UCLouvain

lmat2221

2026

Universal algebra

5.00 credits	30.0 h + 15.0 h	Q2

This biannual learning unit is not being organized in 2026-2027 !

Teacher(s)	Vitale Enrico ;
Language :	French > English-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Knowledge of mathematics bachelor level algebra. It is recommended that the student be familiar with abstract mathematical structures such as vector spaces as covered in LMAT1131 or LINFO1112 or LEPL1101, Euclidean or affine spaces as covered in LMAT1131 or LMAT1141, groups as covered in LMAT1231 or LPHYS2211 or topological spaces as covered in LMAT1323.
Main themes	Three approaches to universal algebra will be introduced, compared and developed (at different levels) : the approach in terms of finitary operations and equations, the approach in terms of Lawvere's algebraic theories and the approach in terms of finitary monads on the category of sets.
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 program in mathematics.** **At the end of this activity, the student will have progressed in his ability to :** - Know and understand a fundamental base of mathematics. In particular, he will have developed his ability to : -- Recognize the fundamental concepts of important current mathematical theories. -- Establish the main links between these theories. - Demonstrate evidence of reasoning, abstraction and critical thinking. In particular, he will have developed his ability to : -- To identify the unifying aspects of different situations and experiences. -- Reasoning in the framework of the axiomatic method. -- Build and write a demonstration independently, clearly and rigorously. - Communicate in a scientific way. In particular, he will have developed his ability to: -- Structuring an oral presentation by adapting it to the level of expertise of the public. - Be autonomous in learning. In particular, he will have developed his ability to: -- Correctly locate an advanced mathematical text in relation to the acquired knowledge. - Start a search through a deeper knowledge of a field of current mathematics. In particular, he will have developed his ability to : -- Develop an autonomous mathematical intuition by anticipating the expected results (formulating conjectures) and checking the consistency with already existing results. -- To autonomously ask relevant questions on an advanced subject of mathematics. **Learning outcomes specific to the course (depending on the topics covered).** **At the end of this activity, the student will be able to :** • To find, in his general mathematical knowledge, several significant examples of algebraic structures and to situate them in relation to the new concepts introduced in the course. • To concretely illustrate the different notions and the abstract results in the categories of sets, groups, abelian groups, modules, etcetera. • Recognize and demonstrate important exactness properties of algebraic categories. • Use the point of view of algebraic theories and the point of view of monads to understand the structures of general algebra and their fundamental properties.
Evaluation methods	The assessment aims to test knowledge and understanding of concepts, examples and fundamental results, the ability to build a coherent reasoning, mastery of demonstration techniques introduced during the course. The assessment is based primarily on a final oral exam. Active participation in the course and any presentations offered voluntarily by the student during the term will be taken into account to establish the final grade. The student can choose the language of the final assessment (English, French or Italian), and of the presentations made during the course (English or French).

Teaching methods	The course is given in the form of a lecture. During the sessions, students are encouraged to ask questions, give suggestions and formulate ideas to move the course forward based on their prior knowledge. Exercises will be proposed and volume 2 will be devoted to the presentation and correction of exercises by students.
Content	This activity consists of introducing the basic language and some fundamental results of universal algebra to explain situations encountered in other courses of the bachelor's and master's program in mathematics. **The following contents are covered in the course :** • signatures, Sigma-algebras and equational categories, • algebraic theories, algebraic categories and algebraic functors, • monads and algebras over a monad, finitary monads.
Inline resources	Moodle site
Bibliography	F. Borceux : Handbook of categorical algebra, Vol. 1-2 (Cambridge University Press, 1994). J. Adamek, J. Rosicky, E.M. Vitale : Algebraic Theories (Cambridge University Press, 2010), disponible sur le site Moodle.
Other infos	The course is biennial and will not be activated in 2024-2025.
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		🔍
Master [120] of Education, Section 4 : Mathematics	MATH2M4	5		🔍