Math 340
Differential Equations

Review for Exam Two – Chapter 3

2.4 & 2.7 Existence & Uniqueness, Numerical Methods

- ❖ Euler's Method
  - understand how Euler's method uses successive tangent lines to a sequence of different solutions $\varphi(t), \varphi_1(t), \ldots$ in order to approximate values of the solution function $\varphi(t)$
  - use Euler's method to construct a sequence of approximations to the solution of an IVP using a fixed step size, h
  - compare errors in Euler's method for different values of h

- ❖ Existence & Uniqueness
  - know the statement of the Existence and Uniqueness Theorems, Theorem 2.4.1 & Theorem 2.4.2
  - understand the consequences of these theorems for differential equations (e.g. over what interval will an IVP have a unique solution?)

3.1 – 3.7 Second Order Linear Equations

- ❖ General Concepts & Definitions
  - homogeneous/nonhomogeneous
  - general form of a second order linear equation (homogeneous or nonhomogeneous)
  - general solution of a second order linear equation
  - fundamental set of solutions
  - Wronskian
  - linear dependence/independence: know the definition and how to use it to show linear dependence or independence
  - four equivalent conditions relating $W(y_1, y_2)$ and linear independence

- ❖ Solutions to Homogeneous Equations
  - characteristic equation
  - form of the general solution in the three cases:
    (i) two distinct real roots
    (ii) two complex roots
    (iii) repeated real roots
  - use the method of reduction of order to find a second solution when the equation has nonconstant coefficients
  - analyze the long term behavior of solutions

- Solutions to Homogeneous Equations
  - Method of Undetermined Coefficients
    - know for which functions $g(t)$ this method applies
    - use the guidelines in Table 3.6.1 to construct the guess for $Y(t)$
  - Method of Variation of Parameters

- Proofs
  - linear independence/dependence of two functions
  - verification of solutions
  - questions similar to questions 11 – 15 on the extra review problems