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MATH42112

Lie Algebras

Unit code:	MATH42112
Credit Rating:	15
Unit level:	Level 4
Teaching period(s):	Semester 2
Offered by	School of Mathematics
Available as a free choice unit?:	N

Requisites

Prerequisite

- [MATH20212 - Algebraic Structures 2](#) (Compulsory)

Additional Requirements

MATH42112 pre-requisites

Students are not permitted to take more than one of MATH32112 MATH42112 or MATH62112 for credit, either in the same or different undergraduate year or in an undergraduate programme and then a postgraduate programme, as the contents of the courses overlap significantly.

Aims

To introduce students to some more sophisticated concepts and results of Lie theory as an essential part of general mathematical culture and as a basis for further study of more advanced mathematics.

Overview

The course unit will deal with finite-dimensional Lie algebras, that is, with anticommutative algebras satisfying the Jacobi identity. These algebras have various applications in representation theory, mathematical physics, geometry, engineering and computer graphics. Lie theory is currently a very active area of research and provides many interesting examples and patterns to other branches of mathematics.

Assessment methods

- Other - 15%
- Written exam - 85%

Assessment Further Information

Coursework: weighted 15%

Examination: of 3 hours duration and weighted 85%

Learning outcomes

On successful completion of the course students will have acquired:

- A sound understanding of basic concepts of the theory Lie algebras.
- Knowledge of some fundamental results of the theory of Lie algebras.
- Knowledge of the Killing-Cartan classification of the finite dimensional simple Lie algebras.

Syllabus

- Definitions and first examples. Ideals and homomorphisms. [4]
- Nilpotent Lie algebras. Engel's theorem. [3]
- Solvable Lie algebras. Lie's theorem. Radical and semisimplicity. [3]
- The Killing form and Cartan's criterion. [2]
- The structure of semisimple Lie algebras. [3]
- Representation theory of the Lie algebras (2). [3]
- Toral subalgebras and root systems. Integrality properties. Simple Lie algebras and irreducible root systems. [4]

For MATH42112 the lectures will be enhanced by additional reading on related topics.

Recommended reading

- Karin Erdmann and Mark J. Wildon *Introduction to Lie Algebras*, Springer Undergraduate Mathematics Series, Springer-Verlag London Limited, 2006.

- J.E. Humphreys *Introduction to Lie Algebras and Representation Theory*, Graduate Texts in Mathematics, Springer, 1972.

Feedback methods

Tutorials will provide an opportunity for students' work to be discussed and provide feedback on their understanding.

Study hours

- Lectures - 22 hours
- Tutorials - 11 hours
- Independent study hours - 117 hours

Teaching staff

Alexander Premet - Unit coordinator