

ODE PhD Written Exam Syllabus

November 15, 2004

1. Explicit solution of linear constant coefficient ODEs in closed form and using matrix exponential.
2. Existence and uniqueness theory for autonomous and nonautonomous equations. Picard iteration. Flows.
3. Smooth dependence of solutions on parameters (and initial conditions); Gronwall's inequality.
4. Existence and nonexistence of solutions for all time
5. Stability of equilibria; asymptotic and linear. Persistence of hyperbolic equilibria. Liapunov functions.
6. Phase plane analysis for linear and nonlinear systems
7. Poincare-Bendixson theorem
8. Gradient systems
9. Stable and unstable manifolds
10. Stability of periodic solutions; Floquet theory, Poincare maps.
11. Elementary bifurcation theory; saddle-node and Hopf bifurcation.

Reference book: 1. Differential Equations, Dynamical Systems, and An Introduction to Chaos by Hirsh, Smale, and Devaney. Elsevier.
2. Differential Equations and Dynamical Systems by Perko. Springer.