Mathematics 304 – Ordinary Differential Equations
Review Sheet – Exam 2
November 12, 2004

General Information

The second midterm exam this semester will be given in class on Friday, November 19, as announced in the course syllabus. As was true for the first exam, this will be a closed-book test. You may use calculators at any point. The exam will cover the material we have covered since the first exam (see topics below), through topics from class on Friday, November 12. If there is interest, I would be happy to arrange a late afternoon or evening review session for the exam. Wednesday, November 17 is probably the best day to aim for.

Topics To Be Included

1) First order systems $X' = AX$. Classification of equilibrium points via the eigenvalues of A and via the "trace-determinant plane" in the 2×2 case. Problems may ask you to work with 2×2, 3×3, or possibly 4×4 matrices. Finding the general solution via the corresponding canonical form system $Y' = BY$ and change of basis.
2) Application to homogeneous harmonic oscillator equations $mx'' + bx' + kx = 0$. Know how to convert to a first order system and apply 1 (with as 2×2 matrix) to find the general solution. The undamped, underdamped, critically damped, overdamped cases, and how solutions in each are different.
3) Forced oscillator equations $mx'' + bx' + kx = g(t)$. The general solution is $x(t) = c_1x_1(t) + c_2x_2(t) + x_p(t)$ where $c_1x_1(t) + c_2x_2(t)$ is the general solution of the homogeneous equation $mx'' + bx' + kx = 0$, and $x_p(t)$ is a particular solution. Finding particular solutions by the method of undetermined coefficients for exponential, polynomial, and sinusoidal forcing terms (including the case where the forcing term is a solution of the homogeneous equation). The phenomenon of resonance in undamped systems.
4) Equilibrium points and linearization for nonlinear systems.

Suggested Review/Practice Problems

From Hirsch, Smale, and Devaney:

Chapter 2/2,3
Chapter 3/2ii, iv, vi, 4, 5, 11, 12, 13, 14, 16 (16 would be an "extra credit"-type problem)
Chapter 4/1,2,3
Chapter 5/5dfgh,6
Chapter 6/1dfgh (note–these are the same matrices as in 5dfgh as above)

From Blanchard, Hall, and Devaney:

Section 4.1/9,25,31,36,41
Section 4.2/1,11
Section 5.1/1,3,4,5 (5 is a good review material from the first part of the course too!)