

# MA243-12 Geometry

23/24

**Department**

Warwick Mathematics Institute

**Level**

Undergraduate Level 2

**Module leader**

Emanuele Dotto

**Credit value**

12

**Assessment**

Multiple

**Study location**

University of Warwick main campus, Coventry

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## Description

### Introductory description

Geometry is the attempt to understand and describe the world around us and all that is in it; it is the central activity in many branches of mathematics and physics, and offers a whole range of views on the nature and meaning of the universe.

Klein's Erlangen program describes geometry as the study of properties invariant under a group of transformations. Affine and projective geometries consider properties such as collinearity of points, and the typical group is the full matrix group. Metric geometries, such as Euclidean geometry and hyperbolic geometry (the non-Euclidean geometry of Gauss, Lobachevsky and Bolyai) include the property of distance between two points, and the typical group is the group of rigid motions (isometries or congruences) of 3-space. The study of the group of motions throws light on the chosen model of the world.

[Module web page](#)

### Module aims

To introduce students to various interesting geometries via explicit examples; to emphasize the importance of the algebraic concept of group in the geometric framework; to illustrate the historical development of a mathematical subject by the discussion of parallelism.

### 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.

- Examples of 'geometries' including: Euclidian, Spherical, hyperbolic and projective.
- For these geometries, a metric will be defined and their isometry groups will be determined in terms of linear maps.
- Their existence and uniqueness of parallel lines and the sum of the angles of a triangle will be analysed.
- Projective linear transformations will be covered, and then the course will build towards axiomatic projective geometry.

## Learning outcomes

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

- Students at the end of the module should be able to give a full analysis of Euclidean geometry.
- Discuss the geometry of the sphere and the hyperbolic plane.
- Compare the different geometries in terms of their metric properties, trigonometry and parallels.
- concentrate on the abstract properties of lines and their incidence relation, leading to the idea of affine and projective geometry.

## Indicative reading list

M Reid and B Szendrői, Geometry and Topology, CUP, 2005 (some Chapters will be available from the General office).

E G Rees, Notes on Geometry, Springer

HSM Coxeter, Introduction to Geometry, John Wiley & Sons

1,2,3 of John G. Ratcliffe, Foundations of hyperbolic manifolds

## Subject specific skills

Ability to qualitatively assess and discuss the different examples of geometry in terms of their metric properties and orthogonal and parallel lines, and to concentrate on the abstract properties of lines and their incidence relation.

## Transferable skills

Students will acquire key reasoning and problem solving skills which will empower them to address new problems with confidence.

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## Study

## Study time

<b>Type</b>	<b>Required</b>
Lectures	30 sessions of 1 hour (77%)
Tutorials	9 sessions of 1 hour (23%)
Total	39 hours

### **Private study description**

Review lectured material, work on set exercises and weekly worksheets.

### **Costs**

No further costs have been identified for this module.

### **Assessment**

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

#### **Assessment group D1**

	<b>Weighting</b>	<b>Study time</b>
Weekly assignments	15%	
In-person Examination	85%	

- Answerbook Pink (12 page)

#### **Assessment group R**

	<b>Weighting</b>	<b>Study time</b>
In-person Examination - Resit	100%	

- Online examination: No Answerbook required

### **Feedback on assessment**

Marked assignments and exam feedback.

[Past exam papers for MA243](#)

### **Availability**

## Courses

This module is Optional for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
- Year 4 of UECA-GL12 Undergraduate Mathematics and Economics (with Intercalated Year)
- 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 Core option list A for:

- Year 2 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list B for:

- UMAA-GV17 Undergraduate Mathematics and Philosophy
  - Year 3 of GV17 Mathematics and Philosophy
  - Year 3 of GV17 Mathematics and Philosophy
  - Year 3 of GV17 Mathematics and Philosophy

This module is Core option list C for:

- Year 2 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list D for:

- UMAA-GV18 Undergraduate Mathematics and Philosophy with Intercalated Year
  - Year 4 of GV18 Mathematics and Philosophy with Intercalated Year
  - Year 4 of GV18 Mathematics and Philosophy with Intercalated Year

This module is Option list A for:

- Year 3 of UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
- UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
  - Year 2 of G106 Mathematics (MMath) with Study in Europe
  - Year 3 of G106 Mathematics (MMath) with Study in Europe
- Year 2 of UPCA-FG33 Undergraduate Mathematics and Physics (BSc MMathPhys)

This module is Option list B for:

- Year 2 of USTA-G300 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics
- USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
  - Year 3 of GG14 Mathematics and Statistics
  - Year 3 of GG14 Mathematics and Statistics

- Year 4 of USTA-GG17 Undergraduate Mathematics and Statistics (with Intercalated Year)
- USTA-Y602 Undergraduate Mathematics,Operational Research,Statistics and Economics
  - Year 3 of Y602 Mathematics,Operational Research,Stats,Economics
  - Year 3 of Y602 Mathematics,Operational Research,Stats,Economics
- Year 4 of USTA-Y603 Undergraduate Mathematics,Operational Research,Statistics,Economics (with Intercalated Year)

This module is Option list E for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
- USTA-G301 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics (with Intercalated
  - Year 3 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
  - Year 4 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)