

# Physics 411, Fall 2009

## Classical Mechanics and Chaos

Instructor: Andrew N. Jordan

Office: Bausch & Lomb 317

Required text: H. Goldstein, *Classical Mechanics*

Optional text: E. Ott, *Chaos in Dynamical Systems*

webbook: <http://chaosbook.org/>

Course Website: <http://www.pas.rochester.edu/~jordan/Phys411/phys411.html>

Class: B&L 269, Tuesday and Thursday 11:05 - 12:20 hours, commencing September 1.

Office Hour: Thursday 4:00 - 5:00

Welcome to Classical Mechanics! The basic plan for the course is outlined below and the books above cover the basic material. In addition, there are many books on Mechanics in the POA library that you may wish to consult.

**Grades.**—This class will be graded **pass/no pass** basis because it is not considered a ‘core graduate course’ at the University of Rochester. There will be some homework (50%), and a final project (50%). The project will be on a topic in chaos, and will take the form of a written paper, as if submitting to a journal.

**Plan for the course.**—I will spend the first half of the class covering core topics in the subject of classical mechanics, following the general outline of Goldstein, including:

- (1) Variational principles for the action, Lagrangian and Hamiltonian formalisms,
- (2) Canonical transformations, Hamilton-Jacobi theory, and action-angle variables,
- (3) Canonical perturbation theory.

Physical examples will be central force problems, rigid body motion, small oscillations, and continuum systems.

I will then turn to a treatment of chaotic dynamics. This will be based on the web-book (above) and the book by Ott. The topics will include:

- (1) maps, hyperbolic flow, attractors;
  - (2) Lyapunov exponents, stable/unstable manifolds, entropies,
  - (3) routes to chaos, KAM theorem, classification of chaotic systems,
  - (4) periodic orbits, thermodynamic formalism, Ruelle resonances, trace formulas, and dynamical zeta functions.
- Time permitting, we may even do a little quantum chaos.