Topics for Exam 2

1. **Analysis of Linear Systems**

   1.1 Construction of solutions

   1.2 Linearly independent solutions

   1.3 The fundamental matrix

   1.4 Existence and uniqueness for linear, initial value problems

2. **Applications to Second Order Linear Differential Equations**

   2.1 Construction of solutions to linear second order equations

   2.2 Linearly independent solutions

   2.3 Structure of the solutions space for linear, second-order, homogeneous differential equations (Problem 3 in Assignment #11)

   2.4 Existence and uniqueness for the initial value problem

3. **Analysis of General Systems**

   3.1 Local Existence and Uniqueness Theorem

   3.2 Maximal interval of existence

   3.3 Global existence

   3.4 Qualitative analysis

       4.1 Nullclines

       4.2 Equilibrium points

   3.5 Principle of Linearized Stability

       5.1 Stable equilibrium points

       5.2 Unstable equilibrium points

       5.3 Types of equilibrium points

Relevant sections in text: Sections 2.2, 2.6, 3.1, 3.2,3.3, 3.4, 3.5, 3.6, 5.1 and 5.2

Relevant chapters in the online class notes: Chapters 3, 4 and 5

Relevant assignments: 7, 8, 9, 10, 11, 12 and 13.

Important concepts: Linearly independent functions, fundamental matrix, local existence and uniqueness, nullclines, equilibrium points, stability of equilibrium points, linearization, Principle of Linearized Stability.

Important skills:

- Know how to compute fundamental matrices for homogenous, autonomous linear systems

- Know how to construct solutions of second order linear equations with constant coefficients

- Know how to apply the existence and uniqueness theorems

- Know how to apply the principle of linearized stability

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