UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Calculus II

2021-2-E4102B009

Learning objectives

This course mainly aims at providing a rigorous introduction to Fourier series and to the differential and integral calculus of functions of d variables, with an emphasis on the case of *very large* d.

Knowledge and understanding
This course provides knowledge and understanding of:

- Problems where Fourier Analysis plays a role
- Regularity of functions of several variables: properties and applications
- Nature and properties of multiple 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:

- Delete "noise" from essentially periodic statistical data. Use trigonometric approximations of periodic functions. Apply Benford's law to investigate corrupted data
- Apply differential calculus in several variables to maxima/minima problems, e.g. linear regression
- Use integral calculus in several variables to study mean value problems, e.g. the Monte Carlo method
- Understand the peculiarity of several geometric and probabilistic problems when the dimension of the space is very large

The course provides a solid background of Fourier series and differential and integral calculus in several variables, needed in every working environment. Moreover such a background is absolutely necessary for the completion of statistical studies.

Contents

Complex numbers and Fourier series.
Differential calculus on R^d.
Integral calculus on R^d.

Detailed program

Complex numbers. Discrete Fourier series. Fourier series, Benford’s law.
Differential calculus on R^d.
Partial derivatives and differentiability.
Maxima and minima (with or without constraint), Lagrange multipliers.
Taylor expansion, Hessian matrix. Linear regression.
Convex functions
Integral calculus on R^d.
Changes of variables.
Monte Carlo method.
Improper integrals.
Integration of radial functions on R^d.

Prerequisites

Differential and integral calculus in one variable. Linear Algebra.

Teaching methods

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=30625 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 2, Zanichelli.
M. Bramanti, Esercizi di Calcolo Infinitesimale e Algebra Lineare, Seconda Edizione, Progetto Leonardo, Esculapio.
M. Boella, Analisi Matematica 2, Pearson.
Notes, videos of all the lessons and hundreds of solved tasks at http://elearning.unimib.it/course/view.php?id=30625

Semester

First semester (from October to November).

Teaching language

Italian