



UNIVERSITÀ  
DEGLI STUDI DI MILANO-BICOCCA

## SYLLABUS DEL CORSO

### Matematica I

2324-1-E3201Q001

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#### Aims

Provide the student with basic notions of mathematical analysis in order to acquire the skills necessary for the study of physical and environmental phenomena.

Develop logical and analytical skills to solve problems and exercises.

Acquire autonomy of judgment in the application of the methods learned.

Being able to express in a precise and exhaustive way both the theoretical knowledge acquired and the solutions, developed independently, of exercises and problems.

#### Contents

Real numbers. Inequalities. Combinatorics. Limits. Continuity. Derivatives. Functions and their graph. . Taylor's formulas. Integrability.

#### Detailed program

Sets: subsets, operations and relations between sets; interior, exterior, boundary, isolated and limit points. Open and closed sets. Bounded and unbounded sets. Countable sets. Supremum, infimum, maximum and minimum. The set of real numbers. The real number are uncountable.

Inequalities

Combinatorics: sequences with and without repetitions. Permutations. Combinations. Newton's binomial formula.

Functions: definition, graph, composite function and inverse function, monotonicity, convexity. Elementary

functions: polynomials, exponentials, logarithms, sine, cosine and tangent, their properties and graphs; inverse functions of sine, cosine and tangent, their properties and graphs.

Limits: definition, theorems: uniqueness of the limit, permanence of the sign, existence of the limit for monotone functions, comparison theorem, calculus of limits. Comparison between infinite and infinitesimal functions and fundamental theorems.

Continuity: definition, discontinuity and continuity points, uniform continuity. The Weierstrass, Heine-Cantor, zeros and Darboux theorems. Common limits.

Derivatives: definition, geometric meaning. Implication of continuity, derivatives of elementary functions, calculus of derivatives: sum, product, reciprocal, quotient, derivative of the composite and inverse functions. The differential and its geometric meaning. Rolle theorem, Lagrange theorem and its corollaries. Taylor's and Mac Laurin's formulas.

Functions and their graph: increasing and decreasing functions and relation with their derivatives. Conditions for the existence of local maximum and minimum; Maxima and minima for  $n$  times differentiable functions. Convexity and asymptotes.

Integrability: definition, properties of the definite integral, sufficient conditions for integrability. Mean value and Torricelli-Barrow theorems, the fundamental theorem of calculus. Primitive functions, indefinite integrals. Integration rules: decomposition, substitution and by parts. Improper integrals.

## **Prerequisites**

Elementary algebra: monomials, polynomials and operations with polynomials. Trigonometry: definition of sine, cosine and tangent, their properties and relations. Analytical geometry: equations of line, circle, ellipse, parabola, hyperbola; intersections of plane figures. Exponential functions and logarithms.

## **Teaching form**

Theoretical lessons in which we provide knowledge of definitions, theorems and relevant examples and calculus lessons in which we try to provide the necessary skills and abilities to use these notions in the resolution of exercises.

## **Textbook and teaching resource**

A. Guerraggio: Matematica Generale, nuova edizione, Bollati Boringhieri

## **Semester**

First semester

## **Assessment method**

Written Exam with Mandatory Oral Component.

Written Exam: The written exam consists of closed and/or open-ended questions. It requires a study of functions and exercises similar to those covered in class based on the completed syllabus. Two partial exams are scheduled during the course.

Admission to Oral Test: Access to the oral exam is granted with a score of 18 or higher in the written exam. With the partial exams, admission to the oral exam is granted with an average score of 18 or higher and a score of 16 or higher in each individual partial exam. The oral exam can be taken in the same session or in the following session.

Oral Exam: The oral exam consists of a discussion of the written exam and questions about the definitions, statements, and proofs of the theorems covered in the syllabus. The oral exam may add or subtract points to the written exam score to determine the final outcome.

## **Office hours**

By appointment

## **Sustainable Development Goals**

QUALITY EDUCATION

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