

Topics for Exam 3**1. Phase–Plane Analysis**

- 1.1 Nullclines
- 1.2 Equilibrium points
- 1.3 Stability
- 1.4 Classification of equilibrium points
 - 4.1 Stable: Center, sink, spiral sink
 - 4.2 Unstable: Saddle point, source, spiral source
- 1.5 Principle of Linearized Stability
- 1.6 Cycles and periodic solutions

2. Analysis of Models

- 2.1 Nondimensionalization
- 2.2 Qualitative analysis

3. Qualitative Analysis of a Single Differential Equation

- 3.1 Analysis of first–order equations
 - 1.1 Equilibrium points
 - 1.2 Stability
 - 1.3 Principle of linearized stability
 - 1.4 Long–term behavior of solutions
- 3.2 Analysis of second order equations
 - 2.1 Phase plane analysis
 - 2.2 Oscillations

4. Special Types of Systems: Conservative systems

Relevant sections in text: Sections 5.1, 5.2 and 5.3

Relevant sections in the online class notes: Sections 5.3, 6.1, 6.2, 6.3 and 6.4

Relevant assignments: 12, 13, 14 and 15.

Important concepts: nullclines, equilibrium points, stability of equilibrium points, linearization, Principle of Linearized Stability, asymptotic stability, neutral stability, source, sink, saddle point, center, spiral sink, spiral source, cycles, oscillations, conserved quantities.

Important skills:

- Know how to nondimensionalize systems involving parameters
- Know how to use nullclines and the principle of linearized stability to sketch the phase portrait of general, two-dimensional, autonomous systems
- Know how to classify equilibrium points of general, two-dimensional, autonomous systems
- Know how to apply the principle of linearized stability for a single first order equation
- Know how to determine the long-term behavior of solutions of a single, autonomous, first-order equation
- know how to apply phase-plane analysis to a single, second-order equation
- Know how to find conserved quantities for conservative systems