

Name:

Lab 4 Math 462 (due in class March 7)

1) Explain the linearization theory and what it gives you in relation to non-linear equations? In your matlab tutorials, people were noticing phase plots and solutions plots that were blowing up. Why? Explain how you can highlight a specific neighborhood of a fixed point when you have positive eigenvalues.

2) Re-analyze the system

$$\frac{dy_1}{dt} = \alpha y_1 - \beta y_2 \quad (1)$$

$$\frac{dy_2}{dt} = \beta y_2 + \alpha y_1 \quad (2)$$

by determining the fixed points and their stability. Also, plot all the phase portraits for this system, using matlab, and discuss your results

3) The Van der Pol equation can be derived from Rayleigh's equation. It is a non-linear equation that describes self-sustaining oscillations in which energy is fed into small oscillations and removed from large oscillations. The equations are given by

$$y'' - \mu(1 - y^2)y' + y = 0$$

Find the fixed points of the system and provide various cases of both solutions plots and phase portraits for $\mu < 1$, $\mu = 1$, and $\mu > 1$. What happens at $\mu = 0$?