MATH 6647. SPRING 2013.

Numerical Dynamica Systems.

Classes:	MWF 11:05-11:55, Skiles 246
Teacher:	Luca Dieci, Skiles 215, ph. 894-9209
	e-mail is best: dieci@math.gatech.edu
Office Hours:	MW 12:00-1:00 pm, or by appointment
Prerequisites:	Linear Algebra, undergraduate ODE and Numerical Analysis

Content. This is a course on development of numerical techniques of use in study of dynamical systems, to increase our awareness of how numerical methods (and which methods) can be used to investigate dynamical systems. Some prior knowledge –at the beginning graduate level– of linear algebra, differential equations, and numerical methods is expected, though more advanced material will be covered in class.

Lectures Plan. Dynamical systems background. Solution of nonlinear systems and path following. Bifurcations of equilibria (flows) and of fixed points (maps). Periodic orbits and boundary value problems (BVPs). Solution of BVPs. Bifurcations of periodic orbits and connecting orbits. Stable and unstable manifolds. Invariant tori. Spectra of dynamical systems. (We will try to cover as much as we can of the above topics, pretty much in the given order, with the material up to connecting orbits being a realistic minimal goal.)

Book. There is no required textbook for the class, and attendance is important in order to take notes. To prepare lectures, I will use some Lecture Notes, written during the last 15 years jointly with Timo Eirola, of Aalto University (Helsinki University of Technology), Finland. I will make these typed notes available to you on a regular basis.

Useful Background References. There are a lot of possibilities, but these below are some with which I am familiar, and that I keep always handy. For the *Numerical Analysis* background part: Atkinson ("An introduction to Numerical Analysis", J. Wiley & Sons), Burden & Faires ("Numerical Analysis", PWS-Kent), Stoer & Bulirsch ("Introduction to Numerical Analysis", Spring Verlag). For the *Differential Equations* and *Dynamical Systems* background part: Coddington & Levinson ("Theory of Ordinary Differential Equations", McGraw Hill), Hale ("Ordinary Differential Equation", Krieger), Hale & Kocak ("Dynamics and Bifurcations", Springer-Verlag). There are also several books which deal with aspects of *Numerical Dynamics* in some form. I am famiiar with those of Y. Kuznetsov ("Elements of Applied Bifurcation Theory", Spring-Verlag), of Stuart & Humphreys ("Dynamical Systems and Numerical Analysis", Cambridge), and of W. Govaerts ("Numerical Methods for Bifurcations of Dynamical Equilibria", SIAM).

Other more specialized references will be given to you along with the typed notes.

Programming. Most computational tasks in this class can be carried out with the help of `MATLAB`. You are encouraged to use it for all assignments. However, depending on how we are progressing, a goal of this class would be to introduce you to some software tool, like `AUTO` or `MathCont`. Details on these will be provided as needed.

Holidays during the term: January 21, and Spring Break March 18-22. Also, on Friday March 15, in lieu of class, **all** students are required to attend at least one of the tutorials associated to the *First International Conference on Dynamics of Differential Equations*, which will be held on our Campus. In fact, **all of you** will want to take part in this conference. See: `www.hale-conf.gatech.edu`

Grading will be based on 5 Homework Assignments, and two Exams. Homework will include exercises of both theoretical and computational flavor, and will count 13% of your final grade. Each Exam will count 17.5% of the grade. Both exams will be open everything.

Homework: Each homework problem must be turned in on one-sided letter size paper. The text must be typed in 10pt font or larger, figures and mathematical formulas may be drawn by hand in black ink. Electronic submission is allowed only in "pdf" format. Due dates are enforced.

HW, Exams.	
Given To You	Due Back
Jan 16 (W)	Jan 23 (W)
Jan 30 (W)	Feb 6 (W)
Feb 18 (M)	Feb 25 (M)
Mar 4 (M)	Mar 11 (M)
Apr 8 (M)	Apr 22 (M)
	(2 weeks)
Feb 11 (M)	Exam #1
Apr 1 (M)	Exam #2

Honor Code: Remember that you must adhere to the Georgia Tech honor code. See

http://www.honor.gatech.edu

In particular, unless otherwise specified, you must work on your own on Homework and exams. If you need help, please seek my assistance sooner rather than later.