# MA448-15 Hyperbolic Geometry

## 22/23

**Department**
Warwick Mathematics Institute
**Level**
Undergraduate Level 4
**Module leader**
Adam Epstein
**Credit value**
15
**Assessment**
Multiple
**Study location**
University of Warwick main campus, Coventry

---

## Description

### Introductory description

The module is an introduction to the modern theory of hyperbolic geometry with focus on dimension 2.

Module web page

### Module aims

To introduce the beautiful interplay between geometry, algebra and analysis which is involved in a detailed study of the Poincaré model of two-dimensional hyperbolic geometry.

### Outline syllabus

This is an indicative module outline only to give an indication of the sort of topics that may be covered. Actual sessions held may differ.

To understand the non-Euclidean geometry of hyperbolic space, tesselations and groups of symmetries of hyperbolic space and hyperbolic geometry on surfaces.

### Learning outcomes

By the end of the module, students should be able to:

- An introduction to hyperbolic geometry, mainly in dimension two, with emphasis on concrete geometrical examples and how to calculate them. Topics include: basic models of hyperbolic space; linear fractional transformations and isometries; discrete groups of isometries (Fuchsian groups); tesselations; generators, relations and Poincaré's theorem on fundamental polygons; hyperbolic structures on surfaces.

### Indicative reading list

J.W. Anderson, Hyperbolic geometry, Springer Undergraduate Math. Series.

S. Katok, Fuchsian groups, Chicago University Press.

S. Stahl, The Poincaré half-plane, Jones and Bartlett.

A. Beardon, Geometry of discrete groups, Springer.

J. Lehner, Discontinuous groups and automorphic functions. AMS.

L. Ford, Automorphic functions, Chelsea (out of print but in library).

J. Stillwell, Mathematics and its history, Springer.

### Subject specific skills

Knowledge of hyperbolic geometry, abstract geometric reasoning, group actions. Ideal for prospective PhD students in geometry, dynamical systems or algebraic geometry.

### Transferable skills

Knowledge of hyperbolic geometry, abstract geometric reasoning, group actions. Ideal for prospective PhD students in geometry, dynamical systems or algebraic geometry.

---

## Study

## Study time

| Type | Required |
|---|---|
| Lectures | 30 sessions of 1 hour (77%) |
| Tutorials | 9 sessions of 1 hour (23%) |
| Total | 39 hours |

### Private study description

Review lectured material and work on set exercises.

## Costs

No further costs have been identified for this module.

---

## Assessment

You do not need to pass all assessment components to pass the module.

Students can register for this module without taking any assessment.

### Assessment group B1

| | Weighting | Study time |
|---|---|---|
| In-person Examination<br>3 hour exam, no books allowed | 100% | |

---

- Answerbook Gold (24 page)

### Assessment group R

| | Weighting | Study time |
|---|---|---|
| In-person Examination - Resit | 100% | |

- Answerbook Gold (24 page)

### Feedback on assessment

Exam feedback

Past exam papers for MA448

---

## Availability

## Courses

This module is Optional for:

- Year 1 of TMAA-G1PE Master of Advanced Study in Mathematical Sciences
- Year 1 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus

MSc)
- Year 1 of TMAA-G1P0 Postgraduate Taught Mathematics
- Year 1 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- Year 1 of TCHA-F1PE Postgraduate Taught Scientific Research and Communication

This module is Option list A for:

- Year 2 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 2 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- Year 4 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 5 of USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

This module is Option list B for:

- Year 2 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 2 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- Year 4 of UCSA-G4G3 Undergraduate Discrete Mathematics
- Year 3 of USTA-G1G3 Undergraduate Mathematics and Statistics (BSc MMathStat)
- Year 4 of USTA-G1G4 Undergraduate Mathematics and Statistics (BSc MMathStat) (with Intercalated Year)

This module is Option list C for:

- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
    - Year 3 of G105 Mathematics (MMath) with Intercalated Year
    - Year 4 of G105 Mathematics (MMath) with Intercalated Year
    - Year 5 of G105 Mathematics (MMath) with Intercalated Year
- UMAA-G103 Undergraduate Mathematics (MMath)
    - Year 3 of G103 Mathematics (MMath)
    - Year 3 of G103 Mathematics (MMath)
    - Year 4 of G103 Mathematics (MMath)
    - Year 4 of G103 Mathematics (MMath)
- UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
    - Year 3 of G106 Mathematics (MMath) with Study in Europe
    - Year 4 of G106 Mathematics (MMath) with Study in Europe