MATH 2921 *Ordinary Differential Equations II* - Spring Semester, 2009

CLASS MEETINGS: MWF, 9:00 PM - 9:50 AM, Thackeray 524

INSTRUCTOR: Dr. Jonathan Rubin, Thackeray Hall # 501, extension 4-6157, rubin@math.pitt.edu

office hours: *tentative:* Wed. 12-1 PM, Fri. 10-11 AM, and TBA

web: http://www.math.pitt.edu/∼ rubin/ will contain links to all homework assignments and this syllabus

TOPICS/OBJECTIVES: This course will build on the introductory material from Math 2920 toward a dynamical systems perspective for the study of ordinary differential equations. Topics considered are likely to include:

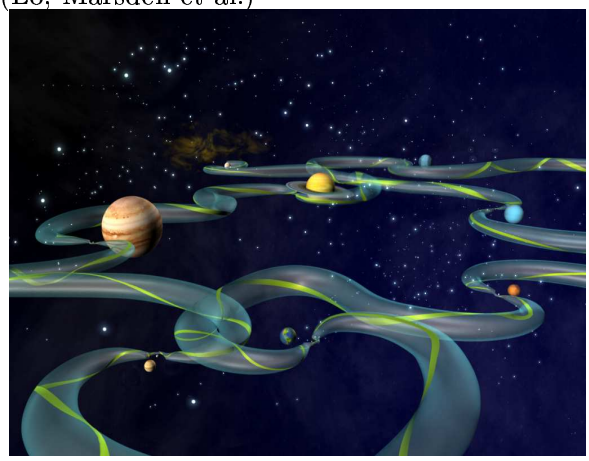
1. basic organization of phase space, including a brief review of linearization, classification of critical points, and the rectification theorem
2. topics in planar geometric theory, including 2-d Hamiltonian and gradient systems, the Poincaré-Bendixson theorem, and Wazewski sets
3. invariant manifold theorems and their proofs
4. flows on center manifolds and local bifurcation theory
5. the method of averaging
6. Melnikov's method
7. an introduction to Smale horseshoes and chaos theory

For most of these topics, proofs of the main results will be given (or assigned) and applications will be considered. We will combine mathematical rigor with an emphasis on practicality. Students who complete Math 2921 are expected to:

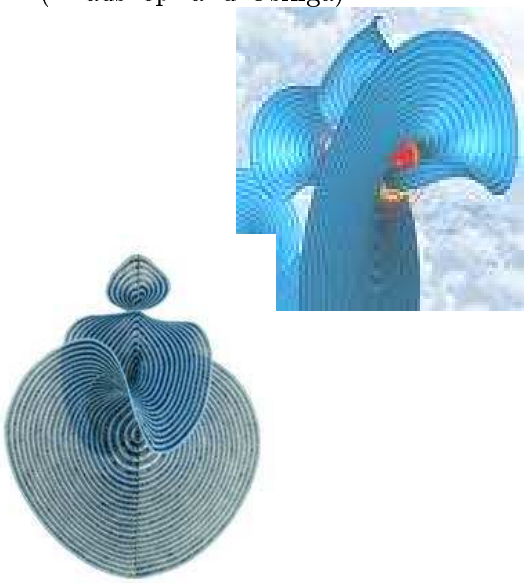
- understand how certain qualitative features organize flows in phase space.
- gain facility in using geometric arguments to analyze the behavior of trajectories generated by nonlinear ordinary differential equations and to demonstrate certain properties of flows in phase space.
- learn a variety of techniques that are useful for studying how changes in parameters can influence dynamics.

TEXT: I am not aware of a single book that gives a thorough treatment of the topics that we will consider in this course. The course textbook is *Differential Equations and Dynamical Systems* by Lawrence Perko, since this provides some background material and at least touches on many of our course topics. The Pitt bookstore has informed us that they will not have this book available until the end of January, so I encourage you to buy it through other sources if possible and I will work on getting copies of some chapters. Further, I have placed a variety of sources, listed here, on reserve at the Mathematics Library on the fourth floor of Thackeray Hall:

Interplanetary Superhighway
(Lo, Marsden et al.)



Lorenz Attractor invariant manifolds
(Krauskopf and Osinga)



1. *Applications of centre manifold theory* by Jack Carr
2. *Ordinary differential equations with applications* by Carmen Chicone
3. *Methods of bifurcation theory* by Shui-Nei Chow and Jack Hale
4. *Nonlinear oscillations, dynamical systems, and bifurcations of vector fields* by John Guckenheimer and Philip Holmes
5. *Ordinary differential equations* by Jack Hale
6. *Elements of applied bifurcation theory* by Yuri Kuznetsov
7. *Introduction to applied nonlinear dynamical systems and chaos* by Stephen Wiggins

Additions to this list, if any, will be announced as the semester progresses.

ASSESSMENT: Grades in this class will be based on homework assignments. Approximately 5-6 of these will be given throughout the semester, with an additional final assignment or project at the end of the semester. You are welcome to work together on homework problems, but in the end each student should be sure to understand and independently write up any solutions submitted. I encourage you to come talk to me about homework problems, or any other questions you may have. **Please remember that your questions are always welcome**.

DISABILITY: If you have a disability for which you are or may be requesting an accommodation, you are encouraged to contact both your instructor and Disability Resources and Services, 216 William Pitt Union, (412) 648-7890/(412) 383-7355 (TTY), as early as possible in the semester. DRS will verify your disability and determine reasonable accommodations for this course.

"The science of numbers isn't romantic...but without mathematics, man would still be an earthbound animal, running naked throughout the primeval forest." $--Mary\ Worth$