Math 211, Differential Equations and Linear Algebra Assignment 1. To be turned in by Tuesday, September 1 at 9PM, either during class to to office 45 in the basement of Herman Brown.

Part 1

Section 2.1: 2, 3, 7, 10, 13

Notes: don't worry about plotting, and remember to check where an alleged solution will be differentiable

Section 2.2: 1, 3, 13

Notes: on 1 and 2 Find the general solution given by assuming that the thing you divide by is non-zero and the constant solutions you get when it is zero

For clarification see the examples corresponding to this assignment.

Part 2

Section 2.4: 1, 11, 36, 42

Additional Problems. These will be a good motivation for the higher order case. Only the first two are required

1. Suppose that y, and $\hat{y}$ solve the ODE

$$y' = p(t)y + q(t).$$

Let $z = y - \hat{y}$. Show that z solves the linear *homogeneous* ODE

$$z' = p(t)z$$

2. Suppose that y, and $\hat{y}$ solve the second order linear ODE

$$y'' = p_1(t)y' + p_0(t)y + q(t).$$

Let $z = y - \hat{y}$. Show that z solves the second order linear *homogeneous* ODE

$$z'' = p_1(t)z' + p_0(t)z.$$

3. *optional problem: will not be graded*

If you'd like to do so, show that this extends to linear ODE's of any order. Suppose that y, and $\hat{y}$ solve the n^{th} Order linear ODE

$$y^{(n)} = \sum_{k=1}^{n-1} p_i(t)y^{(i)} + q(t).$$

Let $z = y - \hat{y}$. Show that z solves the Second order linear *homogeneous* ODE

$$z^{(n)} = \sum_{k=1}^{n-1} p_i(t)z^{(i)}.$$

This will be useful. It will mean that if we can solve the Homogeneous ODE, and can find even one solution to the inhomogeneous ODE, then we have all of the solutions to the inhomogeneous ODE.

Let's say some words about challenge problems:

They will also be entirely optional and are not extra credit. They are really for your own self-edification. But I don't expect that to be motive enough. Solve a challenge problem and I will try to bring in do-nuts, pastries, bagels, or some such for the class. You can either swing by in office hours to present your solution, or else (if you give me fair warning) you may meet me before class in the classroom to present.

this being said I will repeat today's problem:

1. solve the ODE $y' = \sqrt{(|y|)}$ by separation
2. show that

$$y(t) = \begin{cases} \left(\frac{t+c_1}{2}\right)^2 & \text{for } t \geq -c_1, \\ 0 & \text{for } -c_2 \leq t \leq -c_1 \\ \left(-\frac{t+c_2}{2}\right)^2 & \text{for } t \leq -c_2, \end{cases}$$

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   is a solution to the ODE for any choice of $c_1 \leq c_2$, even for the cases $c1 = -\infty$ and/or $c_2 = \infty$, where they are interpreted correctly.

3. show that there are no more solutions.

Feel free to present any parts of this problem once you have worked them out.