UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

## Calculus I

**2223-1-E3201Q001**

### 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 tanget, their properites 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 and oral exam.

Written exam: the written exam consists of open questions. It requires a function study and exercises similar to those carried out in class on the program performed. The written exam can be replaced by the passing of partial tests carried out during the course.

Oral exam: the students can take the oral exam with a score greater than or equal to 16 in the written. The oral exam consists of a discussion of the written test and questions about definitions and theorems in the program.

## Office hours

By appointment

## Sustainable Development Goals

QUALITY EDUCATION