

Course Syllabus - Introduction to Lie Groups

Course Number: Special topic.

Course Title: Introduction to Lie Groups

Credit Hours: 3

Prerequisites: A good comprehension of linear algebra, calculus, and abstract algebra.

Objectives: To give an introductory course on the theory of Lie groups.

Course Content: (totally 38 hours)

- (1) The exponential map
 - vector fields, one-parameter groups [1 hour]
 - Ad , ad , and $d \exp$ [2 hours]
 - the Campbell-Baker-Hausdorff series [2 hours]
- (2) Lie theory
 - linear groups: definitions and examples [4 hours]
 - the Lie algebra of a linear group [3 hours]
 - coordinates on a linear group [1 hour]
 - connectedness [1 hour]
 - the Lie correspondence [2 hours]
 - homomorphisms and coverings of linear groups [3 hours]
 - closed subgroups [1 hour]
- (3) The classical groups
 - the classical groups: definitions, connectedness [4 hours]
 - Cartan subgroups [3 hours]
 - roots, weights, reflections [2 hours]
 - fundamental groups of the classical groups [self-reading]
- (4) Manifolds, homogeneous spaces, Lie groups
 - manifolds [3 hours]
 - homogeneous spaces [2 hours]
 - Lie groups [4 hours]
- (5) Integration on manifolds [optional]
- (6) Representations: definitions and examples [optional]

Major Textbook: [Lie Groups: An Introduction Through Linear Groups](#), Wulf Rossmann, Oxford Graduate Texts in Mathematics, Oxford University Press Inc., New York.

References: (listed from introductory to advanced)

- (1) [Naive Lie Theory](#), John Stillwell, Springer, 2008.
- (2) [Matrix Groups: An Introduction to Lie Group Theory](#), Andrew Baker, Springer, 2003.
- (3) [Lie Groups, Lie Algebras, and Representations: an Elementary Introduction](#), Brian C. Hall, Springer, 2004.
- (4) [Lie Groups: An Approach through Invariants and Representations](#), Claudio Procesi, Springer, 2006.
- (5) [Lie Groups Beyond an Introduction](#), Anthony W. Knap, Birkhäuser, 2002.
- (6) [Differential Geometry, Lie Groups, and Symmetric Spaces](#), Sigurdur Helgason, American Mathematical Society, 2001.

Evaluation Procedures: Homeworks, projects and tests are given at the instructor's discretion. Students are expected to prove rigorous theorems and to compute concrete examples.

Grade Calculation: Homeworks 70%, Tests 30%. There may be variations in these procedures depending on the individual instructors.