UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Mathematical Analysis II

2425-2-E3001Q040

Aims

The course has the following targets:

1. Knowledge of the course topics: differential and integral calculus in several variables, curves and surfaces, differential forms, sequences and series of functions, ordinary differential equations, metric and functional spaces
2. Development of criticism;
3. Problem solving.

Contents

Differential calculus in several variables, integral calculus in several variables, sequences and series of functions, curves and surfaces, differential forms, ordinary differential equations, metric and functional spaces.

Detailed program

- Metric spaces: metrics, neighborhoods, open and closed sets, topology associated to a metric space, density, continuity, completeness and compactness.
- Normed spaces: definition of norm, Banach spaces.
- Differential calculus in several variables: partial derivatives, differentiable functions, chain rule, higher order derivatives, Taylor's formula, maxima and minima of functions of several variables.
- Integral calculus in several variables: Lebesgue integral, integrability of continuous functions, evaluation of multiple integrals by repeated lower dimensional integration, change of variables, polar coordinates in 2 and 3 dimensions, application to area and volume.

- Curves, surfaces, differential forms: curves and surfaces, length of curves, area of surfaces, Implicit Function Theorem, constrained minimization, Lagrange multipliers, differential forms, closed and exact differential forms, Gauss-Green's Theorem, Stokes' Theorem.
- Sequences and series of functions: metric and normed spaces, Cauchy sequences, point-wise and uniform convergence of sequences and series of functions, completeness of the space of continuous functions with the uniform norm, power series, Fourier series.
- Ordinary differential equations: the Cauchy problem, reduction of an equation of order n to a system of n equations of the first order, the Banach Contraction Theorem and the existence/uniqueness of solutions to differential equations, linear differential equations, first order equations, separation of variables, linear and exact equations. Linear systems. Linear systems with constant coefficients, the exponential of a linear transformation, linear differential equations of higher order with constant coefficients. Maximal solutions. Qualitative study of solutions.

Prerequisites

The contents of the Mathematics courses of the first year are required.

Teaching form

A hybrid teaching approach is used, that combines lecture-based teaching (DE) and interactive teaching (DI). DE involves detailed presentation and explanation of theoretical content. DI includes active student participation through exercises and problems, short presentations, group discussions, and group or individual work. It is not possible to precisely determine in advance the number of hours dedicated to DE and DI, as these methods are dynamically intertwined to adapt to the course's needs and promote a participatory and integrated learning environment, combining theory and practice.

Lectures (64 hours) and practical sessions/tutorials (48 hours) are conducted in person and are primarily in Italian.

Textbook and teaching resource

- E. Giusti: *Analisi matematica 2*, terza edizione, Bollati Boringhieri.

Other books:

- P. Marcellini, C. Sbordone: Esercitazioni di Matematica, secondo volume, parte prima e seconda.
- N. Fusco, P. Marcellini, C. Sbordone: Analisi Matematica due, Liguori Editore.
- E. Giusti: Esercizi e complementi di analisi matematica 2, Bollati Boringhieri.
- G. De Marco: Analisi Due, Zanichelli Decibel.
- G. De Marco, C. Mariconda: Esercizi di Analisi Due, Zanichelli Decibel.
- C. D. Pagani, S. Salsa: Analisi matematica 2, Zanichelli.
- V. Barutello, M. Conti, D.L. Ferrario, S. Terracini, G, Verzini: *Analisi 1 e 2.* Apogeo.

Semester

Second year, first semester.

Assessment method

The exam consists of a written part (mandatory) and of an oral one (optional). The written exam is divided into two parts.

1. **Multiple choice test**: 15 multiple choice questions. The evaluation is done by assigning the following scores: +3 for a right answer, ?1 for a wrong answer, 0 for a question left unanswered. The grade will then be rescaled on a scale of thirty points. The minimum threshold for passing this test is 15/30 points. Duration: 30 minutes.
2. **Open-ended test** (exercises and theoretical questions): exercises such as those carried out in class, or of a different type, and answers to theoretical questions. The minimum threshold for passing this test is 15/30 points. Duration: 120 minutes.

The overall grade of the two written tests is obtained by calculating the weighted sum, with weights 3 and 6 respectively, of the marks of the two tests.

Erasmus students are allowed to write their exam answers in English, as well as to speak English during oral exams. However, the texts for the written exams will generally be provided in Italian.

Further information on the tests, details and timetable of the tests can be found in the *e-learning* space of the course.

Office hours

By appointment.

Sustainable Development Goals

QUALITY EDUCATION | GENDER EQUALITY | REDUCED INEQUALITIES