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Group Assignment 1

September 7, 2020

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(a) We plan on using Zoom in order to use the share screen settings for use of the whiteboard and sharing notes/sources.

(b) We will work on Friday and Sunday afternoons.

(c) We will take turns drawing on the whiteboard and talk through the problems together.

(d) When one person explains something, they will ask the other person if things made sense / if they have any questions. We will make sure that we are on the same page before moving forward with each problem or each step of a problem.

(e) We will use Latex.

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Find a general solution to $u_x + u = e^{2x+y}$

1. We will use the method of undetermined coefficients to find our general solution to this PDE. First, we need to find one particular solution to the inhomogenous PDE.
   - Our guess is $U(x,y) = Ae^{2x+y}$, and we need to discover A.
   - Then, we have $2Ae^{2x+y} + Ae^{2x+y} = e^{2x+y}$ by differentiating our guess with respect to x and plugging our guess into $u_x + u = e^{2x+y}$
   - $\implies 3Ae^{2x+y} = e^{2x+y}$
   - $\implies A = 1/3$
   - Therefore, one particular solution is $U(x,y) = 1/3e^{2x+y}$
2. Now, we need to find a general solution in the form:
   $u(x,y) = c_1u_1(x,y) + c_2u_2(x,y) + U(x,y)$, where c_1 and c_2 are constants with respect to x, u_1 and u_2 are solutions to the associated homogenous PDE $u_x + u = 0$, and $U(x,y)$ is a particular solution to the inhomogenous PDE. We used this source: Nonhomogenous Equations: Method of Undertermined Coefficients
   - First, we need to find the solutions u_1 and u_2 such that $u_x + u = 0$:
     $u_1(x,y) = f(y)e^{-x}$
     $u_2(x,y) = e^{-x+g(y)}$,

     where $f(y)$ and $g(y)$ are arbitrary functions.
3. Now, we can begin to write our general solution. We know that $u(x,y) = c_1f(y)e^{-x} + c_2e^{-x+g(y)} + 1/3e^{2x+y}$

4. However, we also know that c_1 and c_2 are constants with respect to x. So, we can represent them as arbitrary functions of y.

5. So, our general solution to this PDE is:
$u(x, y) = f(y)e^{-x} + h(y)e^{-x+g(y)} + 1/3e^{2x+y}$, where $f(y)$, $g(y)$, and $h(y)$ are arbitrary functions.