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$x+ct$   $x - ct$ . (s)ds. (8)

This is the solution formula for the initial-value problem, due to d ' Alembert in 1746. Assuming to have a continuous second derivative

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(written C2)

and to have a continuous first derivative (C1),

we see from (8)

that itself has continuous second partial derivatives in  $x$  and  $t$ .

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$u_{xx} + u_{yy}$  wave

equation  $u_t =$

$u_{xx} + u_{yy}$  heat

equation  $u_{xx} + u_{yy} =$

$f(x,y)$  Laplace

equation The

homogeneous

Laplace equation,

$u_{xx} + u_{yy} = 0$ , can be

thought of as a

special case of the

wave and heat

equation where the

function  $u(x,y,t)$  is

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independent of  $t$ .

Equations

Partial Differential

Equations

Thus the solution of  
the partial

differential equation  
is  $u(x,y)=f(y+\cos x)$ .

To verify the solution,  
we use the chain rule  
and get  $u_x = -\sin x f'(y+\cos x)$   
and  $u_y = f'(y+\cos x)$ . Thus  $u_x + \sin x u_y = 0$ , as desired.

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provides the student a broad perspective on the subject, illustrates the incredibly rich variety of phenomena encompassed by it, and imparts a working knowledge of the most important techniques of analysis of the solutions of the equations.

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2 Partial Differential

Equations Some

examples of PDEs ( all

of which occur in

Physics ) are: 1.  $u_x + u_y = 0$  ( transport

equation ) 2.  $u_x + u u_y = 0$  ( shock waves ) 3.

$u_x + u_t = 1$  ( eikonal

equation )

$u_x + u_t = 1$  ( eikonal

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equation ) 4.  $u_{tt} - u_{xx} = 0$  ( wave equation )

5.  $u_t - u_{xx} = 0$  ( heat or diffusion equation )

6.  $u_{xx} + u_{yy} = 0$  ( Laplace equation ) 7.

$u_{xxxx} + 2u_{xxyy} +$

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EQUATIONS - Sharif

The official

prerequisites for this

course are ordinary



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differential equations (MATH 20D) and linear algebra (MATH 20F), but a thorough understanding of (multivariable) calculus (MATH 20ABCE) is also necessary. Everything in Appendices A1-A4 of the textbook, W. A. Strauss, Partial Differential Equations: An

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Introduction, 2nd ed.

(New York ...

110 Introduction to  
Partial Differential  
Equations

In mathematics, a partial differential equation is an equation which imposes relations between the various partial derivatives of a multivariable

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function. The function is often thought of as an "unknown" to be solved for, similarly to how  $x$  is thought of as an unknown number, to be solved for, in an algebraic equation like  $x^2 - 3x + 2 = 0$ . However, it is usually impossible to write down explicit formulas for solutions

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of partial differential equations. There is, correspondingly, a vast ...

## Solutions

Partial differential equation - Wikipedia  
Hand in: 2.3.2d), 2.3.2e), 2.3.2g), 2.3.4, 2.3.8 (hint for (b): Let  $w(x,t)$  be the solution if  $\alpha = 0$  (we did this in class). Now consider the function

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$u(x,t) = v(t)w(x,t)$ .

Plug this into the PDE  
to find a differential  
equation for  $v(t)$  and  
solve it).

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Equations Math 110,  
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A solution or integral of a partial differential equation is a relation connecting the dependent and the independent variables which satisfies the given differential equation. A partial differential equation can result both from elimination of

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arbitrary constants  
and from elimination  
of arbitrary functions  
as explained in  
section 1.2.

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Edition, by Walter A.  
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identify which  
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Partial Differential Equations presents a balanced and comprehensive introduction to the concepts and techniques required to solve problems containing unknown functions of multiple variables. While focusing on the three most classical partial differential equations

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waves, vibrations of a  
solid, and many  
more. Rigorous  
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frequently, with  
minimal technical  
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a broad perspective  
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and more. Coupled  
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Prerequisites include

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