

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