

MATH-477

**Lie groups**

Raum Sven

| Cursus                   | Sem.     | Type |
|--------------------------|----------|------|
| Ing.-math                | MA2, MA4 | Opt. |
| Mathematics for teaching | MA2, MA4 | Opt. |
| Mathématicien            | MA2, MA4 | Opt. |

|                            |                 |
|----------------------------|-----------------|
| Language of teaching       | English         |
| Credits                    | 5               |
| Session                    | Summer          |
| Semester                   | Spring          |
| Exam                       | Oral            |
| Workload                   | 150h            |
| Weeks                      | 14              |
| <b>Hours</b>               | <b>4 weekly</b> |
| Courses                    | 2 weekly        |
| Exercises                  | 2 weekly        |
| <b>Number of positions</b> |                 |

**Summary**

This course introduces to Lie groups and their correspondence with Lie algebras. Classical groups and compact groups are treated as important classes of examples. The notions of homogeneous spaces and lattices are introduced.

**Content**

1. Lie groups and their Lie algebras
2. Classical groups
3. Compact (Lie) groups
4. Homogeneous spaces and lattices in Lie groups

**Keywords**

Lie groups, Lie group-Lie algebra correspondence, homogeneous spaces

**Learning Prerequisites****Required courses**

- Topology (MATH-225)
- Introduction aux variétés différentiables (MATH-322)
- Group theory (MATH-211)

**Learning Outcomes**

By the end of the course, the student must be able to:

- Structure the relationship between Lie groups and Lie algebras
- Define classical groups
- Describe basic properties of classical groups
- Compute the representation theory of compact Lie groups
- Explain examples of lattices and homogeneous spaces

**Transversal skills**

- Continue to work through difficulties or initial failure to find optimal solutions.
- Take feedback (critique) and respond in an appropriate manner.

- Demonstrate the capacity for critical thinking
- Demonstrate a capacity for creativity.
- Make an oral presentation.

### Teaching methods

Ex-cathedra course with exercises

### Expected student activities

- Participate in the course
- Solve regular exercises
- Present exercises in the classroom
- Acquire one short piece of mathematics independently

### Assessment methods

Oral exam and presentation in the classroom. In case Art. 3 al. 5 of the regulations of the section apply to some student, the exam form will be decided by the teacher and communicated to the student.

### Supervision

|              |     |
|--------------|-----|
| Office hours | Yes |
| Assistants   | Yes |
| Forum        | No  |

### Resources

#### Bibliography

- Alexander Kirillov, Jr. An introduction to Lie groups and Lie algebras. ISBN-13: 978-0-521-88969-8
- Sigurdur Helgason. Differential geometry, Lie groups, and symmetric spaces. ISBN-13: 978-0821828489
- Sigfried Echterhoff & Anton Deitmar. Principles of harmonic analysis. ISBN-13: 978-3319057910
- Theodor Bröcker & Tammo tom Dieck. Representations of compact Lie groups. ISBN-13: 978-3540136781
- David Witte Morris. Introduction to arithmetic groups. ISBN-13: 978-0986571602

#### Ressources en bibliothèque

- [An introduction to Lie groups and Lie algebras / Kirillov](#)
- [Differential geometry, Lie groups, and symmetric spaces / Helgason](#)
- [Principles of harmonic analysis / Echterhoff & Deitmar](#)
- [\(electronic version\)](#)
- [Representations of compact Lie groups / Bröcker & Dieck](#)