

MA4A5-15 Algebraic Geometry

26/27

Department

Warwick Mathematics Institute

Level

Undergraduate Level 4

Module leader

Alexander Kasprzyk

Credit value

15

Module duration

10 weeks

Assessment

Multiple

Study location

University of Warwick main campus, Coventry

Description

Introductory description

Algebraic geometry studies solution sets of polynomial equations by geometric methods. These are called algebraic varieties and arise in innumerable instances in physics as space-times, energy surfaces, phase spaces; in economics as indifference surfaces; in population genetics and other parts of biology; and in general, as the geometries of the “backgrounds” or “state-spaces” of mathematical or general scientific models.

This type of equations is ubiquitous in mathematics and much more versatile and flexible than one might as first expect (for example, every compact smooth manifold is diffeomorphic to the zero set of a certain number of real polynomials in $\mathbb{R}^N$). On the other hand, polynomials show remarkable rigidity properties in other situations and can be defined over any ring, and this leads to important arithmetic ramifications of algebraic geometry.

[Module web page](#)

Module aims

In the lectures, we will introduce the category of (quasi-projective) varieties, morphisms and rational maps between them, and then proceed to a study of some of the most basic geometric attributes of varieties: dimension, tangent spaces, regular and singular points, degree. Moreover, we will present many concrete examples, e.g., rational normal curves, Grassmannians, flag and

Schubert varieties, surfaces in projective three-space and their lines, Veronese and Segre varieties etc.

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.

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Learning outcomes

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

- A first module in algebraic geometry is a basic requirement for study in geometry, number theory or many branches of algebra or mathematical physics at the MSc or PhD level. Many MA469 projects are on offer involving ideas from algebraic geometry.

Subject specific skills

Students will learn in the module how to analyse polynomial equations both quantitatively and qualitatively and get acquainted with several of the algorithms originating in the field, many of which are today extensively used in various types of computer algebra systems and other software. Since the subject is used in the various other disciplines mentioned above, these subject specific skills will often be transferable, too, and lead to employment opportunities in the respective fields.

Transferable skills

Another important skill, beneficial to personal development and elsewhere, communicated to students in most mathematics modules is the point of view and approach to problems provided by the scientific method: you should believe, in science and mathematics, as well as profitably quite a few other disciplines, logic and arguments, carefully drawn, and not authorities. Moreover, Algebraic Geometry in particular is also an excellent example where purely curiosity-driven research, free from corporate agendas, led to the breakthroughs and fundamental insights in the field that were later used in unforeseen ways in the above areas of applications that people profit from today."

In addition, the field has also found extensive recent applications to robotics, computer-aided graphic design and cryptography.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Tutorials	9 sessions of 1 hour (6%)
Private study	111 hours (74%)
Total	150 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 D1

	Weighting	Study time	Eligible for self-certification
Assessment	15%	45 hours	No
Module assignments			
Centrally-timetabled examination (On-campus)	85%	105 hours	No
3 hour exam, no books allowed			

- Answerbook Gold (24 page)

Assessment group R

	Weighting	Study time	Eligible for self-certification
In-person Examination - Resit	100%		No

- Answerbook Gold (24 page)

Feedback on assessment

Marked coursework and exam feedback

[Past exam papers for MA4A5](#)

Availability

Courses

This module is Optional for:

- TMAA-G1PE Master of Advanced Study in Mathematical Sciences
 - Year 1 of G1PE Master of Advanced Study in Mathematical Sciences
 - Year 1 of 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
- TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
 - Year 1 of G1PC Mathematics (Diploma plus MSc)
 - Year 2 of G1PC Mathematics (Diploma plus MSc)

This module is Core option list F for:

- Year 4 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Option list A for:

- TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
 - Year 1 of G1PD Interdisciplinary Mathematics (Diploma plus MSc)
 - Year 2 of G1PD 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 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:

- TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)

- Year 1 of G1PD Interdisciplinary Mathematics (Diploma plus MSc)
- Year 2 of G1PD Interdisciplinary Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- Year 4 of UCSA-G4G3 Undergraduate Discrete Mathematics
- Year 5 of UCSA-G4G4 Undergraduate Discrete Mathematics (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 4 of G103 Mathematics (MMath)
- Year 4 of UMAA-G107 Undergraduate Mathematics (MMath) with Study Abroad
- 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

This module is Option list E for:

- Year 5 of USTA-G301 Undergraduate Master of Mathematics, Operational Research, Statistics and Economics (with Intercalated