MA3J9-15 Historical Challenges in Mathematics

21/22

Department
> Warwick Mathematics Institute

Level
> Undergraduate Level 3

Module leader
> Damiano Testa

Credit value
> 15

Module duration
> 10 weeks

Assessment
> Multiple

Study location
> University of Warwick main campus, Coventry

Description

Introductory description

The module will cover several topics each year, usually inspired by questions asked by David Hilbert in his address to the International Congress of Mathematicians in 1900.

[Module web page](#)

Module aims

To show how a range of problems both theoretical and applied can be modelled mathematically and solved using tools discussed in core modules from years 1, 2.

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.

Sample Topic 1: Hilbert's 3rd problem and Dehn invariants
Scissor congruence in the plane. Scissor congruence in R^n and Hilbert's 3rd problem. Dehn invariant for R^3.

Sample Topic 2: Hilbert's 17th problem and Sums of squares
Polynomials having only non-negative values. Polynomials and rational functions that are sums of squares. Real closed fields.

Sample Topic 3: Hilbert's 10th problem and Undecidability
Decidability, recursively enumerable set and Diophantine sets. Computing and algorithms.

Sample Topic 4: Four colour theorem
Graphs, colourings. Five colour theorem. The role of computers.

Sample Topic 5: Fermat's little theorem and RSA Cryptography
Residue classes modulo primes. Fermat's little theorem. Cryptographic applications. May include Elliptic Curve factorisation.

Learning outcomes

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

- For each of the topics discussed appreciate their importance in the historical context, and why mathematicians at the time were interested in it.
- For each of the topics discussed understand the underlying theory and statement of the result, and where applicable how the proof has been developed (or how a proof has been attempted in the case of unsolved problems).
- For each of the topics discussed understand how to apply the theory to similar problems/situations (where applicable).
- For each of the topics discussed understand the connections between the results/proofs in question and the core mathematics modules that the student has studied.

Subject specific skills

To show how a range of problems both theoretical and applied can be modelled mathematically and solved using tools discussed in core modules from years 1, 2.
Develop tools and techniques to approach and solve problems from a variety of sources.

Transferable skills

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

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (20%)
Total	150 hours

Type	Required
Private study	120 hours (80%)
Total	150 hours

Private study description

self working: reviewing lectured material and accompanying supplementary materials; working on both summative and formative coursework; revising for exams. Remaining activity hours.

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

	Weighting	Study time
Assignments	15%	
In-person Examination	85%	

- Answerbook Pink (12 page)

Assessment group R

	Weighting	Study time
In-person Examination - Resit	100%	

- Answerbook Gold (24 page)

Feedback on assessment

Marked homework (both assessed and formative) is returned and discussed in smaller classes and exam feedback.

[Past exam papers for MA3J9](#)

Availability

Courses

This module is Optional for:

- Year 1 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 1 of TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
- UCSA-G4G1 Undergraduate Discrete Mathematics
  - Year 3 of G4G1 Discrete Mathematics
  - Year 3 of G4G1 Discrete Mathematics
- Year 3 of UCSA-G4G3 Undergraduate Discrete Mathematics
- Year 4 of UCSA-G4G2 Undergraduate Discrete Mathematics with Intercalated Year
- USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
  - Year 3 of G300 Mathematics, Operational Research, Statistics and Economics
  - Year 4 of G300 Mathematics, Operational Research, Statistics and Economics
- Year 3 of UMAA-GL11 Undergraduate Mathematics and Economics

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
- Year 3 of UMAA-GV19 Undergraduate Mathematics and Philosophy with Specialism in Logic and Foundations

This module is Core option list D 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)
- TMAA-G1P0 Postgraduate Taught Mathematics
  - Year 1 of G1P0 Mathematics (Taught)
  - Year 1 of G1P0 Mathematics (Taught)
- TMAA-G1PC Postgraduate Taught Mathematics (Diploma plus MSc)
  - Year 1 of G1PC Mathematics (Diploma plus MSc)
  - Year 2 of G1PC Mathematics (Diploma plus MSc)
- UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
  - Year 3 of G105 Mathematics (MMath) with Intercalated Year
  - Year 5 of G105 Mathematics (MMath) with Intercalated Year
- UMAA-G100 Undergraduate Mathematics (BSc)
  - Year 3 of G100 Mathematics

- ○ Year 3 of G100 Mathematics
  - ○ Year 3 of G100 Mathematics
- UMAA-G103 Undergraduate Mathematics (MMath)
  - ○ Year 3 of G100 Mathematics
  - ○ 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
- UPXA-GF13 Undergraduate Mathematics and Physics (BSc)
  - ○ Year 3 of GF13 Mathematics and Physics
  - ○ Year 3 of GF13 Mathematics and Physics
- Year 4 of UPXA-GF14 Undergraduate Mathematics and Physics (with Intercalated Year)
- 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)
- Year 4 of UMAA-G101 Undergraduate Mathematics 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 B for:

- Year 1 of TMAA-G1PE Master of Advanced Study in Mathematical Sciences
- 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)
- 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)

This module is Option list E for:

- USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
  - ○ Year 3 of G30D Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
  - ○ Year 4 of G30D Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)
- 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 5 of G30H Master of Maths, Op.Res, Stats & Economics (Statistics with Mathematics Stream)