

APPLIED MATHEMATICS 2190
Nonlinear Dynamical Systems: Theory and Applications (Fall 2010)

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Office Hours: Tuesdays 4-5, Thursdays 11-12, and by appointment
Class Meetings: Tuesdays & Thursdays 2:30-3:50 in Wilson Hall 204

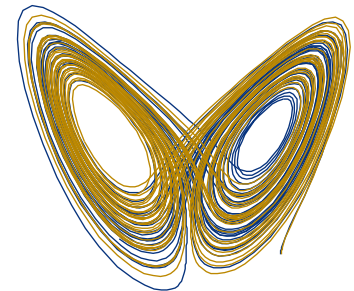
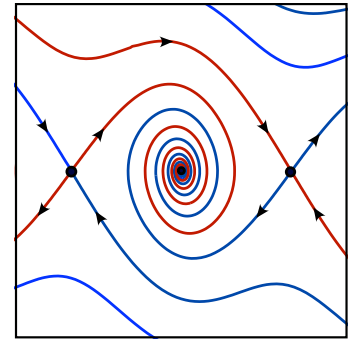
Course material

This course provides a rigorous introduction to ordinary differential equations, studied from a dynamical-systems viewpoint. Motivated by examples from ecology, chemistry, mechanics, and physics, we will study the existence and uniqueness of solutions and the dynamical behavior near equilibria and periodic orbits.

- Existence and uniqueness, dependence on parameters
- Dynamical systems, flows and maps, orbits
- Linear equations and Floquet theory
- Stable and unstable invariant manifolds for equilibria and periodic orbits
- Planar systems: Poincaré–Bendixson theorem
- Hamiltonian and gradient systems
- Center manifolds
- Normal forms
- Bifurcation theory for equilibria including Hopf bifurcations

The following topics will be covered in Spring:

- Melnikov method
- Horsehoes, and chaotic dynamics
- Averaging
- Geometric singular perturbation theory
- Lyapunov–Schmidt reduction



Literature

No textbook is required. Most of the material covered in the course can be found in

- C Chicone: *Ordinary differential equations with applications*, Springer.

Other books that contain some or all of the material covered in the course are

- S-N Chow and J Hale: *Methods of bifurcation theory*, Springer;
- H Amann: *Ordinary differential equations*, de Gruyter;
- E A Coddington and N Levinson: *Theory of ordinary differential equations*, McGraw- Hill;
- P Hartman: *Ordinary differential equations*, Wiley.

Grade

The grade is determined by homework problems (70%) and a group project (30%). Homework problems will be handed out every Tuesday and are due a week later. You can work together on homework problems, but you need to write up your solutions individually.