UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

# COURSE SYLLABUS

# Calculus

**2526-1-E0202Q001**

## Aims

The course aims to provide students with basic mathematical tools for the modeling and quantitative analysis of natural phenomena. The competencies developed are articulated according to the Dublin Descriptors as follows
**Knowledge and understanding** : students will become familiar with fundamental concepts of set theory, differential and integral calculus for real-valued functions of a real variable, linear algebra, and ordinary differential equations. This knowledge is gradually developed through a structured path that combines theoretical lectures with guided presentation of relevant examples, in order to consolidate the understanding of general principles and their mathematical formalization.
**Applying knowledge and understanding** : the application of acquired knowledge is fostered through the integration of theory and exercises, with a focus on problem-solving activities inspired by real or simplified scenarios from the field of biotechnology. Operational skills are built progressively, guiding students from the comprehension of methods to their practical use, and encouraging critical awareness in selecting the most suitable techniques.
**Making judgements** : students are guided to identify recurring structures and patterns in the problems addressed, to formalize concrete situations using mathematical language, and to critically evaluate the results obtained. Independent judgement is encouraged through activities that promote individual analysis and reflection on the adopted procedures.
**Communication skills** : the course fosters the acquisition of a precise and rigorous technical vocabulary, promoting the ability to express and articulate concepts, procedures, and solutions clearly. This competence is developed through the exposition of mathematical reasoning during exercises, active participation in class discussions, and engagement with both theoretical and applied questions.
**Learning skills** : students learn to autonomously recognize and connect fundamental concepts, acquiring a study method that enables them to effectively approach mathematical content in subsequent courses. Learning skills are enhanced by a structured progression of topics, the development of self-assessment abilities, and the internalization of logical frameworks that can be transferred to other disciplinary areas.

## Contents

Review of basic set theory and properties of functions. Limits and continuous functions. Differentiable functions and derivative. Applications to the study of a graph. Primitive functions and Riemann integral. Ordinary differential equations. Fundamentals of linear algebra.

## Detailed program

1. Review of set theory and functions: number sets and elementary functions.
2. Limits of single-variable functions.
3. Continuous functions: basic properties and fundamental results.
4. Differential calculus: derivative of a single-variable function, derivatives of elementary functions, derivative rules.
5. Fundamental theorems of differential calculus: Rolle, Lagrange, Fermat.
6. Derivatives and limits: De l'Hospital theorem.
7. Drawing the graph of a function.
8. Primitive functions and Riemann integral.
9. The fundamental theorem of calculus.
10. First-order ordinary differential equations: separable and linear equations.
11. Linear algebra: linear systems and matrices.

## Prerequisites

Background: basic algebra of real numbers, analytic geometry, trigonometry.

Prerequisites: none.

## Teaching form

The course is organized as follows:
-Lectures (48 hours) in person;
-Exercises classes (20 hours) in person.

Both provide lecture-based teaching to deliver the fundamental concepts.
Definitions and relevant will be discussed in Lectures, providing examples and problems making use of the notions introduced. Exercises on the subject matters covered in the lectures are presented and solved during Exercise classes.
Some exercise sets will be made available regularly on the e-learning website to encourage participation. At the webpage of the course students can find self-assessment quizzes realating to topics covered in the lectures.
A tutor will provide students with support in solving the exercises published on the e-learning website.
contents by the lecturer and the tutor.
All lectures and exercises classes are video recorded, the recording are available at the e-learning website.
The course is delivered in Italian.

## Textbook and teaching resource

Textbook:
A. Guerraggio, Matematica per le scienze (seconda edizione), Pearson 2018.

On the e-learning web page of the course are published:
slides of lectures;
exercises;
quizzes.

## Semester

First semester.

## Assessment method

**Written** and **optional oral** examinations.

**Written exam**
It consists of two parts, which will take place on the same day, usually the first one in the morniong and the second one in the afternoon:

- the **first part** (1 hour) consists of a multiple-choice test;
- the **second part** (2 hours) involes the solution of some problems.
  Both are evaluated on the basis of correctness, completeness, precision, and clarity of the answers.
  The maximum score is 33 points for each part, but the second part will be evaluated only if the score in the first part reaches 15, the final score is the average. The passing score of the written exam is 18 points.

The optional oral test can be taken **only** if the written test is sufficient. In order to pass the exam the oral test must be sufficient and the final score is the average of the scores obtained in the written and oral tests.

There are 8 exam sessions.

## Office hours

By appointment arranged via campus email.

## Sustainable Development Goals

QUALITY EDUCATION