MA249-12 Algebra II: Groups and Rings

23/24

Department
Warwick Mathematics Institute
Level
Undergraduate Level 2
Module leader
Nicholas Jackson
Credit value
12
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

This is an introductory abstract algebra module. As the title suggests, the two main objects of study are groups and rings.

Module web page

Module aims

To study abstract algebraic structures, their examples and applications.

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.

- Groups, subgroups and normal subgroups, rings and fields.
- Isomorphisms, homomorphisms, direct products and quotients for both groups and rings.
- Examples of groups including cyclic, dihedral, symmetric and alternating groups, additive and multiplicative groups of a ring, and general linear groups over a field.
- Generators and relations for groups.

- Order of an element, cosets, Lagrange's theorem, Euler's theorem.
- First, second and third isomorphism theorems and the correspondence theorem for groups.
- Group actions, the Orbit-Stabiliser theorem, conjugacy classes and centralisers.
- Conjugacy classes in symmetric and alternating groups, simplicity of A5.
- Chinese Remainder Theorem.
- First isomorphism theorem and correspondence theorem for rings.
- Ideals, maximal ideals, domains and field of fractions.
- Unique factorisation domains, principal ideal domains, prime and irreducible elements.
- Factorisation in polynomial rings, remainder theorem for polynomials over a field, Gauss's Lemma and Eisenstein's criterion.

Learning outcomes

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

- Recall definitions, theorems and proofs of syllabus material. Calculate with examples of groups and rings and solve problems using algebraic techniques. Recognise, classify and construct examples of groups and rings with specified properties by applying the concepts listed in the syllabus. Apply the orbit-stabiliser theorem to conjugacy classes and centralisers, as well as to examples from number theory, geometry and combinatorics.

Indicative reading list

Niels Lauritzen, Concrete Abstract Algebra, Cambridge University Press.

Subject specific skills

Students will improve their skills in thinking algebraically in a variety of settings.
This includes working with axiomatic definitions of algebraic objects and analysing the structure and relationships between algebraic objects using fundamental tools such as subobjects and homomorphisms, laying a foundation for future study in algebra, number theory and algebraic geometry.

Transferable skills

The module emphasises the power of generalisation and abstraction.
Students will improve their ability to analyse abstract concepts and to solve problems by selecting and applying appropriate abstract tools.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (61%)
Tutorials	9 sessions of 1 hour (18%)
Other activity	10 hours (20%)
Total	49 hours

Private study description

Review lectured material and work on set exercises.

Other activity description

Collaborative project

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
Assignments	15%		No
In-person Examination	85%		No

2 hour exam, no books allowed

- Answerbook Pink (12 page)

Assessment group R

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

- Answerbook Pink (12 page)

Assessment group S

	Weighting	Study time	Eligible for self-certification
Assignments	15%		No
In-person Examination	85%		No

- Answerbook Pink (12 page)

Feedback on assessment

Marked coursework and exam feedback.

Past exam papers for MA249

Availability

Courses

This module is Core for:

- Year 2 of UMAA-G106 Undergraduate Mathematics (MMath) with Study in Europe

This module is Core optional for:

- Year 2 of UMAA-GV17 Undergraduate Mathematics and Philosophy
- Year 2 of UMAA-GV18 Undergraduate Mathematics and Philosophy with Intercalated Year

This module is Optional for:

- Year 3 of USTA-G300 Undergraduate Master of Mathematics,Operational Research,Statistics and Economics
- 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 C for:

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

This module is Option list A for:

- Year 2 of UPXA-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
- Year 3 of USTA-GG14 Undergraduate Mathematics and Statistics (BSc)
- Year 4 of USTA-GG17 Undergraduate Mathematics and Statistics (with Intercalated Year)
- Year 3 of USTA-Y602 Undergraduate Mathematics,Operational Research,Statistics and 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)