UCLouvain

lmat2430

2026

Lie's therory elements and differential geometry

5.00 credits	30.0 h + 15.0 h	Q2

Teacher(s)	Bieliavsky Pierre ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	It is recommended that the student master the fundamentals of differential and Riemannian geometry as covered in LMAT1241 and LMAT1342 and the fundamentals of group theory as covered in LMAT1231.
Main themes	Differential varieties with a topological viewpoint. Cohomology of de Rham and various related notions.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 Contribution of the course to the learning outcomes of the Master's programme in mathematics. **At the end of this activity, the student will have progressed in his/her ability to :** - Know and understand a basic foundation of mathematics. In particular, he/she will have developed the ability to: -- Recognise the fundamental concepts of important current mathematical theories. -- Establish the main links between these theories. - Demonstrate abstraction, reasoning and critical thinking skills. In particular, he/she will have developed the ability to : -- Identify the unifying aspects of different situations and experiences. -- Reason within the framework of the axiomatic method. -- Construct and write a demonstration in an autonomous, clear and rigorous way. Learning outcomes specific to the course. **At the end of this activity, the student will be able to :** - Master some fundamental tools of differential topology that may be useful in a research work in topology, geometry or physical mathematics
Evaluation methods	After each section of the oral course, we offer a homework on that section. These homeworks will consist of three exercise questions and will be corrected by the lecturer and the teacher during the course of the term. Each homework will be marked out of 20 points. Afterwards there will be an oral exam on the theoretical notions seen in the course used to solve the homeworks. This exam will also be marked out of 20 points. The overall grade for the course is the average of the grades for the homework and the oral exam.
Teaching methods	The course is given in lecture form. After each section (chapter) of the oral course, we propose a homework on this section. These homeworks will consist of three exercise questions and will be corrected by the lecturer and the assistant during the course of the term.
Content	- Introduction to the notion of Lie groups and Lie algebras. - Elementary theory of homogeneous spaces and orbit spaces. - Symmetric Riemannian spaces. - Introduction to symplectic geometry. - Introduction to the representation theory of Lie groups, method of Kirilov orbits. - Introduction to the mathematical theory of quantization of Hamiltonian systems and quantum geometry.
Inline resources	Syllabus, homework statements and answer keys available on moodle.
Bibliography	• P. Malliavin, Géométrie différentielle intrinsèque. • J. Milnor, Topology from a differentiable viewpoint. • S. Kobayashi and K. Nomizu, Foundations of differential geometry. • S. Helgason, Differential geometry, Lie groups and symmetric spaces. • A. Kirillov, Lectures on the orbit method.
Faculty or entity in charge	MATH

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [60] in Physics	PHYS2M1	5		
Master [120] in Mathematics	MATH2M	5		
Master [60] in Mathematics	MATH2M1	5		
Master [120] in Physics	PHYS2M	5		
Master [120] of Education, Section 4 : Mathematics	MATH2M4	5		