Math 5173: Qualifying Exam Syllabus

August 2024 Exam

Textbook: *Differential equations and dynamical systems*, third edition, by Lawrence Perko

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Linear systems

- Uncoupled linear systems (1.1)
- Diagonalization (1.2)
- Exponentials of linear operators (1.3)
- Fundamental Theorem for Linear Systems (1.4)
- Linear systems in $\mathbb{R}^2$ (1.5)
- Complex eigenvalues (1.6)
- Multiple eigenvalues (1.7)
- Jordan Forms (1.8)
- Stability (1.9)

Nonlinear systems: local theory

- Preliminary concepts (2.1)
- The Fundamental Existence and Uniqueness Theorem (2.2)
- Dependence on initial conditions and parameters (2.3)
- The maximal interval of existence (2.4)
- The flow defined by a differential equations (2.5)
- Linearization (2.6)
- The Stable Manifold Theorem (2.7)
- The Hartman-Grobman Theorem (2.8)
- Stability and Lyapunov functions (2.9)
- Gradient and Hamiltonian systems (2.14)

Nonlinear systems: global theory

- Dynamical systems and global existence (3.1)
- Limit sets and attractors (3.2)
- Periodic orbits and limit cycles (3.3)
- The Poincaré-Bendixson Theorem in $\mathbb{R}^2$ (3.5)