UCLouvain

lmat2250

2023

Calculus of variations

5.00 credits	30.0 h + 15.0 h	Q2

This biannual learning unit is not being organized in 2023-2024 !

Language :	French > English-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	It is recommended that the student is familiar with the basic notions of the Lebesgue integral as covered in the LMAT1221 undergraduate course and of Functional Analysis as covered in the LMAT1321 undergraduate course.
Main themes	Direct method of the calculus of variations, minimax methods, symmetry properties of optimal solutions. The theme of the course will vary.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 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 the fundamental concepts of important current mathematical theories. - Establish the main connections between these theories, analyse them and explain them. - Recognise the fundamental concepts of important current mathematical theories. - 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. - Write a mathematical text in French according to the conventions of the discipline. - Structure an oral presentation and adapt it to the listeners' level of understanding. - Find sources in the mathematical literature and assess their relevance. - Correctly locate an advanced mathematical text in relation to knowledge acquired. - Ask himself relevant and lucid questions on a mathematical topic in an independent manner. Learning outcomes specific to the course (en fonction des thèmes traités). Initiate to the current research in minima and critical points of integral functionals. - Start a research project with a deeper knowledge of an area of current mathematics. In particular, he will have developed his ability to: -- Independently develop mathematical intuition by anticipating expected results (formulating conjectures) and checking for consistency with already existing results. -- Independently ask relevant and lucid questions on an advanced mathematical topic.
Evaluation methods	The acquisition of skills will be assessed during projects during the semester and a final exam. The questions will ask : • restore material, including definitions, theorems, proofs, examples, • choose and apply methods of the course to solve problems and exercises, • adapt course demonstration methods to new situations, • synthesize and compare objects and concepts. The evaluation will focus on : • knowledge, understanding and application of the different mathematical objects and methods of the course, • the rigor of the developments, proofs and justifications, • the quality of the writing of the responses.
Teaching methods	The learning activities consist of lectures and practical work sessions. Lectures aim to introduce fundamental concepts, to motivate them by showing examples and establishing results, to show their reciprocal links and their links with other courses. The practical work sessions aim to deepen the concepts covered during the lectures.
Content	The course will cover elements of Calculus of Variations in one variable : • optimization problems;

	• Euler-Lagrange equation; • absolutely continuous functions and one-dimensional Sobolev spaces; • not smooth extrema; • Ekeland's variational principle; • Mountain pass theorem.
Inline resources	Additional documents on Moodle.
Bibliography	Le cours sera basé sur des extraits des références suivantes : The course will be based on excerpts from the following references : 1. Troutman, John L. Variational calculus and optimal control. Second edition. Undergraduate Texts in Mathematics. *Springer-Verlag, New York,* 1996. 2. Brezis, Haïm Functional analysis, Sobolev spaces and partial differential equations. Universitext. *Springer, New York,* 2011. 3. Buttazzo, Giuseppe; Giaquinta, Mariano; Hildebrandt, Stefan One-dimensional variational problems. An introduction. Oxford Lecture Series in Mathematics and its Applications, 15. *The Clarendon Press, Oxford University Press, New York ,* 1998. 4. Clarke, Francis Functional analysis, calculus of variations and optimal control. Graduate Texts in Mathematics, 264. *Springer, London,* 2013. 5. Mawhin, Jean; Willem, Michel Critical point theory and Hamiltonian systems. Applied Mathematical Sciences, 74. *Springer-Verlag, New York,* 1989.
Other infos	This course will not be offered in 2021-2022.
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		