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# Textbook

* + <http://www.math.toronto.edu/ivrii/PDE-textbook/>

# Chain Rule:

* + If:
  + Then: and

# First Order PDEs:

* + General form:
  + Characteristic:
  + Process:
    - Pick two characteristics and integrate like a separable equation
    - Be sure to know what the constant is in terms of
      * For homogeneous, where obtained from above integration
  + IVP:
    - Find , the plug in I.C.
      * Solve for constant D in the case
      * Then plug in case for D

# 1D Wave Equation

## IVP with inhomogeneous wave equation

* + - If:
      * ,
    - Then:

## IVBP:

* + - If:
      * ,
    - Then
      * ,
      * ,

## 1D wave on a finite interval with Neumann boundary conditions:

* + - If:
      * ,
    - Then:
      * Start with:
      * Then complete the following reflections until you get to desired point

Use all found and make a piecewise

Similarly, do this will all known

* + - * + After each reflection, we gain either another or and this can be repeated infinitely to find the whole line

# 1D Heat equation

* + If:
  + Then

## IVP:

* + - If:
    - Then

## On the half line:

### Dirichlet:

* + - Then:
      * Where:

### Newmann:

* + - Then:
      * Where:

## Inhomogeneous B.C.’s

* + - Skipped

## Inhomogeneous Heat Equation

* + - Then:

## Inhomogeneous half line heat equation

* + - Then:

## Error function

* + - Go from to this with the following substitution:

# Separation of variables

* + Assume
  + Get and from eigenvalue problems. Then use in

## Wave equation:

* + - Characteristic:

## Heat equation:

* + - Characteristics:

# Eigenvalue problem

* + D for Dirchlet and N for Newman

## “DD”

* + - If:
    - Then:

## “NN”



## “DN”



## “ND”



## Periodic condition

* + - If:
    - Then:

      * If It can be any constant
      * If

# Fourier series

## Full

* + Given on , Can be any length interval so also
  + on

## Parseval’s Equality

## Cos Fourier

* + - Given on

      * Parseval’s Equality

## Sin Fourier

* + - Given on
      * Parseval’s Equality

## Sin with half integers

* + - Given on

      * Parseval’s Equality

## Complex Fourier

* + - * Parseval’s Equality

# Laplace Equation

* + - Some easy solutions
    - Boundary

## Half Strip

* + - If:
    - Then: AGAIN this is “DN”

To ensure

## Rectangle

* + - If:
    - Then:
    - “ND” example:

## Polar Coordinates

### Disc

* + - * If:
      * Then:
        + Characteristics:

Solutions:

* + - * + Plug in conditions:

#### Poisson formula

### Everything but the disc

* + - * If:
      * Then:
        + Characteristics:

Same as the disc above

* + - * + Plug in conditions:

Mostly the same but now

#### Poissonish formula

### Donut

* + - * If:
      * Then:
        + Characteristics:

Same as the disc above

* + - * + Solution:
        + Plug in conditions

Use Full Fourier series to get 3 equations

Use Full Fourier series to get 3 more equations

* + - * + 6 letters and 6 equations, should all be solvable

# Fourier Transform

* + Inverse Fourier Transform
  + Plancherel’s formula

## Properties

* + - F represents the fourier transform
    - Linearity
    - Modulation
    - Derivatives
      * + Only if
    - Non zero scalar
    - Convolution