Topics for Final Exam

1. **The Fundamental Theorem of Calculus**

   1.1 Solving the initial value problem $\begin{cases} \dfrac{dy}{dt} &= f(t) \\ y(t_o) &= y_o, \end{cases}$ where f is a continuous function defined on an interval containing t_o.

   1.2 Evaluating integrals: Changing variables.

2. **The Natural Logarithm and Exponential Functions**

   2.1 Solving first order differential equations.

   2.2 Separation of variables.

3. **Solving First Order Linear Differential Equations**

   3.1 Method of Integrating Factor.

   3.2 Integration by parts.

4. **Solving the Non–Linear, First–Order Differential Equation**

   4.1 Existence and Uniqueness.

   4.2 Partial Fractions.

5. **Linear Approximations**

   5.1 Linear approximation to a differentiable function.

   5.2 Error in the linear approximation.

6. **Qualitative Analysis of First Order Equations**

   6.1 Isolated equilibrium points; stability and asymptotic stability; unstable equilibrium point.

   6.2 Existence and uniqueness; global existence and long–term behavior.

   6.3 Principle of Linearized Stability

7. **Applications to Modeling**

   7.1 Conservation principles.

   7.2 One compartment Models.

   7.3 Analysis of population models for single species.

Relevant Sections in the Text and Class Lecture Notes:

Sections 4.24, 4.4, 4.2, 4.3, 4.5, 4.6, 5.2 and 5.1 in the text; Chapters 2, 3, 4 and 5 in the class lecture notes.

Relevant Assignments: 1–19.

Important Concepts: Differential equation, initial value problem, conservation principle, linear approximation, linearized equation, equilibrium point, stability.

Important Skills: Know how to apply the conservation principle to derive differential equation models; know how to use separation of variables to solve first order differential equations; know how to obtain qualitative information about solutions to first order differential equations; know how to integrate by parts; know how to use partial fractions; know how to use linear approximations to differentiable functions; know how to estimate the error in the linear approximation; know how to apply the principle of linearized stability.