MAT475 Ordinary Differential Equations Fall 2009
line #: 74672
Text: Differential Equations, Dynamical Systems & An Introduction to Chaos, Hirsch, Smale, Devaney
Instructor: Hal L. Smith; URL: http://math.la.asu.edu/~halsmith
Office: PSA 631, Phone: 965-3743, messages: 965-3951, e-mail:halsmith@asu.edu
Office Hours: TTh 4:30-5:30 or by appt.
T&Th 3:00-4:15; LL145
Prerequisites: linear algebra (MAT342) and multi-variable calculus.

This course is an introduction to the qualitative theory of ordinary differential equations, dynamical systems and bifurcation theory. Topics include: linear systems, existence and uniqueness of solutions, stability, elementary bifurcation theory, phase plane analysis, Poincaré-Bendixson theory, and chaotic dynamics.

Homework, a midterm exam and a final exam, counted equally, will determine the course grade. A substantial project may substitute for final exam. See below.

Project Guidelines: A project should be on a subject of personal interest to the student and that makes use of the tools and techniques studied in the course. It should only be undertaken by a highly motivated student; it is not way to simply avoid an exam. Student must take initiative in arriving at topic and obtain my approval. Project must contain something original; it cannot be a book report or summary of stuff on the web. I will want periodic updates on progress and may make suggestions on content. Project must be in written form with complete references to all books, web sites, materials used. Alternatively, with my approval, it could involve class presentation.

- Detailed analysis and computer simulations of a particular equation from an application area.
- Exploration of a class of equations and their properties.
- Exploration of methods not covered in the course.

EXAM 1: October 8
Final Exam in class

Computer software packages Matlab, Maple, or Mathematica are very useful; they are available on most computers on campus. I will use Matlab and "pplane" package available at: http://math.rice.edu/∼dfield/dfpp.html
Here is web-based phase portrait sketcher:
http://www.math.rutgers.edu/courses/ODE/sherod/phase-local.html

Homework assignments: **subject to change**

Due Thursday Sept. 3: Ch.1-# 2,3,4; Ch.2-# 2,3,6

Due Sept. 10: Ch. 3-# 1,2(ii),(iii), (vi),7,9; Ch. 4: # 2,3
Due Sept. 17 : Ch. 5-# 2 (a), (d), 3,5 (a),(e); Ch. 6-# 1 (a),(b),(e),4,5,6
Due Sept. 24: Ch. 6-12 (b),(d),(e) and use the variation of constants formula to solve the initial value problem

$$x' = \begin{pmatrix} -1 & 1 \\ -1 & -1 \end{pmatrix} x + \begin{pmatrix} \sin t \\ 0 \end{pmatrix}, \ x(0) = \begin{pmatrix} 0 \\ 1 \end{pmatrix}$$

Another way to solve the above system is to guess a particular solution and then add the general solution to the homogeneous system to it, as you did in our first ODE course. Show that

$$x_p(t) = \begin{pmatrix} a\cos t + b\sin t \\ c\cos t + d\sin t \end{pmatrix}$$

solves the ODE (but not the initial conditions!) for some choice of a, b, c, d. Use this to find the solution of the initial value problem above and that your two answers agree. Finally, show that the solution of the initial value problem converges to $x_p(t)$ when $t \to \infty$.