

MA32007: Differential Geometry Guide 2012

Introduction

The basic ideas at the foundations of many physical theories, such as continuum mechanics, fluid dynamics, electromagnetism, thermodynamics, general relativity and gauge theories, are geometrical. This course develops some of the geometrical concepts and tools that are essential for understanding classical and modern physics and engineering. Methods of differential geometry are also often used in the analysis of differential equations, dynamical systems and topology.

Organisation

The MA32007 module is an introduction to Differential Geometry. In order to take this course you should have passed modules MA21001 and MA22001, or have an equivalent qualification. The Module Leader is Dr Hornig.

You may bring matters of concern about the course to the attention of the Mathematics Division Staff/Student Committee, which meets once each semester. A volunteer from one of the level 3 courses will act as class representative to sit on the Staff-Student Committee; their name will be posted on BlackBoard.

Timetable

The course consists of 44 lectures/workshops. The timetable is available on the websites of the Division of Mathematics and the University.

Your Commitment

You should attend all lectures and workshops except on medical grounds or with the special permission of the lecturer concerned. If you are absent from a Class Test on account of medical problems, you should submit a medical certificate to your Faculty Office.

Study Support

If you are having difficulty with the course work you are encouraged to seek help at an early stage at the Workshops. You may also obtain help your lecturer or your Personal Tutor.

Syllabus

Manifolds (3)

- Submanifolds in \mathbb{R}^n
- Implicit Function theorem
- Examples

Vector fields on manifolds (4)

- The tangent space
- Vectors as differential operators
- Vector fields and flows

Covectors and exterior forms (3)

- Linear functionals and the dual space
- Differential of a function
- The pull-back of a covector

The exterior algebra (6)

- The geometric meaning of forms in \mathbb{R}^n
- Exterior product
- Inner product
- Exterior differential
- Relation to vector analysis

Integration of forms (3)

- Line and surface integrals
- Independence of parameterisation
- Integrals and pull-backs
- Stoke's Theorem

Lie-derivative (3)

- The Lie-derivative of forms
- Relation to equations in physics

Assessment

There will be Homeworks and a Degree Examination in May. These contribute to the overall assessment as shown in the Table below.

Homeworks	20%
Degree Examination	80%

The Head of Division may debar a student not performing at a satisfactory level in the continuous assessments from entering the Degree Examination.

Feedback

At the end of the module you will be asked to complete a confidential questionnaire regarding the content and presentation of the module. This is an important element in the University's Academic Standards procedures.

Recommended Books

The main text for this module is:

The Geometry of Physics, 2nd Edition

by Theodore Frankel

Publisher: Cambridge University Press.

Many similar textbooks may be found in the University Library.