Math 677. Fall 2009. Final Exam Review.

Material: Perko, Chapters 1, 2, 3.1-3.3, 4.2-4.3; lectures 1-24.

1. Linear systems $\dot{x} = Ax$:

- Diagonalization and Jordan representation
- Properties of operator exponentials
- Solution to IVP $\dot{x} = Ax, x(0) = x_0$, stability theory
- Fundamental matrices and nonhomogeneous systems

2. Nonlinear systems $\dot{x} = f(x,t)$ - local theory

- Fundamental Existence-Uniqueness theorem
- Dependence on initial data and parameters
- Maximal interval of existence
- Stability theory

---------- Material After Midterm ----------

- Normal Form Theory
  (a) Reduction to normal form
  (b) Classification of nonhyperbolic critical points in planar systems

- Gradient and Hamiltonian Systems
  (a) Hamiltonian systems, Newtonian systems
  (b) Classification of critical points

3. Nonlinear systems - bifurcation theory, global theory

- Bifurcations at nonhyperbolic points
  (a) Saddle-node, transcritical, pitchfork bifurcations
  (d) Sotomayor theorem
  (e) Bifurcation diagrams

- Higher-codimension bifurcations and nonhyperbolic points
  (a) Universal unfolding
  (b) cusp bifurcation

- Hopf bifurcations
- Attractors, limit sets and periodic orbits