UCLouvain

lmat1331

2026

Commutative algebra

5.00 credits	30.0 h + 15.0 h	Q1

Teacher(s)	Vitale Enrico ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	Linear Algebra (LMAT1131 or equivalent).
Main themes	Rings and their ideals. In particular, local rings and polynomial rings. Modules over a ring.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 • Establish the link between congruences and ideals. • Distinguish between different types of ideals by their quotient rings and locate a ring. • Deal with problems of divisibility and decomposition in Noetherian, factorial, principal and Euclidean rings. • Appreciate the difference between modules and vector spaces. • Recognise the role of rings and modules in other courses in the Bachelor's degree programme in mathematics.
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 consists of a final oral exam. To establish the final grade, we will take into account the oral exam and active participation in the practical work.
Teaching methods	Learning activities consist of lectures including supervised exercise sessions The lectures aim to introduce fundamental concepts, to explain them by showing examples and by delineating their use, to show their reciprocal connections and their connections with other courses in the programme for the Bachelor in Mathematics. The supervised exercise sessions aim to teach how to select the appropriate method in the resolution of exercices. The two activities are given in presential sessions.
Content	This course introduces abstract algebraic notions playing an important role throughout the cursus of Bachelor and Master in Mathematics : commutative rings and modules. **The following topics are discussed :** - Commutative rings and ideals, quotient rings, isomorphism theorems. - Integral domains, local rings, localisations, fields of fractions. - Maximal ideals and Krull's theorem. - Polynomial rings. Euclidean rings, unique factorization domains (UFD). - Gauss' theorem : if A is a UFD, then the polynomial ring A[X] is UFD. - Noetherian rings, Hilbert's basis theorem. - Modules, direct sums and direct products, free modules and projectives, modules of finite type. - (Time permetting) Exact sequences, tensor products.
Inline resources	The syllabus, also including the exercise statements for the practicals, is available on the course's MoodleUCLouvain site.
Bibliography	Saunders MacLane & Garrett Birkhoff, Algebra, third edition, AMS Chelsea Publishing 1988 Hymann Bass, Algebraic K-theory, W.A. Benjamin Inc. 1968
Faculty or entity in charge	MATH

Programmes containing this learning unit (UE)

Program title	Acronym	Credits	Prerequisite	Learning outcomes
Additionnal module in Mathematics	APPMATH	5		
Minor in Mathematics	MINMATH	4		
Bachelor in Mathematics	MATH1BA	5		
Master [120] of Education, Section 4 : Mathematics	MATH2M4	5		