

Activity 8: Nonhomogeneous differential equations and systems of differential equations
Names: _____ Date: November 19, 2009 Score: _____

Show your work for each of the following. You should submit one copy for your group. Feel free to ask your instructor for advice if you need it.

1. (15 pts) Consider the differential equation

$$\begin{aligned}x_1' &= -x_1 + 3x_2 + \cos(t) \\x_2' &= 4x_1\end{aligned}$$

(a) Write this differential equation as a (nonhomogeneous) matrix differential equation.

(b) Solve the corresponding homogeneous matrix differential equation.

(c) Write the nonhomogeneous system of differential equations as a single higher order differential equation.

(d) Find a single solution to the single higher order differential equation.

(e) Use your answer to (d) to find a single solution to the nonhomogeneous matrix differential equation.

(f) Find the general solution to the nonhomogeneous matrix differential equation.

2. (5 pts) Find the general solution to the differential equation $2y'' + y' - 3y = e^t$.

3. (Review for exam) Our methods for solving non-homogeneous equations in this course have three parts. First, we solve the homogeneous problem, whose solution is a subspace. Then we find a single solution to the nonhomogeneous problem. Finally, we find the general solution to the nonhomogeneous problem. We have seen this three times: for linear systems of algebraic equations, for linear differential equations, and for systems of first order, linear differential equations. The first problem on this assignment shows how the method works for an example system of linear differential equations with constant coefficients. Explain how the method works for each kind of problem. In your explanation, highlight the techniques we have learned and the special cases to which they apply. This is an essay question.