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