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# Lie Algebras

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## Instructor and Class Information

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Lecturer:	Course Num.:
Office:	Lecture Room:
Phone:	Lecture Times:
Email:	Office Hours:

## About Course Goals

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### FORMAT

The course will meet three times a week for 55 minutes each meeting. Instructions will be mainly by lecture delivered by the instructor. It may also include occasional in-class discussion as well as short student presentations, particularly, by post-candidacy students.

### CONTENT & GOALS

This course is intended to provide students with a solid knowledge of the structure theory of Lie algebras, as well as the representation theory of Lie algebras. The course is part of a year-long course sequence followed by Math 7162 on Lie Groups. The material is a basic tool in a wide range of research directions, including representations theory, number theory, harmonic analysis, ergodic theory, differential geometry and topology.

### PREREQUISITES

This section is open only to mathematics post-candidacy students and requires, in addition, the permission of the instructor.

## Textbook

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### MAIN REFERENCE

James E. Humphreys: *Introduction to Lie Algebras and Representation Theory*. Springer, 1972.  
ISBN:3540900527.

### ADDITIONAL REFERENCES

W. Fulton and J. Harris: *Representation Theory – A first course*. Springer 1999.  
ISBN:0387974954.

R. Carter, G. Segal, and I. MacDonald: *Lectures on Lie groups and Lie Algebras*. Cambridge University Press, 1995. ISBN:0521499224.

## Assessments

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### READING, PARTICIPATION, AND ATTENDANCE

Students are required to read scheduled textbook materials and actively participate in class room discussions that arise from lecture material. Students are expected to attend all classes.

**RESEARCH ORIENTED PRESENTATION**

Post-candidacy students in this section are required to deliver a half hour presentation that both synthesizes lecture material and connects it to relevant research questions, more advanced theoretical topics, or applications in other fields of mathematics. The topic and required independent reading will be determined by the instructor individually in negotiation with the student. Presentations may also be replaced by respective research papers upon the request of the student.

**Grading****COURSE GRADE**

The grades for this course section are "satisfactory" (S) or "unsatisfactory" (U). A satisfactory outcome requires continued active participation in class (weighed about 20%) and is further based on the student's performance during the presentation (weighed about 80%).

**Weekly Schedule**

Week 1	Definitions and first examples; ideals and homomorphisms
Week 2	Solvable and nilpotent Lie algebras; Theorems of Lie and Cartan
Week 3	Killing form; Complete reducibility of representations
Week 4	Representations of $SL(2, F)$ ; Root space decompositions
Week 5	Root system axiomatics; Simple roots and Weyl groups
Week 6	Classification of root systems; Construction of root systems and automorphisms
Week 7	Abstract theory of weights ; Isomorphism theorem
Week 8	Cartan subalgebras; Conjugacy theorems
Week 9	Universal enveloping algebras; Generators and Relations
Week 10	Simple algebras; Weights and maximal vectors
Week 11	Finite dimensional modules; Multiplicity formula
Week 12	Characters; Formulas of Weyl, Kostant, and Steinberg
Week 13	Chevalley algebras; Kostant's theorem
Week 14	Admissible lattices

**General Policies****ACADEMIC MISCONDUCT**

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct ([http://studentaffairs.osu.edu/info\\_for\\_students/csc.asp](http://studentaffairs.osu.edu/info_for_students/csc.asp)).

**DISABILITY SERVICES**

Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD 292-0901; <http://www.ods.ohio-state.edu/>.