Mathematics 304 – Ordinary Differential Equations
Review Sheet – Exam 1
September 28, 2000

*General Information*

The first midterm exam this semester will be given in class on Thursday, October 5, as announced in the course syllabus. This will be a closed-book exam, but you may use calculators at any point, and I will provide a copy of the table of integrals from the endpapers of our textbook for your use during the exam.

The exam will cover the material from Chapters 1 - 3 of the text that we have studied since the start of the semester (see specific topics and review problems below).

If there is interest, I would be happy to arrange a late afternoon or evening review session for the exam. Tuesday, October 3 is probably the best day to aim for.

*Topics To Be Included*

1) ODE, solutions, initial value problems, the Existence and Uniqueness Theorem for solutions of first order initial value problems
2) Qualitative theory for 1st order ODE: Direction Fields, special techniques for autonomous equations (identifying equilibrium solutions, determining whether they are "stable" or "unstable" – see section 1.4 in the text and Discussion 1)
3) Techniques for deriving analytic solutions of 1st order ODE: Separable equations, linear equations, exact equations, integrating factors, substitutions and transformations for homogeneous equations, equations of the form $\frac{dy}{dx} = g(ax + by + c)$, Bernoulli equations.
4) 1st order ODE in modeling of mixing problems, heating/cooling, etc.

*Suggested Review Problems*

From §1.2: 16, 17, 18, 20, 21, 23 - 28

From §1.3: 1, 3, 4, 5

From §1.4: 3, 4, 5 (Note: a "sink" is an equilibrium with the property that all solutions that start with $y$ near the equilibrium level tend *toward* that level as the independent variable tends to $+\infty$; a "source" is an equilibrium with the property that all solutions that start with $y$ near the equilibrium level tend *away from* that level as the independent variable tends to $+\infty$. Equilibria that are neither sinks nor sources are called "nodes".)

From Review Problems at end of Chapter 2 (page 87): try a good selection of these. Of course the first issue is to decide which class of equation you have and what method(s) apply.

From §3.2: 1, 3, 7, 9 (the "Malthusian law" is $\frac{dP}{dt} = kP$ for some constant $k$), 13, 18

From §3.3: 1, 3, 7, 11 (Note: in the ODE

$$\frac{dT}{dt} = K(A(t) - T) + H(t) + K_U(T_D - T)$$

representing "proportional control" heating and air conditioning ($T_D$ = desired temperature, $H(t)$ is the heat added from sources other than the heating/ac system, $A(t)$ is the ambient temperature), the "time constant" with heating/ac is $\frac{1}{K+K_U}$; the time constant for the building or van without heating/ac is $\frac{1}{K}$.