Syllabus

Course Description

Course Title	Mathematical Analysis 1
Course Code	42193
Course Title Additional	
Scientific-Disciplinary Sector	MATH-03/A
Language	Italian
Degree Course	Bachelor in Industrial and Mechanical Engineering
Other Degree Courses (Loaned)	
Lecturers	Dr. Laura Levaggi, laura.levaggi@unibz.it https://www.unibz.it/en/faculties/engineering/academic-staff/person/27466
Teaching Assistant	
Semester	First semester
Course Year/s	1
CP	9
Teaching Hours	60
Lab Hours	30
Individual Study Hours	135
Planned Office Hours	27
Contents Summary	The objective of this course is to give a sound background on notions and techniques of mathematical analysis for real functions of one real variable. The course covers topics in infinitesimal, differential and integral calculus and gives an introduction to complex numbers. • Introduction to the set of real numbers and to complex numbers. • Basic notions on real functions of one real variable. • Real sequences and numerical series. • Limits and continuity of functions. • Landau symbols and rate of convergence/divergence.

	• Differential calculus and its applications. • Local comparison and Taylor expansions. • Antiderivatives and integral calculus for functions of one real variable. • Definite and improper Riemann integrals.
Course Topics	• Complex numbers. Definition, algebraic operations, trigonometric and exponential form, algebraic equations. • Real functions, limits and continuity in one variable. Review of the properties of real numbers and the basic concepts on real functions of one real variable. Sequences and limits for sequences. Limits and continuity of functions. Infinite and infinitesimal functions: Landau symbols and rate of convergence. • Differential calculus of real valued functions in one variable. Tangent to a graph and first derivative. Rules of differentiation. Differentiability and singular points. Theorems of Rolle and Lagrange. Absolute and relative extrema. Higher-order derivatives. Qualitative study of a function. •Local comparison of functions and Taylor expansions in one variable. Taylor formulas. Expansions of elementary functions and algebraic techniques to determine Taylor polynomials. Local analysis and limits calculation using Taylor expansions. • Real sequences and numerical series. Convergence criteria for numerical real series. Fundamentals of Taylor series • Integral calculus of real valued functions in one variable. Antiderivatives and rules of indefinite integration for functions in one real variable. Definite and improper integrals.
Keywords	Infinitesimal calculus, differential calculus, integral calculus, complex numbers
Recommended Prerequisites	Mastery of the topics and techniques of the preparatory course in mathematics.
Propaedeutic Courses	
Teaching Format	The course is made up of a series of frontal lectures, both devoted to the presentation of theoretical concepts and to their application in exercises. Topics will be presented on the blackboard and explanations will be supported by the use of software, both in analysing calculations and for the graphical visualization.

	The reference textbook for theory is cited in the bibliography. During the course lists of exercises will be made available to the students. Each of the activities carried out during the course's hours will be documented on the OLE web site.
Mandatory Attendance	Recommended.
Specific Educational Objectives and Learning Outcomes	The course is part of basic didactic activities and in particular in the disciplinary sector "Mathematics, Informatics and Statistics". The course is compulsory. It is and introductory course, devoted to the basic notions of mathematical analysis, in particular of infinitesimal, differential and integral calculus for real functions of one real variable. The objective is not only to convey a set of notions and tools, but also to acquire a deeper understanding of the mathematical concepts from which they are derived. This is fundamental in order to be able to use learned techniques in a rational way and to apply them to other technical and scientific subjects Intended Learning Outcomes (ILO) Knowledge and understanding 1. Knowledge of the fundamental concepts and basic tools of infinitesimal, differential and integral calculus for real functions of one real variable. Applying knowledge and understanding 2. Mastering of a methodology of non-mechanical, rational application of calculus techniques. Making judgements 3. Ability to evaluate the characteristics of the problem to be solved, set it in the correct theoretical framework and subsequently choose the most suitable method to get to its solution. Communication skills 4. Mastery of the use of the specific mathematical lexicon. Learning skills 5. Capability to a rational, analytical approach in handling problems.
Specific Educational Objectives and Learning Outcomes (additional info.)	
Assessment	The final exam consists of: - a written examination, with exercises about the topics covered during the course, that aims at verifying the understanding of the

	theory and the ability in using the relevant calculus techniques; - the subsequent discussion of the corrected test.
Evaluation Criteria	A single final mark will be given. The written examination is composed of a first part in which the achievement of the minimal requisites of understanding of concepts and ability in the application of calculus tools is proofed (ILOs 1-2) and a second part consisting in the solution of exercises where the mastery of different topics, the ability to combine calculus tools and to have a comprehensive vision of the problem are evaluated (ILOs 3-5). In the second part, the clarity of the solution scheme, the appropriateness of the methodology chosen in solving the problems (ILOs 3-4) and the correctness of the application of calculus techniques (ILOs 1-2) are assessed. Any errors and omissions underlined during the correction will be discussed with the student. Summative assessment First paper Format: Written short answer test with pass threshold of 60% Length /duration: 18 questions/60 minutes ILOs assessed: 1-2 A test mark below the pass threshold results in the exam failure. Second paper Form: written exam + (optional) Discussion of the written exam Length/Duration: 4/5 exercises (120 minutes) for the written exam + 5-10 minutes for the discussion Grade: 95% for the written exam + 5% for the discussion ILOs assessed: 1-5 for the written exam + 4-5 for the discussion In case an intermediate exam (non compulsory) is agreed upon, a passing grade allows candidates (within the exam sessions of the academic year) to be dispensed with solving some exercises, indicated on the final exam paper. In this case the final grade of the written part is obtained by summing the points in the two evaluations.
Required Readings	Textbook:

	C. Canuto, A. Tabacco “Analisi Matematica I”, Springer Verlag Italia, 2014. (Print: ISBN: 88-470-5722-1 Online: Ebook Springer) An english version of the text is also available: C. Canuto, A. Tabacco, “Mathematical Analysis I”, Springer International Publisher, 2015. (Print: ISBN: 978-3-319-12771-2 Online: Springer Ebook)
Supplementary Readings	Other bibliographic references for exercises or further study (available at the University library) may be suggested during the course, also in languages different from the official one. The student can refer to the web site of the course for any related information.
Further Information	
Sustainable Development Goals (SDGs)	Quality education