

## The Department of Mathematics

2022–23–A term

**Course Name** LIE ALGEBRAS AND THEIR REPRESENTATIONS

**Course Number** 201.2.0491

**Course web page**

<https://www.math.bgu.ac.il/en/teaching/fall2023/courses/lie-algebras>

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**Office Hours** <https://www.math.bgu.ac.il/en/teaching/hours>

### Abstract

### Requirements and grading<sup>1</sup>

### Course topics

#### Aims of the course

1. to introduce students to the new algebraic structure of Lie algebras, to teach them to recognize examples and to see deep consequences achieved using mostly the technique of linear algebra.
2. Representation theory is about understanding and exploiting symmetry using linear algebra. The students will study basics of representation theory, that are common for representations of associative algebras or groups. They will see how representation theory is used for the classification of simple Lie algebras.
3. After taking this course the students will be much better prepared to study Lie groups, or representation theory of groups. Root systems, studied in the course, which is a combinatorial object, and associated Coxeter groups often appear in geometric group theory, as well as in singularity theory.
4. The students will practice both proving statements and doing explicit computations in matrix algebras, that are the main source of Lie algebras

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<sup>1</sup>Information may change during the first two weeks of the term. Please consult the webpage for updates



5. Motivated students will have a chance to present a topic from the course before their peers, which is an instructive task.
6. The course is useful for the graduate students in Physics. Their participation is an excellent opportunity for the students of two departments to meet and exchange their views on the topic.

#### Course topics

1. Basic concepts and examples
2. Connection to Lie groups.
3. Nilpotent and solvable algebras
4. Killing form and semisimplicity
5. Weyl's theorem
6. Root systems
7. Classification of simple Lie algebras
8. Classification of irreducible representations of simple Lie algebra
9. Additional topics (time permitted)