Chapter Review Sheets for
Elementary Differential Equations and Boundary Value Problems, 8e

Chapter 2: First Order Differential Equations

Definitions:

- First Order Ordinary Differential Equation
- Integrating Factor, Integral Curves
- Variation of parameters (p. 41)
- Separable
- Homogeneous differential equations (p. 49)
- Implicit solutions (p. 74)
- Bernoulli Equations (p. 77)
- Logistic equations, intrinsic growth rate (p. 79)
- Existence and Uniqueness of Solutions General Solutions,
- Autonomous, Logistic Growth, Equilibrium Solutions,
- Stable solutions, asymptotically stable solutions, unstable equilibrium solution (p. 83)
- Threshold (p. 87)
- Integrating factors, Exact equations (p. 94-98)
- Critical Points Exact ODE
- Tangent Line Method (Euler's Method)
- First Order Difference Equation
- Method of successive approximations (p. 111)

Theorems:

- Theorem 2.4.1: Existence and uniqueness of solutions to linear first order ODE's.
- Theorem 2.4.2: Existence and uniqueness of solutions to first order IVP’s
- Theorem 2.6.1: Existence and uniqueness of solutions to exact first order ODE's.
- Theorem 2.8.1: Restatement and elaboration of theorem 2.4.2.

Important Skills:

- Be able to determine if a first order differential equation is linear or nonlinear. Equation (3) on page 32 gives the form for a linear ODE.
- If the differential equation is linear, compute the integrating factor, and then the general solution (Example 4, p. 38)
- Be able to graph integral curves for an ODE. (Example 4, p. 38)
- If it's nonlinear, is it separable? If it's separable, you will need to compute two different integrals.
- It crucial to know integration of basic functions and integral methods from your calculus course. For Example, various substitutions, integration by parts, and partial fractions will all be utilized (Examples 2&3, p. 44 & 46)
- If the differential equation is not separable, is it exact? If so, solve it using the method in section 2.6 (Example 2, p. 92)
- If it isn't separable or exact, check for substitutions that would convert it into a linear equation, nonlinear equation that is then separable. For example, exercises 27-31 in section 2.4, show how)
- Bernoulli equations can be transformed into linear equations.
- What happens to solutions as time tends to infinity? Understand stability, asymptotic stability and instability.

- These important qualitative classifications are at the heart of dynamical systems. Important with this is the concept of a threshold value (Section 2.5)
- Know how to obtain approximate solutions using Euler's method if an analytical solution cannot be found. (Example 2, p.104)
- Understand the three steps in the process of mathematical modeling: construction of the model, analysis of the model, and comparison with experiment or observation. (Example 3 p. 54)
- Determine the existence and uniqueness of solutions to differential equations. (Example 2, p. 61)
- Know how to recognize autonomous equations, and utilize the direction field to represent solution to them. Be able to determine asymptotically stable, semi-stable, and unstable equilibrium solutions. (Example 1, p. 83)

Relevant Applications:

- Mixing Problems, Compound Interest, Motion in a Gravitational Field, Radioactive Carbon Do