UCLouvain

lmat2220

2017

Special topics in category theory

6 credits	45.0 h	Q2

Teacher(s)	Gran Marino ;Vitale Enrico ;
Language :	English
Place of the course	Louvain-la-Neuve
Main themes	One or several advanced topics in category theory. Among the possible topics are: protomodular and semi-abelian categories, categorical Galois theory, localisations, factorisation systems and torsion theories, algebraic theories and monads, sheaf theory and topos theory, categorical groups and homological algebra.
Aims	Contribution of the course to learning outcomes in the Master in Mathematics programme. By the end of this activity, students will have made progress in: - Recognise and understand a basic foundation of mathematics.He will have made progress in: -- 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. - Communicate in a scientific manner. He will have made progress in: -- Structure an oral presentation and adapt it to the listeners' level of understanding. - Show evidence of independent learning. He will have made progress in: -- Correctly locate an advanced mathematical text in relation to knowledge acquired. - Begin a research project thanks to a deeper knowledge of one or more fields and their problematic issues in current mathematics. He will have made progress in: -- Develop in an independent way his mathematical intuition by anticipating the expected results (formulating conjectures) and by verifying their consistency with already existing results. -- Ask relevant and lucid questions on an advanced mathematical topic in an independent manner. Learning outcomes specific to the course. By the end of this activity, students will be able to: - Understand the notion of commutator from a categorical point of view, and use it to compute group homology. - Characterise Galois coverings corresponding to different Galois structures, making the link with coverings in algebraic topology and Galois extensions in algebra. - Analyse properties of reflective subcategories and of (semi)localisations using factorization systems and closure operators. - 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. - Use sheaf theory and topos theory to study the passage from local to global. Make the link between intuitionistic logic and topos theory. - Understand some constructions in homological algebra and ring theory using categorical groups. 1 - - - - *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled "Programmes/courses offering this Teaching Unit".*
Evaluation methods	Assessment may be in various forms, which will be established by the teacher at the beginning of the activity. Assessment may be based solely on student presentations during the course, but there may also be additional work to submit after the end of the course or a more traditional oral examination. In the case of work to be submitted or an oral examination, students may choose the examination language (English or French).
Teaching methods	The course is taught through lectures. During sessions, students are regularly called on to give their contribution in the form of presentation of parts of the course, as previously established by the teacher.
Content	Advanced topics in category theory, related to the research interests of the members of the category theory research group. Depending on the chosen topic, the following arguments can be treated during the course: - Protomodular and semi-abelian categories, commutators, non abelian homology.

	- Factorisation systems, reflective subcategories, Galois structures, Galois coverings, classification theorem. - Torsion theories, closure operators, localisations. - Algebraic categories, completion of categories, algebraic functors and Birkhoff's theorem, monads and their algebras, monadicity theorem. - Sheaves on a topological space, étale maps, associated sheaf, Grothendieck topology, variable sets and first order intuitionistic logic. - Categorical groups and crossed modules, limits in bicategories, Picard and Brauer categorical groups, homology and algebraic K-theory for categorical groups, homotopy categorical groups.
Inline resources	Website iCampus (http://icampus.uclouvain.be/). Under construction
Bibliography	J. Adamek, J. Rosicky, E.M. Vitale : Algebraic Theories (Cambridge University Press) F. Borceux, D. Bourn : Mal'cev, Protomodular, Homological and Semi-Abelian Categories (Kluwer Academic Publishers) F. Borceux, G. Janelidze : Galois Theories (Cambridge University Press) D. Bourn, M. Gran : Torsion theories in homological categories (Journal of Algebra) A. Carboni, G.M. Kelly, G. Janelidze, R. Paré : On localization and stabilization of factorization systems (Applied Categorical Structures)
Faculty or entity in charge	MATH

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Aims
Master [120] in Mathematics	MATH2M	6		🔍