MATH 345: APPLIED NONLINEAR DYNAMICS AND CHAOS: JAN-APRIL 2014

This is an introductory course in nonlinear dynamics and bifurcation theory, emphasizing qualitative analysis for nonlinear ODE models and the visualization of dynamical behavior through computer modeling. Applications of the theory are drawn from a wide range of areas of application including, classical mechanics, math biology, chemical physics, etc.

Text (Required): *Nonlinear Dynamics and Chaos*, by S. Strogatz. (This is truly an excellent text).

Topics:

- Flows on the line and bifurcations, numerical methods (brief).
- Phase plane methods, fixed points and linearizations.
- Limit cycles, Poincaré-Bendixson theorem, Hopf bifurcations, relaxation and weakly nonlinear oscillations, Poincaré maps.
- Applications to predator-prey, nonlinear mechanics, chemical oscillators etc.
- Topics from: Lorenz equations, one-dimensional discrete maps, strange attractors and fractals.
- A computer package called XPPAUT will be used throughout the course to supplement the analytical theory and to visualize and explore nonlinear dynamics.

Grading: There will be (roughly) bi-weekly homework assignments. Final 45%, Lab 10%, Midterm 25%, HW 20%.

Lab: There will be 6 lab assignments that can be done either at home or in the Math Lab where students will use a computer package to visualize nonlinear dynamics. Students are also encouraged to use the lab at other times between 9:00-5:00, provided that no class is occupying the room.

Instructor: Michael Ward. Contact: 822-5869. Room 1217 Math Annex.