Mathematics 266 — Spring 1999

Vector calculus and complex analysis for electrical engineers

Course outline

This course makes a quick tour through two topics which are only weakly related, **vector calculus** and **complex analysis**. The first will take up about 4 weeks, the second about 8. The first is all about mathematical **fields** of various kinds. A field is a quantity which varies continuously in space. This will extend what you have learned about functions of several variables (which are sometimes called **scalar fields**) to **vector fields**. Vector fields occur often in engineering and physics problems. They arise mainly as **force fields**, such as electric and magnetic fields or gravitational fields, but also in other ways such as the velocities in fluid flows. You are supposed to have already met one kind of vector field in a previous course, the **gradient** of a scalar field. Most of the time we spend on this topic in this course will be concerned with generalizations of the gradient, the **curl** and **divergence** of vector fields. All of these are examples of different kinds of derivatives of vector fields. We shall also look at certain minds of integrals of vector fields.

The subject of complex variables extends calculus of a single variable to consider certain functions of a complex varaible whose values are also complex. This topic will seem at first quite strange to you, so we shall have to go more slowly. The main application of this subject which you will see in your courses will be towards understanding the Laplace transform in a new way, but another application will be to certain kinds of vector fields in two dimensions.

This course is still somewhat experimental. There is no required text. For the first topic, you might want to use as a reference your text book from your course on calculus of several variables, but we shall not refer explicitly to it. The reference we (the instructors) are using is Volume II of Richard Feynman's **Lectures on Physics**, particularly Chapters 1–4: *1. Electromagnetism*, *2. Differential Calculus of Vector Fields*, *3. Vector Integral Calculus*, *4. Electrostatics*. This is available from the Reserve holdings of the UBC Library, and we will try to put some copies on reserve in the Mathematics Library as well.

Lecture notes will also be handed out from time to time.

There will be homework throughout the term. In order to pass this course you are required to do essentially all of the problems assigned.

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