UCLouvain

lmat1131

2023

Linear Algebra

8.00 credits	45.0 h + 45.0 h	Q1

Teacher(s)	Gran Marino ;
Language :	French
Place of the course	Louvain-la-Neuve
Prerequisites	Mathematical skillsat the level corresponding to the last year of the secondary school education. Language skills : French (written and spoken) at high school level.
Main themes	Solution of systems of linear algebraic equations. Matrix algebra. Vector spaces, linear applications and linear operators. Euclidian spaces. Quadratic forms.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 Contribution of the course to learning outcomes in the Bachelor in Mathematics programme. By the end of this activity, students will have made progress in : - Recognise and understand a basic foundation of mathematics. -- Choose and use the basic tools of calculation to solve mathematical problems. -- Recognise the fundamental concepts of some important current mathematical theories. - Establish the main connections between these theories, analyse them and explain them through the use of examples. - Identify, by use of the abstract and experimental approach specific to the exact sciences, the unifying features of different situations and experiments in mathematics. - Show evidence of abstract thinking and of a critical spirit. -- Argue within the context of the axiomatic method. -- Recognise the key arguments and the structure of a proof. -- Construct and draw up a proof independently. -- Evaluate the rigour of a mathematical or logical argument and identify any possible flaws in it. Learning outcomes specific to the course. By the end of this activity, students will be able to : - To use finite dimensional vector spaces in order to describe the set of solutions of a system of linear equations. - To use matrix representation of linear applications to understand matrix operations, including determinant of a square matrix. - To use properties of linear applications and the rank theorem in order to construct vector spaces and to evaluate their dimension. - To use euclidian spaces and orthogonal projection in order to solve approximation problems and problems involving distance in R^3 and in some other spaces. - To use technique of diagonalisation of a linear operator in order to study the evolution of a linear system and to determine the character of a quadratic form.
Evaluation methods	The final grade will take into account the continuous assessment conducted during the quadrennium. This portion of the grade will be used for the January 2022 session only. The written exam in the January session will be closed book. It will test knowledge and understanding of fundamental concepts and results, ability to construct and write coherent reasoning, and mastery of computational techniques. The answer key for the exam will be available on the course Moodle after the session ends.
Teaching methods	Learning activities consist of lectures, exercise sessions and tutorial sessions. The lectures aim to introduce fundamental concepts, to explain them by showing examples and by determining their results, to show their reciprocal connections and their connections with other courses in the programme for the Bachelor in Mathematics. The exercise sessions aim to teach how to select and use calculation methods and how to construct proofs.
Content	In this course we introduce abstract algebraic notions playing an important role during bachelor and master programs in mathematics and in physics : vector spaces, euclidian spaces, linear applications, linear operators.

	The study of systems of linear algebraic equations is the main objective of the course and, at the same time, the motivation to introduce the above mentioned algebraic structures. The following subjects are introduced during the course (this list might be slightly modified during the semester) : - Operations on vectors in R^n. - Subspaces, generating families, basis, dimension. - Gauss method, structure of the set of solutions of a system of linear equations. - Complex numbers. Vector spaces on a field, linear maps, kernel and image of a linear map. - Matrix operations, row space and column space, matrix representation of a system of linear equations. - Matrix representation of a linear map. - Cartesian product of vector spaces, sum of subspaces, rank theorem. - Determinant. - Euclidian spaces, orthogonal projections. - Linear operators, eigenvectors, diagonalisation. - Adjoint operator, spectral theorem.
Inline resources	Moodle website. Available on the website are problems from examinations of previous years with solutions, problems to be solved during tutorial sessions with solutions, a lecture notes, and a detailed outline of the course.
Bibliography	Les notes du cours et de capsules vidéos seront disponibles sur le site Moodle du cours. ------- Course notes and video clips will be available on the course Moodle site.
Faculty or entity in charge	MATH

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Bachelor in Mathematics	MATH1BA	8		🔍
Bachelor in Physics	PHYS1BA	8		🔍