

## ODE Prelim Topics:

1. Examples of Explicit Solution Techniques
2. Initial Value Problems
  - a. Existence and Uniqueness of Solutions
  - b. Continuation and Maximal Intervals of Existence
  - c. Dependence on Data
  - d. Applications of Gronwall type inequalities
3. Linear Differential Equations
  - a. Nth Order Linear Equations
  - b. Linear Systems with Constant Coefficients
  - c. Matrix Algebra (including Matrix Exponentials and Canonical Forms)
  - d. General Solutions and Vector Space Concepts
  - e. Wronskian
  - f. Abel Formula
  - g. Fundamental Set, Fundamental Matrix, Fundamental Solution
  - h. Variation of Parameters Formula for Nonhomogeneous Equations
  - i. Linear equations with Periodic Coefficients, Floquet theory, Nonhomogeneous linear periodic systems
4. Stability Theory
  - a. Stability of Linear Systems with Constant Coefficients
  - b. Routh-Hurwitz Criteria
  - c. Stability of Linear Systems with Variable Coefficients
  - d. Autonomous Systems and the Phase Plane
  - e. Stability of Nonlinear Systems
  - f. Stability by Linearization
  - g. Lyapunov Functions and Lyapunov Theorems
  - h. Stable and Center Manifold Theory
5. Global Theory
  - a. Dynamical Systems and Global Existence Theorems
  - b. Limit Set and Attractors
  - c. Periodic Orbits and Limit Cycles
  - d. Poincare Map
  - e. Poincare-Bendixson Theorem
  - f. Bendixson's Dulac Criteria
  - g. Index Theory
6. Bifurcation Theory
  - a. Bifurcations at nonhyperbolic equilibria
  - b. Saddle node, transcritical, and pitchfork bifurcations
  - c. Hopf Bifurcations and Periodic Orbits
  - d. Homoclinic bifurcations
  - e. Global bifurcations of limit cycles