UCLouvain

lmat2266

2022

Lie Theory

5.00 credits	30.0 h + 15.0 h	Q1

This biannual learning is being organized in 2022-2023

Teacher(s)	Marquis Timothée ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	It is recommended that the student be familiar with the fundamental notions of linear algebra, as developed for example in the courses LMAT1131 or LEPL1101, as well as those of multilinear algebra and group theory, as developed for example in the course LMAT1231. It is interesting but not essential that the student be familiar with the notion of ring, in particular with polynomial rings, as developed for example in the course LMAT1331, as well as with the basic notions of Euclidean and differential geometry, as developed for example in the course LMAT1141.
Main themes	Lie algebras, classification of semisimple Lie algebra, groups associated to semisimple algebras and their generalisations.
Learning outcomes	**At the end of this learning unit, the student is able to :** Recognise and understand a basic foundation of mathematics. • Recognise the fundamental concepts of some important current mathematical theories. • Establish the main connections between these theories. Show evidence of abstract thinking and of a critical spirit. He will have made progress in : • Identify the unifying aspects of different situations and experiences. • Argue within the context of the axiomatic method. • Construct and draw up a proof independently, clearly and rigorously. Analyse a mathematical problem and suggest appropriate tools for studying it in depth. **Course Specific Learning Outcomes :** By the end of this activity, students will be able to show his mastering of fundament concepts in classical Lie theory, including those concerning semisimple algebras (Killing form, root space decomposition, root system and Weyl group), and to illustrate them on examples. They will also be able to explore a more advanced topic of Lie theory.
Evaluation methods	Oral exam, with lecture notes if needed.
Teaching methods	Lecture courses (and exercise sessions). Possibility (non-compulsory) for the students to hand over solutions to exercises during the course period, so as to get feedbacks as well as collect points towards the final exam.
Content	**Part on Lie algebras :** 1. Lie algebras: motivation, definitions and examples 2. Nilpotent Lie algebras 3. Solvable Lie algebras 4. Levi decomposition 5. Killing form and Cartan criteria 6. Semisimple Lie algebras 7. Representations of semisimple algebras 8. Classification of semisimple complex algebras 9. Serre's therorem **Part on algebraic groups :** 1. Affine algebraic groups 2. Affine groups schemes 3. Hopf algebras 4. Representations of affine groups schemes 5. Lie algebra of an affine group scheme 6. Semisimple groups over an algebraically closed field

Bibliography	• J. E. Humphreys, *Introduction to Lie algebras and representation theory*. Graduate Texts in Mathematics, **9**. Springer-Verlag, New York-Berlin, 1972. xii+169p. • Waterhouse, William C., *Introduction to affine group schemes*. Graduate Texts in Mathematics, **66**. Springer-Verlag, New York-Berlin, 1979. xi+164p.
Other infos	LaTex-typed lecture notes will be made available.
Faculty or entity in charge	MATH

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Mathematics	MATH2M	5		🔍
Master [60] in Mathematics	MATH2M1	5		🔍