UCLouvain

lmat1222

2023

Complex analysis 1

5.00 credits	30.0 h + 15.0 h	Q2

Teacher(s)	Claeys Tom ;
Language :	French > English-friendly
Place of the course	Louvain-la-Neuve
Prerequisites	Calculus LMAT1121 and LMAT1122. Language skills: French (written and spoken) at high school level.
Main themes	Power series, analytic functions, holomorphic functions, Cauchy integral, Taylor expansion, isolated singular points, Laurent expansions, residue calculus.
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. In particular: -- Choose and use the basic tools of calculation to solve mathematical problems. -- Recognise the fundamental concepts of 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 or in closely related fields. - Show evidence of abstract thinking and of a critical spirit. In particular: -- 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. -- Distinguish between the intuition and the validity of a result and the different levels of rigorous understanding of this same result. Learning outcomes specific to the course. By the end of this activity, students will be able to : - Master the different types of convergence for numerical series and series of functions. - Master the notion of a power series, the calculation of its radius of convergence and the link with the notions of analytic and holomorphic functions. - Use the fundamental principles of the theory of analytic functions: identity theorem, principle of the isolated zeros, principle of analytic continuation and maximum modulus principle. - Determine the isolated singular points of an analytic function, compute the Laurent expansion in the neighborhood of an isolated singular point. - Master the residue calculus, its application to the calculation of definite integrals and the determination of the number of zeros and poles of a meromorphic function.
Evaluation methods	Final exam testing the understanding of the theory and the ability to solve problems.
Teaching methods	Learning activities consist of lectures and exercise 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 focus on constructing proofs, examining numerous examples and counter-examples, and mastering methods of calculation.
Content	Complex analysis is a central subject in mathematics, which possesses many applications in Engineering and Physics. The course deals with the study of the basic methods in the theory of analytic functions of one complex variable. It also aims at developing a geometric intuition of the subject and discusses several applications. The following subjects are treated in the course : - Series : numerical series and series of functions. - Power series and analytic functions: radius of convergence of a power series, notion of an analytic function, identity theorem, principle of the isolated zeros, principle of analytic continuation.

	- Holomorphic functions: definition and properties, Cauchy-Riemann equations, holomorphic character of analytic functions, integration along a path, Cauchy integral formula and analytic character of holomorphic functions, Liouville theorem, fundamental theorem of algebra, principle of the maximum modulus, Schwarz lemma. - Laurent series, isolated singular points: homotopy of paths and integration of holomorphic functions, holomorphic functions in an annulus and Laurent series, isolated singular points (poles and essential singularities), Riemann apparent singularity theorem, notion of a meromorphic function, Casorati-Weierstrass theorem. - Residue theorem and applications: problem of primitives and complex logarithm, residue theorem, calculation of integrals by the method of residues, argument principle, Rouché theorem, residue at infinity.
Inline resources	Moodle page
Faculty or entity in charge	SC

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Minor in Mathematics	MINMATH	5		🔍
Bachelor in Mathematics	MATH1BA	5		🔍
Bachelor in Physics	PHYS1BA	5		🔍