEM 2.** The system shown below

$$\begin{aligned}\dot{x}_1 &= x_1^2x_2 - \frac{1}{3}x_1e^{(x_2-x_1)} \\ \dot{x}_2 &= x_1 - (1 - x_1^2)x_2\end{aligned}$$

has *four* distinct equilibria.

- Compute these equilibria using Newton's method.
- Determine the stability of each equilibrium using linearization.
- Solve the equations numerically for different initial conditions, and verify the results obtained in Part b).

**PROBLEM 3.** The system shown below

$$\begin{aligned}\dot{x}_1 &= x_1^3 + 5x_1^2x_2 + 8x_1x_2^2 + 4x_2^3 + 2x_1 + 2x_2 + 1 \\ \dot{x}_2 &= -x_1^2 + 2x_1x_2 + 5x_2^2 - 1\end{aligned}$$

has *two* distinct equilibria.

- Compute these equilibria using Newton's method.
- Determine the stability of each equilibrium using linearization.

**NOTE.** In this problem, there is no need to solve the equations numerically.