Main information on the course		
Course name	**Elements of Mathematical Analysis**	
Degree	Computer Science Degree (I level)	
Academic year	2023-2024	
European Credit Transfer and Accumulation System (ECTS), in Italian Crediti Formativi Universitari (CFU)	9 CFU (each CFU corresponds to 25 hours (h) of student's time); CFU are of type T1, T2 or T3 T1 = 8 h lecture + 17 h individual study T2 = 15 h practice + 10 h individual study T3 = 25 h individual study	
SSD	MAT-05	
Course language	Italian	
Year of study	First	
Academic semester	Second Semester	
Attendance	Not mandatory (but strongly recommended)	
Web page	https://www.uniba.it/it/ricerca/dipartimenti/informatica/didattica/corsi-di-laurea/informatica-270/laurea-triennale-in-informatica-d.m.-270-1	

Teacher(s)	
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e-learning platform	Piattaforma ADA - https://elearning.di.uniba.it/
Teacher's homepage	https://www.dm.uniba.it/it/members/cappellettimontano
Office hours	Students can request an appointment by e-mail. At the beginning of the semester, a schedule is established (announced on the web page dedicated to this course) which remains valid unless conflicting commitments arise. Consultations can be conducted via video call on the Teams platform.

Syllabus	
Course goals	The course aims to present basic notions of functions, graphs and their transformations, introduce the concepts of derivative, integral and numerical series, provide the knowledge related to concepts and mathematical tools needed to describe the main aspects of the real world. In particular, the course aims to strengthen the aptitude for logical-deductive reasoning, increase students' understanding and enable them to reason rigorously and analytically when facing new problems.

Prerequisites/requirements	The course requires knowledge of the basic mathematics content provided insecondary school: algebraic symbolic manipulation, principles of analytical geometry, basic definitions about sets and functions, solution of algebraic equations and inequalities. It is also necessary to have acquired the basic logic knowledge acquired during the course of Discreet Mathematics.

Course program	**Real Numbers (7 hours)** Definitions and main properties of **N, Z, Q, R**. Field axioms for real numbers. The completeness axiom. The real line. Intervals. Maximum and minimum, sup and inf of numerical sets. Absolute value. **Real Functions (12 hours)** Functions. Injective, surjective, bijective functions. Function composition. Inverse function. Real functions and their graph. Bounded functions. Monotonic functions. Symmetric functions. Periodic functions. Elementary functions. Graph transformations. **Sequences (11 hours)** Real sequences. Recurrence relations. Bounded sequences. Convergent and divergent sequences. Limit of a sequence. Bounded sequences and convergent sequences. Sign permanence theorems. Comparison theorems. Monotone sequences and their limit. Algebraic limit theorem. Ratio and root tests. **Continuous functions (15 hours)** Limit of a function. Asymptotes. Continuous functions. Discontinuities. Continuity over an interval. Bolzano's theorem. Intermediate value theorem. Weierstrass theorem. Monotonic functions and continuity. **Differential calculus (16 hours)** Derivative. Differentiability and continuity. Local extrema of functions, stationary points, Fermat's theorem. Lagrange's mean value theorem and its consequences. de l'Hôpital's theorem. Convex functions, inflexion points. Differentiability and graphs of functions. Taylor's theorem. **Series (10 hours)** Convergent and divergent series. Convergence tests. Absolute convergence. Leibniz's alternating series test. Power series. **Integral calculus (15 hours)** Antiderivatives. Indefinite integrals. Integration techniques. Riemann integral and its properties. Mean value theorem for integrals. Fundamental theorem of calculus. Fundamental formula of calculus. Improper integrals.

Books of reference	1. M. Bramanti, C.D. Pagani e S. Salsa, Analisi matematica 1, Zanichelli 2. G.C. Barozzi, G. Dore, E. Obrecht, Elementi di Analisi Matematica, Zanichelli. 3. M. Bramanti, Esercitazioni di Analisi matematica 1, Societa' Editrice Esculapio Students can borrow the texts from the library. It may be convenient to check availability via the University Library Systemhttps://opac.uniba.it/easyweb/w8018/index.php? and contact the library to arrange the loan.
Notes to the books	In the text 1), theoretical topics are covered (Chapters 1-6). Text 2) contains exercises, many of which come with solutions. Slides and lecture notes are posted on the e-learning platform.

Organization of the didactic activities

Hours

Total	Lectures	Practice sessions	Individual study
225 hours	56 hours	30 hours	139 hours

CFU/ETCS

9 CFU	7 CFU	2 CFU	

Teaching methods

	Lectures are held in a classroom, After each session these notes are made available on the e-learning platform https://elearning.uniba.it

Expected learning outcomes

Knowledge and understanding	Knowledge of basic principles and techniques of Mathematical Analysis, strengthening of logical reasoning skills.
Applying knowledge and understanding	Ability to solve problems by utilizing theoretical knowledge, draw and read graphs of functions, estimate the order of a function, study a numerical series, solve integrals.

Soft skills	*Making informed judgments and choices* Development of critical thinking, ability to choose the right mathematical tools to solve specific problems, ability to recognize the limits of one's knowledge. *Communicating knowledge and understanding* Ability to use the mathematical language in an appropriate way to communicate acquired knowledge and to describe, analyze and solve problems. *Capacities to continue learning* Ability to study independently and to identify and to consult appropriate textbooks and other resources useful for further study.

Assessment	
Assessment methods	The final exam consists of a written exam, divided into two parts. The first part consists in solving exercises. The second part deals with the theoretical results and consists in showing examples, counterexamples definition and proofs on the theoretical results.
Evaluation criteria	*Knowledge and understanding* The student must be able to explain definitions and theoretical results, including some proofs. *Applying knowledge and understanding* The student must be able to solve problems. *Autonomy of judgment* The student must identify the most suitable tools for the resolution of the given problems. *Communicating knowledge and understanding* The student must be able to explain theoretical results clearly and completely, using precise mathematial language. *Capacities to continue learning* The student must be able to study independently and identify and consult appropriate textbooks and other resources useful for further studies
Measurements and final grade	The written exam consists of theoretical problems (definitions, theorems with their respective proofs and counterexamples) and exercises. The final grade, is awarded out of thirty. The exam is considered passed when a student answers correctly to at least one theoretical problem and obtains a final grade which is greater than or equal to 18/30.

Further information	Students are advised to rely exclusively on information/communications provided on the official websites of the Computer Science Department, or on social groups only if established and administered exclusively by the teachers of the relevant courses: • https://www.uniba.it/it/ricerca/dipartimenti/informatica/teaching/degree-courses/degree-courses • https://www.uniba.it/it/ricerca/dipartimenti/informatica • https://elearning.uniba.it/ The teaching programs are available here: • https://elearning.uniba.it/ Information that all students should know is written in the teaching regulations and available in the site: • https://www.uniba.it/it/ricerca/dipartimenti/informatica/teaching/degree-courses/degree-courses Students are advised to be wary of information and materials circulating on unofficial sites or social groups, as they often were found to be unreliable, incorrect or incomplete.