

ME 406 ASSIGNMENT #2

PROBLEMS DUE IN CLASS THURSDAY JANUARY 29, 2009

This assignment has two objectives: (1) to give you practice using DynPac, and (2) to give you some experience with the basic concepts for two-dimensional systems.

LECTURE SCHEDULE AND READING

<u>Section in Class Notes</u>	<u>Date</u>	<u>Section in Text</u>
1.1 General Concepts	Th, T Jan. 15, 20	5.0, 5.1, 6.0-6.2
1.2 Basic Concepts of Stability	Th Jan. 22	---

Work through Tutorials 0 and 1 of DynPac. Tutorial 0 is very short and gives you an overview of basic processes. Tutorial 1 is longer and deals with integrating and plotting. Most of what is in tutorial 0 is also in Tutorial 1. The explanations in Tutorial 0 are more detailed. You will be using some of the techniques from the tutorials for the work below. You do not need to hand in anything from the worked tutorials.

PROBLEMS

Consider the system of differential equations given by $\dot{x} = 3y$, $\dot{y} = x + 2y - 2$. All of the problems below refer to this system.

(1) (20 points)

(a) Find the equilibrium point for this system.

(b) If necessary, make a translational change of coordinates so that your equilibrium point is at the origin in the new system. For the rest of this assignment, x and y will refer to these translated coordinates.

(2) (40 points)

(a) Look analytically for any straight line solutions passing through the origin (i.e., solutions with orbits of the form $y = kx$). Does your result violate the result obtained in class that orbits cannot cross?

(b) Use your results of part (a) to write down the general solution of the system.

(c) Is the equilibrium stable or unstable? Explain your answer.

(d) Find analytically the solution with initial point (1,1).

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(3) (40 points)

(a) Use DynPac to construct a direction field for this system, and explain how your conclusion of part 2c can be seen in the direction field.

(b) Use DynPac to construct phase plane plots of several integral curves, and plot these on a single graph with the direction field.

(c) Use DynPac to construct phase plane plots of the two straight-line solutions. (You will have to choose your initial conditions carefully to get these solutions, and you may want to use your option to integrate backwards in time.)

(d) Combine all of the integral curves you have constructed into a single phase plane plot without the direction field. If necessary, add a few new integral curves so that your final picture gives a reasonable picture of the family of solutions.

(e) Use the DynPac function SaddlePortrait to construct a phase portrait of this system.