LIE GROUPS AND DISCRETE SUBGROUPS  
(ECTS) 7.5 COURSE CREDITS

1. COURSE DESCRIPTION

Lie groups, and generally algebraic groups, are some fundamental subjects in Modern Mathematics. They play the role of being unifying concepts and also powerful technical tools. Many of the current developments in mathematics, such as Langlands program and automorphic forms, are on the harmonic analysis on algebraic groups.

This course is (a) to introduce general theory of Lie algebras and Lie groups, (b) to cover the classification theory of semisimple complex Lie algebras and root systems and Dynkin Diagrams, and (c) to study elementary theory of algebraic groups and their discrete subgroups.

In the first part (a) we shall study the geometric and analytical properties of general Lie groups, in particular compact Lie groups, such as Haar measures and Mauer-Cartan equations. The second part (b) will be on the classification of semisimple Lie algebras, starting with Cartan’s criterion and root systems. The final part (c) is to introduce some general frame for and examples of algebraic groups and their discrete subgroups. We shall mostly study some important examples.

2. AIM OF THE COURSE

After finishing the course the students should (1) understand the algebraic structure of some fundamental classes of Lie groups such as nilpotent and semisimple Lie groups, (2) master the basic techniques in classification of reflection groups and root systems, and (3) be able to construct some examples of discrete subgroups by using the reflection groups and algebraic groups.

3. DURATION

The course will be in LP4, the academic year 2014-15, with two lectures per week two hours each.

4. PREREQUISITES

Basic knowledge of abstract algebra, real analysis, functional analysis and elementary differential geometry.

5. LECTURERS AND COURSE ORGANIZER

Genkai Zhang, genkai@chalmers.se
6. LECTURES AND EXAMINATION

Lecture twice a week two hours each. There will be home assignments during the lectures. At the end of the course there will be presentations by the participants and oral examination.

7. LITERATURE

J. Humphreys, Introduction to Lie Algebras and Representation Theory, Springer-Verlag.

8. REGISTRATION

Please send email to the course organiser for registration.