UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Calculus I

2021-1-E4102B001

Learning objectives

This course mainly aims at providing a rigorous introduction to differential and integral calculus for functions of one variable.

Knowledge and understanding
This course provides knowledge and understanding of:

- The language of Mathematics and the method of studying math issues
- Nature of integer and real numbers, definition and handling of numerical sequences and series
- Families of functions and their properties
- Nature and properties of integrals which are relevant in Statistics

Ability to apply knowledge and understanding

At the end of the course and of their personal work the students will be able to:

- Schematise a technical or scientific problem, to approach this latter by finding suitable examples, to break the problem into steps, to recognise similar problems which may suggest a solution
- Understand the mathematical language used in math or statistical books or papers
- Use the tools of differential and integral calculus in a critical way
- Carry out by herself/himself calculations related to numerical series, differentiation, integration, and cumulative distribution functions

The course provides a solid background of one dimensional differential and integral calculus, needed in every working environment. Moreover such a background is fully necessary for the completion of statistical studies.

Contents

Mathematical and daily language. Studying a Math book.
Sequences and series.
Differential calculus of one variable. Functions.
Taylor series.
Integral calculus of one variable.
Integral functions and cumulative distribution functions.

Detailed program

Mathematical and daily language. Quantifiers and conjunctions. Structure of a mathematical sentence. The language of sets. Negating a mathematical sentence. Contrapositives and converses. Unknowns in mathematical statements. Indices in sums and in set theoretic operations. Studying a Math book. Definitions and examples. Studying a proof: checking the steps, looking at a few examples, applying the argument to similar problems.

Real numbers: metric and arithmetic properties. Powers with a real exponent. Equations and inequalities. Supremum. Sequences and limits. Monotone sequences. Indeterminate forms. The number "e". Computing some limits. Series. Geometric series.

Limits and continuity of functions. Composition of functions. Differentiation of a function. Using differential calculus to draw the graph of a function. The mean value theorem. Higher order derivatives. Convexity. Taylor expansions and Taylor series. The exponential series.

Riemann integral. The fundamental theorem of Calculus. Improper integrals. Numerical series and improper integrals. The Gamma function. Cumulative distribution functions and their graphs.

Prerequisites

- Algebra: inequalities (I and II degree, irrational, exponential, logarithmic).
- Euclidean Geometry.
- Analytic Geometry.
- Trigonometry (trigonometric functions, equations and inequalities).
- Elementary properties of integer and rational numbers.

Teaching methods

There will be regular lessons (in a classroom) and distance lessons (hopefully in streaming).

Assessment methods

Written and (compulsory) oral exam.

No midterm exam.

The result of the written exam below grade 15 precludes the admission to the corresponding oral exam.

The written exam consists of math exercises concerning the content of the course. At http://elearning.unimib.it/enrol/index.php?id=30634 texts and detailed solutions of all the written exams starting from 2006 are available.

The aim of the written exam is to check the ability to solve calculus problems in a correct and detailed way, and to show math skills and ability of reasoning and applying the tools provided during the course. For this reason the students are allowed to consult books or personal notes during the written exam, but they are not allowed to use calculators. The oral exam gives a definitely better understanding of how the students master the topics of the course. The oral exam consists partly of a written test concerning the theory of the course, checks knowledge and understanding of the proofs of the theorems presented during the course, as well as the ability to introduce and discuss definitions and computational techniques. The solutions of few exercises can be part of the oral exam, depending on the outcome of the written exam.

According to the situation of the Covid-19 emergency, exams can be held via Webex on the e-learning page

Textbooks and Reading Materials

M. Bramanti, C. Pagani, S. Salsa, Analisi Matematica I, Zanichelli.
M. Bramanti, G. Travaglini, Matematica. Questione di Metodo, Zanichelli.
M. Bramanti, Precalculus, Progetto Leonardo, Esculapio.
M. Bramanti, Esercizi di Calcolo Infinitesimale e Algebra Lineare, Seconda Edizione, Progetto Leonardo, Esculapio.
M. Boella, Analisi matematica e algebra lineare, vol.1, Pearson.
Notes, videos of all the lessons and hundreds of solved tasks at

http://elearning.unimib.it/enrol/index.php?id=30634

Semester

First semester (from September to January).

Teaching language

Italian