MA473-15 Reflection Groups

26/27

Department
Warwick Mathematics Institute
Level
Undergraduate Level 4
Module leader
Ric Wade
Credit value
15
Module duration
10 weeks
Assessment
Multiple
Study location
University of Warwick main campus, Coventry

Description

Introductory description

A reflection is a linear transformation that fixes a hyperplane and multiplies a complementary vector by -1. The dihedral group can be generated by a pair of reflections. The main goal of the module is to classify finite groups (of linear transformations) generated by reflections. The question appeared in 1920s in the works of Cartan and Weyl as the Weyl group is a finite crystallographic reflection group.

Module web page

Module aims

The main aim of this module is to classify all finite reflection groups. The key to their understanding is the fact that they are the same as finite Coxeter groups. Techniques will include combinatorics of the root systems and geometry of Euclidean spaces. The module is essential for understanding Cartan-Killing combinatorics, the cornerstone of modern Lie Theory.

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.

Finite reflection groups
Root systems
Coxeter groups and their geometric realisation
Fundamental chamber
Classification of finite Coxeter groups
Crystallographic groups

Learning outcomes

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

- Understand reflections in Euclidean spaces and groups generated by them
- Use Coxeter groups to describe reflection groups
- Identify fundamental chambers, corresponding to the positive roots
- State and prove classification of finite Coxeter groups and finite reflections groups
- Recognise crystallographic groups

Indicative reading list

Reading lists can be found in Talis

Subject specific skills

This module lays a solid foundation to the study of Cartan-Killing combinatorics. It develops in depth the notions that allow one to investigate Lie algebras, Coxeter groups, buildings and crystallography. Students taking the module will learn some of the techniques required for working on a large-scale research project. These techniques are partly theoretical, and partly computational.

Transferable skills

Clear and precise thinking, and the ability to follow complex reasoning, to construct logical arguments, and to expose
illogical ones. The ability to retrieve the essential details from a complex situation and thereby facilitate problem
resolution.

Study

Study time

Type	Required
Lectures	30 sessions of 1 hour (26%)
Total	114 hours

Type	Required
Seminars	9 sessions of 1 hour (8%)
Tutorials	(0%)
Private study	75 hours (66%)
Total	114 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.

Assessment group B

	Weighting	Study time	Eligible for self-certification
Centrally-timetabled examination (On-campus) 3 hour exam, no books allowed	100%	36 hours	No

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- 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

Unmarked coursework, seminars and exam feedback.

Past exam papers for MA473

Availability

Courses

This module is Optional for:

- Year 1 of TMAA-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:

- Year 2 of TMAA-G1PD Postgraduate Taught Interdisciplinary Mathematics (Diploma plus MSc)
- Year 4 of UPXA-FG31 Undergraduate Mathematics and Physics (MMathPhys)
- 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:

- Year 2 of TMAA-G1PD Postgraduate Taught Interdisciplinary 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