lmat2120 — Groups theory

2022

5.00 credits	30.0 h + 15.0 h	Q1

This biannual learning unit is not being organized in 2022-2023 !

Teacher(s)	Caprace Pierre-Emmanuel ;
Language :	French > English-friendly
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 and the fundamental notions of 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 module on a ring, as developed for example in the course LMAT1331.
Main themes	Group theory provides a formal framework for studying the notion of symmetry. The ubiquity of groups in mathematics and physics stems from the prominent role played by the notion of symmetry in science. The course will provide a broad introduction to the theory of groups, both finite and infinite, using explicit examples. **The following topics will be covered :** • Basic examples and constructions • Permutation groups, linear and projective groups • Free groups and group presentations • Resolvable and nilpotent groups, links with Galois theory • Abelian groups and Pontryagin duality • Construction of simple, finite and infinite groups • Burnside problem on torsion groups • Groups acting on trees, hyperbolic groups • Representations, characters of finite groups and applications From one year to the next, some aspects will be developed more than others.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 At the end of this activity, the student will have progressed in his/her ability to : **(a) Know and understand a fundamental foundation of mathematics.** **In particular, he/she will have developed the ability to :** i. Recognize the fundamental concepts of important current mathematical theories. ii. Establish the main links between these theories. **(b) Demonstrate abstraction, reasoning and critical thinking skills.** **In particular, the student will have developed the ability to :** i. Identify unifying aspects of different situations and experiences. ii. Reason within the framework of the axiomatic method. iii. Construct and write a demonstration in an independent, clear and rigorous manner. **(c) analyze a mathematical problem and propose adequate tools to study it independently.**
Evaluation methods	The evaluation for this course consists of : • continuous evaluation, including projects during the quadrimester (50% of the final grade), • an oral examination during the exam session (50% of the final grade). The evaluation assesses knowledge and understanding of fundamental concepts, examples and results, ability to construct a coherent argument, and mastery of the techniques of proof introduced during the course.
Teaching methods	The course is taught through lectures and practical exercises. In the practical exercise sessions, students will be asked to make suggestions and formulate ideas in order to further the course on the basis of their prior knowledge.
Content	This course aims at introducing some of the fundamental concepts from the theory of groups. A special emphasis is put on finitely generated infinite groups, and their study by geometric methods. The following themes will be discussed, starting from concrete examples.

	• Abelian, nilpotent and soluble groups. • Free groups and groups acting on trees, theorem of Nielsen-Schrier. • Structure of the autormorphism group of a vector space, and the orthogonal groups • Linear groups and residual finiteness. • Word problem and decidability
Inline resources	Moodle: https://moodle.uclouvain.be/
Bibliography	C. Drutu and M. Kapovich, Geometric Group Theory. American Mathematical Society Colloquium Publications 63, 2018. P. de la Harpe, Topics in Geometric Group Theory. Chicago Lectures in Mathematics, 2000. J. Meier, Groups, graphs and trees. An introduction to the geometry of infinite groups. London Mathematical Society Student Texts 73, Cambridge UP, 2008. D. Robinson, A course in the theory of groups. (Second edition). Graduate Texts in Mathematics, Springer, 1996. J. Rotman, An introduction to the theory of groups. Graduate Texts in Mathematics, Springer, 1995. J.-P. Serre, Arbres, amalgames, SL2. Astérisque, No. 46. *Société Mathématique de France, Paris,* 1977.
Other infos	This biennial course is not taught during the academic year 2022-2023.
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		