M336 Differential Equations Review Guide for Test 1 -- Friday February 10th

Covered Sections from text: 1.1, 1.2, 1.3, 1.4 2.2, 2.3, 2.4, 3.2, 4.2 (Maybe on 4.2)

Chapter 1: Introduction
Section 1.1: Background
What is a differential equation (this is the first question on the test!!!)
Recognize in a differential equation: Dependent variable, independent variable, ordinary differential equation, partial differential equation, linear differential equation, nonlinear differential equation, order of a differential equation.

Practice Problems: Exercises 1 – 12, page 5

Section 1.2 Solutions and Initial Value Problems
Explicit solution to a diff eq.
Implicit solution to a diff eq.
Given a d.e. and a proposed solution, verify whether or not it is a solution
For implicit solutions, be able to use implicit differentiation to determine whether it is a solution.
Verify solutions to initial value problems.
Understand the statement of the Existence and Uniqueness Theorem and determine whether or not a given initial value problem satisfies the hypotheses of the theorem , page 14)
Practice Problems: 2, 4, 8, 10, 12, 24, 26, 27, 28, page 14

Section 1.3: Direction Fields (through page 20)
Know what a direction field is.
Given a direction field, "rough" sketch a solution curve satisfying a given initial condition.
Given a first order differential equation, calculate the direction arrow at a given point for the direction field.
Practice problems 1, 2 and worksheet we did in class (for sample “arrows” for a d.e.)

Section 1.4 The Approximation Method of Euler.
Describe precisely this method. What type of differential equations may it be used on?
Given a simple differential equation with an initial condition, compute the first three or four iterations of the approximations using Euler's method.
(Practice: Examples 1 and 2, and Exercises like 1-4)

Chapter 2 First Order Differential Equations
Section 2.2: Separable Equations
Determine whether a given equation is separable. Practice Problems 1,3,4
Solve a separable equation. Practice Problems: 8, 9
Solve a separable equation with an initial value. Practice Problems: 8, 10, 11, 18, 22, 25,

Section 2.3: Linear Equations
Recognize a linear first order d.e. Practice Problems 1 through 6
Solve such an equation using the general method of integrating factors in this section.
(Both general solution and initial value problem) Practice Problems: Examples 1 and 2, and 8, 9, 20

Section 2.4: Exact Equations
Given an equation, determine whether it is exact. Practice Problems 1-6
If it is exact, use the method of this section to solve it (both general solutions, and initial value problems).
Practice: Examples 1 and 3, 10, 12, 16, 18, 22

Chapter 3 Mathematical Models and Numerical Methods Involving First Order Equations
Section 3.2 Compartmental Analysis (through page 97 top, equation (15))
Describe a basic one-compartment system. Give an example of a such a system.
Mixing Problems: Given a mixing problem like example 1 (or exercises 2, 4, 8), set up and solve the differential equation.

Population Models:

Exponential Model: Recognize the differential equation (10) for the exponential model. Be able to solve it.
Practice Problems: Application problems like 9, 14
Logistic Model: Recognize the ***logistic differential equation***. Describe the type of population growth that it represents. Given a logistic differential equation OR the logistic equation (solution), identify the carrying capacity and growth rate -- use the lab handout.
Practice Problems: See example 3, 4

Section 4.2 Homogeneous Linear Equations: The General Solution
Recognize general form of linear second order differential equation with constant coefficients – and homogeneous vs. nonhomogeneous forms.
Statement of Theorem 1 -- Existence and Uniqueness of solution to Homogeneous IVP
What does it mean for two functions to be *linearly independent* on an interval I.
Definition of Wronskian.
Lemma 1: What condition on Wronskian is sufficient for two solutions to homogeneous IVP problem to be linearly independent.
Statement of Theorem 2 on solutions to homogeneous IVP.
Auxiliary equation.
General form of solution to homogeneous d.e. when 1) two distinct real roots to auxiliary equation and 2) Repeated root to auxiliary equation.
Good practice problems 2, 4, 5, 12, 14, 15, 18