MA132-10 Foundations

23/24

Department
Warwick Mathematics Institute
Level
Undergraduate Level 1
Module leader
David Wood
Credit value
10
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

University mathematics introduces progressively more and more abstract ideas and structures, and demands more and more in the way of proof, until by the end of a mathematics degree most of the student's time is occupied with understanding proofs and creating his or her own. This is not because university mathematicians are more pedantic than schoolteachers, but because proof is how one knows things in mathematics, and it is in its proofs that the strength and richness of mathematics is to be found.

Module web page

Module aims

But learning to deal with abstraction and with proofs takes time. This module aims to bridge the gap between school and university mathematics, by beginning with some rather concrete techniques where the emphasis is on calculation, and gradually moving towards abstraction and proof.

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.

Indicative Content:

Naive Set Theory, Counting and Lists:
Sets and functions, injections, surjections and bijections, permutations.
Lists, sublists, lists as functions, strings.
Subsets, power sets, partition, infinite versus finite, Cantor's Theorem.

Operations on Sets, Lists, Functions:
Ordered pairs, cartesian products, functions and graphs, functions and lookup tables.
Union, intersection, set difference, list concatenation.
Composition, iteration, orbits, Cantor-Schroeder-Bernstein, cardinalities.
Relations:
Reflexive, symmetric, transitive.
Orders, equivalence classes and relations: integers, rational numbers, partitions.
Kernels and co-kernels, well-definedness, modular arithmetic.

Logic:
Variables, booleans, negation, operations.
Operators and formulas via truth tables.
Quantifiers, tautologies, deduction rules.

Proof:
What is proof? False proofs, examples, subtle issues (diagrams, hand-waving)
Kinds of proof: direct, contraposition, contradiction, construction, cases.
Recursion, induction, pigeonhole principle, counting.

Algorithms in Algebra and Cryptography:
What is algorithm? Euclid's algorithm, operational complexity, P=NP
Discrete Logarithm, introduction to cryptography, Diffie-Hellman key exchange.
Prime factorisation, primality testing, Chinese Remainder Theorem
RSA (Rivest–Shamir–Adleman) public key exchange

Learning outcomes

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

- Students will work with number systems and develop fluency with their properties;
- they will learn the language of sets and quantifiers, of functions and relations, and will become familiar with various methods and styles of proof.

Indicative reading list

None of these is the course text, but each would be useful, especially the first:
A.F.Beardon, Algebra and Geometry, CUP, 2005.
I.N. Stewart and D.O. Tall, Foundations of Mathematics, OUP, 1977.
J. A. Green, Sets and Groups; First Course in Algebra, Chapman and Hall, 1995.

Subject specific skills

After taking this module, students will be familiar with the concept of a rigorous mathematical proof and most of commonly used notations.

Transferable skills

Students will work with number systems and develop fluency with their properties; they will learn the language of sets and quantifiers, of functions and relations, and will become familiar with various methods and styles of proof.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (30%)
Tutorials	8 sessions of 30 minutes (4%)
Private study	66 hours (66%)
Total	100 hours

Private study description

Reviewing lectured material and revising for 10 weekly assignments with 5 fortnightly tests based on them.

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	Eligible for self-certification
Moodle Quizzes	15%		Yes (extension)

Several multiple choice tests over the teaching term.

	Weighting	Study time	Eligible for self-certification
In-person Examination Exam	85%		No

- Answerbook Pink (12 page)

Assessment group R1

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

- Answerbook Pink (12 page)

Feedback on assessment

Tests will be marked and feedback given after exam.

Past exam papers for MA132

Availability

Courses

This module is Core for:

- Year 1 of UMAA-G105 Undergraduate Master of Mathematics (with Intercalated Year)
- Year 1 of UMAA-G100 Undergraduate Mathematics (BSc)
- UMAA-G103 Undergraduate Mathematics (MMath)
  - Year 1 of G100 Mathematics
  - Year 1 of G103 Mathematics (MMath)
- Year 1 of UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe
- Year 1 of UMAA-G1NC Undergraduate Mathematics and Business Studies
- Year 1 of UMAA-G1N2 Undergraduate Mathematics and Business Studies (with Intercalated Year)
- Year 1 of UMAA-GL11 Undergraduate Mathematics and Economics
- Year 1 of UECA-GL12 Undergraduate Mathematics and Economics (with Intercalated Year)
- Year 1 of UMAA-G101 Undergraduate Mathematics with Intercalated Year