

MATH 525-Q1 Graduate ODE IIB, Winter, 2009-10

- Instructor: Michael Li, Office: CAB 643, 492-2032,
mli@math.ualberta.ca <http://www.math.ualberta.ca/~mli/>
- Time of Class: MWF: 10:00 - 10:50 am, CAB 563
- Textbook: Lecture notes will be handed out and posted online on my homepage.
- Reference books:
1. L. Perko, Differential Equations and Dynamical Systems
 2. S. Wiggins, Introduction to Applied Nonlinear Dynamical Systems and Chaos
 3. Guckenheimer and Holmes, Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields.
- Office Hours: Tuesday: 2:00 - 3:30 pm, Friday: 3:00 - 4:30 pm
- Homework: Homework will be assigned bi-weekly.
- Exams: Midterm: There will be a take-home midterm exam.
Final Exam: final exam will be in the form of final project.
- Final Project: Individual projects that investigate ODE related problems will be assigned around mid-term time. Each student is required to submit a proposal outlining the problem to be investigated, methods to be used to investigate the problem, and expected results. Final reports of the projects are due at the end of the term. Each student will also be required to give a 20-minute oral presentation on the project.
- Final Grades: Your final grade in percentage will be calculated according to the formula:

30% Homework + 30% Midterms + 30% Final Project Report + 10% Presentation,

based on which letter grades will be decided.

Tentative Syllabus:

1. Global Theory of 2-dimensional systems

- Global existence, limit sets
- The Poincare-Bendixson Theorem, Lienard equations, van der Pol equations
- Poincare's index theory
- Flows on torus

Estimated lectures: 7

2. Invariant manifolds at an equilibrium

- The stable and unstable manifolds at a hyperbolic equilibrium
- Foliation at a hyperbolic equilibrium
- Center manifold theorem.
- Approximation of center manifolds

Estimated lectures: 7

3. Behaviours near a periodic orbit

- Hyperbolicity, nondegeneracy, and bifurcation
- Compound matrices and Poincare's stability condition in higher dimensions
- First integrals

Estimated lectures: 5

4. Bifurcations

- Elementary bifurcations
- Hopf bifurcations
- Homoclinic bifurcations

Estimated lectures: 5

5. Elementary properties of chaos

- The Smale horseshoe and transverse homoclinic orbits at fixed points
- Exponential dichotomy of linear systems
- Periodically perturbed systems

Estimated lectures: 7