Topics for Exam 3

1. **Linear Vector Fields**

   1.1 Definition of linear vector fields

   1.2 Vectors and matrix algebra

   > 2.1 Addition of vectors and matrices
   >
   > 2.2 Scalar multiplication
   >
   > 2.3 Matric multiplication

   1.3 Eigenvalues and eigenvectors of 2×2 matrices

2. **Flows of Linear Vector Fields**

   2.1 Line solutions

   2.2 Nullclines

   2.3 Equilibrium points

   2.4 Classification of equilibrium points

   > 4.1 Stable: Center, sink, spiral sink
   >
   > 4.2 Unstable: Saddle point, source, spiral source

3. **Flows of General Two–Dimensional Vector Fields**

   3.1 Phase–plane analysis

   3.2 Principle of Linearized Stability

Relevant sections in text: 12.1, 12.2, 12.3, 12.4, 13.3, 14.1, 14.2, 14.3, 14.4, 14.6
Relevant chapters in the online class notes: Chapters 6 and 7

Relevant assignments: 15, 16, 17, 18 and 19.

Important concepts: Linear vector fields, flow of a vector field, 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

Important skills:

- Know how to find eigenvalues and eigenvectors of 2×2 matrices

- Know how to find line–solutions of linear systems

- Know how to sketch the flows of linear vector fields

- Know how to use nullclines and the principle of linearized stability to sketch the phase portrait of general, two–dimensional systems

- Know how to classify equilibrium points of general, two–dimensional, autonomous systems