Midterm 1 Review Outline

Instrutor: Wenjing Liao

1 Chapter 1: introduction

Section 1.1: use differential equations for modeling.

Section 1.2 and Section 2.5: Autonomous differential equations: find equilibrium solutions (also called critical points or stationary points), draw phase lines, sketch integral curves, and determine whether a critical point is asymptotically stable, semistable or unstable. You are not required to draw direction fields.

Section 1.3: definition of linear and nonlinear differential equations.

2 Chapter 2: first order differential equations

Section 2.1: solve separable equations

Section 2.2: solve first order linear differential equations by using integrating factors.

Section 2.3: modeling - in particular write down a differential equation to model a problem and then solve the differential equation.

Section 2.4: Theorem 2.4.1, Theorem 2.4.2 and the applications (see HW problems).

Section 2.5: requirements are the same as Section 1.2.

Section 2.6: Theorem 2.6.1. Recognize an exact equation and solve it.

Section 2.7 is not on Midterm 1.

3 Chapter 3: Systems of two first order equations

Solve the homogeneous equation $x' = Ax$: Section 3.3, 3.4 and 3.5

- Superposition principle, Wronskian and linear independence: Theorem 3.3.1, Theorem 3.3.3 and Theorem 3.3.4;
- When A has complex eigenvalues, write the solution in terms of real solutions (remember the table on Page 172).
- Draw phase portraits when A has two distinct real eigenvalues (Table 3.3.1) or complex eigenvalues (Table 3.4.1). Determine whether $(0, 0)$ is a nodal sink, a nodal source, a saddle, a spiral sink, a spiral source, or a center.
- Solve for the solution when A has repeated eigenvalues. Phase portrait is not required for repeated eigenvalues.

Solve the non-homogeneous equation $x' = Ax + b$: See Section 3.3 about reducing $x' = Ax + b$ to $x' = Ax$.