Math 256 Midterm 1 study guide.

- Section 1.1: Modeling via differential equations. Writing equations from given assumptions and altering equations to incorporate new assumptions. Unlimited population growth model. Logistic population model. Predator-prey model. Finding equilibrium solutions.
- Section 1.2: Initial value problems. Solving separable equations. MIssing solutions. Mixing problems.
- Section 1.3: Slope fields. Qualitative analysis of slope fields.
- Section 1.4: Euler's method. Graphical and formulaic understanding of Euler's method.
- Section 7.1: Error estimate for Euler's method. Using the formula $e_n \leq \frac{M_1}{2M_2}\left(e^{M_2(t_n-t_0)}-1\right)\Delta t$ where $M_1 = max|\frac{\partial f}{\partial t}+\frac{\partial f}{\partial y}f(t,y)|$ and $M_2 = max|\frac{\partial f}{\partial y}|$. (I'll give you this formula on the exam.)
- Section 1.5: Existence and Uniqueness of solutions. Hypotheses of Existence and Uniqueness theorems. Extendability. Equilibrium solutions and Uniqueness.
- (not in text) partial fractions.
- Section 1.6: Phase line. If $\frac{dP}{dt} = f(P)$, graph the phase line. Sink/source/node & Linearization theorem.
- Section 1.8: Linear equations. Finding general solutions. Solving initial value problems. Guessing and integrating factors.
- Section 2.1: Modeling via systems. Interpreting solutions in the phase plane. Equilibrium points. Modified Predator-prey model. Mass attached to a spring model. Relationship between 2nd order differential equation and a first order system.
- Section 2.2: Vector fields, direction fields.
- Section 2.3: Solving systems which are decoupled or partially decoupled. Damped harmonic oscillator.
- Section 2.4: Euler's method for systems. Existence and Uniqueness for systems. Swaying Skyscraper example.