

Geometry F10PG2/F11PG2
Second Semester 2011/12
Course Document¹

Lecturer: David Rule

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Lectures: Monday 12.15pm, Wednesday 12.15pm and Friday, 2.15pm (50 minutes) in CM G01

Tutorials: Tuesday at 2.15pm in CM G01

Website: www.ma.hw.ac.uk/~rule/geometry/

Useful References: If you are looking for references for further reading, the following texts may be useful. You are not required to purchase any books, but obviously may if you so wish. Thorpe contains most of the material covered in this course.

- J.A. Thorpe, *Elementary Topics in Differential Geometry*
- R. Fenn, *Geometry*
- M.P. Do Carmo, *Differential Geometry of Curves and Surfaces*
- J. McCleary, *Geometry from a Differentiable Viewpoint*
- P.M.H. Wilson, *Curved Spaces*

Course Summary: The aim of this course is to provide an introduction to ideas in geometry, primarily differential geometry. We will study this mainly by studying n -dimensional surfaces in $(n + 1)$ -dimensional Euclidean space which arise as level sets of functions.

F10PG2 Syllabus: The principal material in this course will be roughly the following.

- **Graphs, Level Sets and Vector Calculus.** Definitions and basic properties; reminder of material seen earlier in calculus courses; notational conventions for the course; integral curves.
- **The Tangent Space and Surfaces.** Characterisation of tangent space for smooth surfaces; useful examples.
- **Vector Fields on Surfaces and Orientation.** Integral curves of n -surfaces; normal vector fields on n -surfaces; orientation; consistent bases for the tangent space.
- **The Gauss Map and Geodesics.** The Gauss map on compact surfaces; derivatives of smooth vector fields and associated calculus; existence and uniqueness of geodesics.
- **The Weingarten Map.** Differentiation with respect to a vector and associated calculus; Weingarten map; connection to the acceleration vector; self-adjoint property of the Weingarten map.
- **Curvature of Plane Curves and Surfaces.** Parametrisation of a curve; curvature; normal curvature; principal curvatures and principal curvature directions.

If there is time, we will cover additional material.

F11PG2 Syllabus: All of the above, plus the following.

- **Private Reading.** Learn assigned reading material which will investigate topics related to the course, but be beyond the scope of material taught in lectures.

Assessment: There will be an examination later in the year. The University sets the date and time of the examination. The F10PG2 version has is a two hour exam, with a choice of three questions from four. The F11PG2 version has is a three hour exam, with 5 compulsory questions.

Homework and Tutorials: Excercises will be assigned regularly to help you understand and gain familiarity with the material. You are encouraged to work on problems together but should write up

¹Date: 9/1/12

solutions independently to ensure you really understand it yourself. We will discuss solutions to the exercises in the tutorial the following week, but you must spend time thinking about problems before hand. Taking part in the tutorials is a compulsory component of the course. It is essential that you spent a significant amount of time thinking about the material taught and problems assigned in order to gain understanding of it and so pass the course. You are also welcome to ask me questions after class or arrange an appointment at some other time if you would like additional help.

Academic Misconduct: Zero marks for the course will be assigned if evidence of cheating or academic misconduct is found in any part of your work for it. Please see the University guidelines on plagiarism and related matters.

David Rule