

Course Title: **Ordinary Differential Equations** August 20, 2012  
Course Number: **MATH 6410 - 1**  
Instructor: Andrejs Treibergs  
Home Page: <http://www.math.utah.edu/~treiberg/M6414.html>  
Place & Time: M, W, F, 2:00 – 2:50 in JWB 308  
Office Hours: 10:45 – 11:35 M, W, F, in JWB 224 (tent.) & by appt.  
E-mail: [treiberg@math.utah.edu](mailto:treiberg@math.utah.edu)  
Prerequisites: Math 5210 or consent of instructor.  
Main Text: Lawrence Perko, *Differential Equations and Dynamical Systems*, Springer Texts in Applied Mathematics 7, 1991.

**Grading.** The course grade will be based entirely on homework solutions. Students are expected to complete all assigned problems. Students are encouraged to study and work on problems together, but the solutions should be written up individually. Make your papers self-contained. This means that your papers should include a statement of the question as well as enough description of any theorems and formulas used so that the reader doesn't have to refer to the text or another source to follow your solution.

**Content.** In this first semester of a year long graduate course in differential equations, we shall focus on ordinary differential equations and dynamical systems. The second semester, Math 6420 taught by P. Bressloff will emphasize partial differential equations. In this course, along with the Math 6420, we shall try to cover the syllabus for the qualifying exam in differential equations. Although some mathematical sophistication is required to take the course, we shall provide any background materials needed by the class. Topics include (depending on time): Introduction to ODE. Applications. Review of calculus. Existence, uniqueness and continuity theorems. Linear systems and stability. Qualitative theory, Liapunov stability. Limit sets and attractors. Applications to physical, biological, charged particle, coupled pendula and planetary systems. Invariant manifolds and linearizations. Grobman-Hartmann theorem. Planar flows. Poincaré-Bendixon theory. Periodic solutions and their stability. Floquet Theory. Sturm-Liouville Theory. Bifurcation Theory. Chaos.

**Expected Learning Outcomes.** At the end of the course the student is expected to master the theorems, methods and applications of

- Local Theory: Proof of the Local Existence and Uniqueness Theorem for ODE's, Continuation of solutions, Gronwall's Inequality, Dependence of the solution on parameters, Contraction Mapping Principle
- Linear Equations: Linear systems with constant coefficients, Jordan Normal Forms, Matrix exponential and logarithm, Fundamental Solution, Variation of Parameters Formula, Floquet Theory for periodic equations
- Stability: Liapunov Stability, Asymptotic Stability of solutions, Liapunov Functions, Proof of the Linearized Stability for Rest Points Theorem, Grobman - Hartman Theorem, Stable and Center Manifold Theorems
- Dynamical Systems:  $\omega$ -limit sets and limit cycles, Poincaré-Bendixson Theorem, Poincaré Map and stability of periodic orbits
- Bifurcation Theory: Persistence of periodic orbits, Normal forms for saddle-node, transcritical and pitchfork bifurcations, Hopf Bifurcation

**ADA.** The Americans with Disability Act requires that reasonable accommodations be provided for students with cognitive, systemic, learning and psychiatric disabilities. Please contact me at the beginning of the quarter to discuss any such accommodations you may require for this course.