

Linear Analysis

Course description from the schedule of classes

Presents a study of first and second order differential equations, linear algebra and systems of differential equations.

Catalog description

Presents a study of separable and linear ordinary differential equations with selected applications; numerical and analytical solutions; second order differential equations; Laplace transforms. Delves into Linear Algebra with a study of vectors in n -space, matrices, linear transformations, eigenvalues, eigenvectors, diagonalization; applies linear algebra in the study of systems of linear differential equation.

Reading both of these descriptions you should realize there are three major subjects in this course:

1. Differential Equations
2. Linear Algebra
3. Applications of linear algebra to differential equations

So, what are differential equations and what is linear algebra? Here are some definitions for these subjects

Differential Equations (three definitions):

1. A differential equation is an equation that contains derivatives of one or more dependent variables with respect to one or more independent variables. (Jerry Farlow et al *Differential Equations and Linear Algebra*)
2. Differential equations are equations to be solved in which the unknown element is a function, rather than a number, and in which the known information relates that function to its derivatives. (Dave Rusin *The Mathematical Atlas*)
3. An ordinary differential equation is an equation that contains one or several derivatives of an unknown function ... which we want to determine from the equation. (Erwin Kreyszig *Advanced Engineering Mathematics*)

We'll be studying differential equations in chapters 1, 2, 4, 6, and 8

Linear Algebra (three definitions):

1. Linear algebra is the branch of mathematics that has grown out of a theoretical study of the problem of solving systems of linear equations. (Charles Curtis *Linear Algebra*)
2. Linear algebra, sometimes disguised as matrix theory, considers sets and functions which preserve linear structure. (Dave Rusin *The Mathematical Atlas*)
3. Linear algebra includes the theory and application of linear systems of equations, linear transformations, and eigenvalue problems... (Erwin Kreyszig *Advanced Engineering Mathematics*)

We'll be studying linear algebra in chapters 3 and 5.

Why are these topics important parts of modern mathematics? Here are some more quotes from the same authors:

1. The ideas that developed in this way have become part of the language of practically all of higher mathematics. They also provide a framework for applications in mathematical economics, computer science, and the natural sciences (Charles Curtis *Linear Algebra*)
2. ...In practice this includes a very wide portion of mathematics! Thus linear algebra includes axiomatic treatments, computational matters, algebraic structures, and even parts of geometry; moreover, it provides tools used for analyzing differential equations, statistical processes, and even physical phenomena. (Dave Rusin *The Mathematical Atlas*)

3. The content and character of mathematics needed in applications are changing rapidly. Linear algebra - especially matrices - and numerical methods for computers are of increasing importance... Real analysis (ordinary and partial differential equations) and complex analysis remain indispensable. (Erwin Kreyszig *Advanced Engineering Mathematics*)

How do these subjects fit with other math classes? Calculus and statistics are still the most fundamental mathematical tools for solving problems in the physical and biological sciences, engineering, economics, and the social sciences. Differential equations provide a way to translate problems from these other fields into the language of calculus and also provide a way to solve these problems. Linear algebra will allow us to solve more difficult differential equations and provide a framework for understanding the solution sets of a wide variety of problems. So the topics we will cover in this class will help you apply your calculus knowledge to a wider group of problems. After this class there are many, many areas of mathematics that you could venture into. Here are some of the most common areas of applied mathematics you could study next;

- Complex Analysis
- Numerical Analysis
- Vector Calculus
- Fourier Analysis
- Partial Differential Equations
- Statistics
- Calculus of Variations