# Mathematics

## Prof. Alfredo Malavolta

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

The overriding objective of the course is to develop students' aptitude for critically examining the mathematical concepts encountered along their learning path and to stimulate their ability to use methods, tools and mathematical models in disciplines with economic, statistical and financial content that the they will later face. The course aims to provide the basics of linear algebra, differential and integral calculus, and optimisation, which constitute an effective tool for analysing economic and business phenomena. Theoretical lectures will be supplemented by tutorials carried out in the classroom, meetings in which students actively participate in solving problems, including theoretical ones, and exercises assigned with subsequent correction.

At the end of the course, students will be able to:

1. Know and understand the main parts of the programme and be able to apply the mathematical methods described in the programme to solving problems and exercises;
2. Translate real world situations, especially in the economic, financial and social fields, into mathematical symbols and formalities;
3. Deal with complex problems through the logical and formal tools offered by mathematics;
4. Possess a rigorous and essential language that allows them to communicate their acquired knowledge clearly and effectively;
5. Possess good learning skills that allow them to advance their studies with greater autonomy.

***COURSE CONTENT***

– Overview of sets; Cartesian product; relations and functions; inverse functions; composite functions. Number sets and algebraic structures.

– Real numbers: algebraic properties, order, metrics and continuity.

– Elementary equations and inequalities. Sets in R and their properties.

– Real functions of a real variable and their properties; elementary functions. Sequences.

– Limits of real functions of a real variable; forms of indecision; infinitesimals and infinities.

– Continuous functions. Properties of limits and continuous functions.

– Derivatives: definition; geometrical interpretation; differentiable functions; rules of calculus; higher derivatives; Taylor’s formula. Relative and absolute turning values; function studies.

– Riemann integral. Integral. Main integration methods.

– Real functions of several real variables: partial derivates; first order extrema conditions, free or bound

– Elements of linear algebra: vector spaces, , linear functions, matrices, determinant, rank, linear systems.

***READING LIST***

A. Malavolta-A. Campaner, *Raccontare di matematica,* CUSL, Milano, 2016.

A. Cicchetti-A. Mainini-D. Polieri, *Fare della matematica,* CUSL, Milano, 2017.

A. Malavolta, *Appunti di Matematica generale-equazioni e disequazioni,* CUSL, Milano, 2015.

Further reading.

G.C. Barozzi-C. Corradi, *Matematica generale per le scienze economiche,* Il Mulino, Bologna, 1999.

V.E. Bononcini-G. Fanti, *Esercizi di analisi matematica,* CEDAM, Padova, 1970 (vol I).

***TEACHING METHOD***

Lectures, exercises, pre-course work (all conducted in class), tutoring, correction of assigned exercises and optional residential seminars.

***ASSESSMENT METHOD AND CRITERIA***

Written paper (application exercises) plus oral examination (only if the written paper is passed). The final mark is essentially determined by the oral exam. There is an interim test open to all, with questions and theoretical problems and application exercises. The assessments of this test are subdivided into a "theoretical" part, which constitutes a bonus for the oral exam, and an applied part, which constitutes a bonus for the written exam. More detailed indications, both on the exam and the interim test, can be found on the lecturer's personal page.

There is a mid-course examination open to all.

To sit the written paper, students must pass a preliminary test of their basic knowledge (as shown in the entry test section of the Faculty website). Students who correctly answered at least 8 questions in the mathematics section of the entry test do not have to sit the preliminary test.

The preliminary test can be taken at the end of the course, during the interactive student-lecturer meetings, or at another time agreed with the lecturer.

***NOTES AND PREREQUISITES***

Participation in the lectures and tutorials, starting with the pre-course, is strongly recommended to successfully face the exam. However, considering the needs of working students, several tutoring opportunities will be available throughout the year on agreed days and times.

*Prerequisites*

The elements of algebra covered in the first two years of high school: N, Z, Q, R operations in sets; monomials and polynomials; decomposition of a polynomial into factors; 1st and 2nd order equations.

*These topics constitute the pre-course programme along with the second chapter of the text, Appunti di Matematica Generale-equazioni e disequazioni, written specifically for the pre-course.*

In case the current Covid-19 health emergency does not allow frontal teaching, remote teaching will be carried out following procedures that will be promptly notified to students.

Further information can be found on the lecturer's webpage at http://docenti.unicatt.it/web/searchByName.do?language=ENG, or on the Faculty notice board.