# **Course Structure**

## **Contact Information**

Lecturer: Charles Walkden email: charles.walkden@manchester.ac.uk web: http://www.maths.manchester.ac.uk/~cwalkden phone: x55805 (0161 275 5805) office: Turing 2.241 office hours: Fri 2:30-3:30, or email me to arrange a time.

#### **Course Structure**

MATH32051 is a 10 credit course. There will be about 22 lectures and a weekly examples class. The examples classes will start in Week 1.

MATH42051/62051 are 15 credit courses. The course will consist of the taught lectures, together with independent reading material. There will be fortnightly support classes for the reading material, starting in week 3 (see the timetable for details).

The examples classes are a key part of the course. I will try to make them as interactive as possible by getting you to revise material that will be useful in the course or getting you to work through some of the exercises, perhaps with additional hints. Towards the end of the course we will spend time doing past exam papers. You should consider attendence at the examples classes to be compulsory.

The lecture notes are available via the School's website. The lecture notes contain slightly more material than I present in the lectures. This allows me to expand on minor points for the interested student, present alternative explanations, etc. Only the material I cover in the lectures is examinable. The lectures also contain the exercises. For your convenience I've collated all the exercises into a single file (also available on the website); in this file I've indicated which exercises are particularly important and which are there for completeness only. The exercises are a key part of the course.

There is no coursework or in-class test for this course. However, there will be an 'informal quiz' in week 7/8 based around past exam questions that you can submit for marking and for feedback.

The course is examined by a 2hr (3hrs for the M.Math/M.Sc. exam) written examination in May/June. The exam is in the same format as previous years: Section A contains 4 questions worth a total of 40 marks, Section B contains 3 questions, each worth 20 marks, of which you must do 2. For the M.Math/M.Sc. version of the course, there is also an additional Section C with 3 questions worth a total of 50 marks.

## Recommended texts

J. Anderson, *Hyperbolic Geometry*, 1st ed., Springer Undergraduate Mathematics Series, Springer-Verlag, Berlin, New York, 1999.

S. Katok, *Fuchsian Groups*, Chicago Lecture Notes in Mathematics, Chicago University Press, 1992.

A. Beardon, *The Geometry of Discrete Groups*, Springer-Verlag, Berlin, New York, 1983.

The book by Anderson is the most suitable for the first half of the course. Katok's book is probably the best source for the second half of the course and for those of you doing the 15-credit version. Beardon's book contains everything in the course, and much more. You probably don't need to buy any book and can rely on the lecture notes.

## Contents of the course

- 1 Where we are going
- 2 Length and distance in hyperbolic geometry
- 3 Circles and lines, Möbius transformations
- 4 Möbius transformations and geodesics in  $\mathbb H$
- 5 More on the geodesics in  $\mathbb H$
- 6 The Poincaré disc model
- 7 The Gauss-Bonnet theorem
- 8 Hyperbolic triangles
- 9 Fixed points of Möbius transformations
- $10\,$  Classifying Möbius transformations: conjugacy, trace, and applications to parabolic transformations
- 11 Classifying Möbius transformations: hyperbolic and elliptic transformations
- 12 Fuchsian groups
- 13 Fundamental domains
- 14 Dirichlet polygons: the construction
- 15 Dirichlet polygons: examples
- 16 Side-pairing transformations
- 17 Elliptic cycles
- 18 Generators and relations
- 19 Poincaré's theorem: the case of no boundary vertices
- 20 Poincaré's theorem: the case of boundary vertices
- 21 The signature of a Fuchsian group
- $22\,$  Existence of a Fuchsian group with a given signature
- 23 Where we could go next