

Intro to Lecture 9

Oct. 5, 2016

Last time we discussed how linear partial differential equations involving the laplacian played such a dominant role in physics. We began our discussion of how to solve these equations by separation of variables. When this works, it decomposes the problem into a set of ordinary differential equations, which are much easier to solve. There are now have a large set of beautifully analyzed equations and the functions which are their solutions. This may be nineteenth century mathematics, but it is still crucial to being able to pursue problems in twenty-first century physics.

Today we will discuss the method of separation of variables in general and consider in particular cartesian coordinates, spherical coordinates and cylindrical polar coordinates, reducing the partial differential equation to several ordinary differential equations. We we will meet the equations which determine several of physicists' favorite special functions, in particular Bessel, spherical Bessel and Legendre functions, and spherical harmonics.

Then we will turn to methods of evaluating these functions using general mathematical techniques of infinite series and products, and later complex variables. In the course of doing so we will meet a number of other very important special functions, such as the Gamma function, elliptic integrals, Bernoulli numbers and functions, and Riemann's zeta function.

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- Homework 3, after an extension, is due now.
 - Project 1 is due Thursday, Oct. 13, at 5:00 PM
 - The midterm exam will be on Oct. 19.
 - Homework 5 will be due Monday, Oct. 24 at 5:00 PM