

UNIVERSITY OF BRITISH COLUMBIA

MATH 345 Jan-apr 2013

Applied Nonlinear Dynamics and Chaos

Description: 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.

Prerequisite: A score of 68% or higher in one of MATH 215, MATH 255, MATH 256, or MATH 265.

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

Topics:

- Flows on the line, bifurcations.
- The phase plane, fixed points, stability and linearizations.
- Limit cycles, Poincaré-Bendixson theorem, relaxation and weakly nonlinear oscillations, Hopf bifurcations, 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:

1. Homework assignments 15%, Lab assignments 10%, Midterm 20%, Final 55%.
2. There will be weekly homework assignments due in class on Wednesdays, except when there is an exam. The first is due January 16. Assignments and solutions will be posted on web. A selection of the problems will be graded. No late homework accepted. The lowest score will be dropped.
3. There will be biweekly lab assignments. They require the computer software XPPAUT, which can be downloaded at <http://www.math.pitt.edu/~bard/xpp/xpp.html>
4. There will be one midterm exam, in class on Wednesday February 13. There is no make-up exam. If you miss the midterm for a valid medical reason, the weighting for the final exam will be adjusted.
5. The period for final exams is April 10–24, 2013 inclusive. The exact time will be announced by the University by the middle of term. Students should not make early travel plans that overlap with the scheduled exam period.

Instructor: Dr. Tai-Peng Tsai, Math 109, phone 604-822-2591, ttsai@math.ubc.ca

homepage: <http://www.math.ubc.ca/~ttsai/courses/345-13S/>