UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Mathematics III

2021-2-E2701Q063

Aims

The objectives of the course are the following.

Knowledge and understanding. The student will learn the principal results of multi-variable integral calculus, vector calculus and linear algebra and will become acquainted with their tools and techniques.

Applying knowledge and understanding. By means of several examples and exercises, the student will develop the ability of applying the theorical results presented in the lectures to problems of integration in several variables, vector calculus and linear algebra.

Making judgements. The student will be able to face critically problems of integration in several variables, vector calculus and linear algebra, identifying by himself/herself the most appropriate tools among those introduced in the course.

Communication skills. The student will become familiar with the introduced language and mathematical formalism, which will make him/her able to communicate with rigor and clarity the acquired knowledge.

Learning skills. The student will be able to apply the acquired knowledge to different contexts, in particular in the study of other scientific disciplines (such as chemistry and physics) which require a good mathematical background.

Contents

Integral calculus in several variables, vector calculus, linear algebra.

Detailed program

1. **Double integrals.** Double integrals over rectangles, iterated integrals, double integrals over general regions, change of variables in double integrals, double integrals in polar coordinates.

2. **Triple integrals.** Triple integrals over boxes, iterated integrals, change of variables in triple integrals, triple integrals in cylindrical and spherical coordinates.
3. **Surface integrals.** Surfaces in $\mathbf{R}^3$, parametrization of a surface, regular surfaces, normal vector, orientation of a surface, surface integrals, flux of a vector field across a surface.

4. **Vector calculus.** Green's Theorem, Stokes' Theorem, Divergence Theorem.
5. **Linear Algebra.** Real and complex vector spaces, dependent and independent sets in a linear space, subspaces. Bases and dimension of a linear space, euclidean spaces, norms and (Hertmitian) inner products, Cauchy-Schwarz inequality, orthogonality. Orthonormal bases. Linear transformations: matrix representation, null space and range, nullity and rank, matrices, matrix operations, determinants, Binet formula, Laplace expansion; inverses of square matrices, change of the bases. Eigenvalues and eigenvectors of endomorphisms, diagonalizability. Adjoint endomorphism, hermitian operators, Spectral Theorem, simultaneous diagonalization.

Prerequisites

Matematica I e Matematica II

Teaching form

Textbook and teaching resource

Notes, exercises sets and other material will be distributed. It will be available from the e-learning site.

Bibliography:

For the first part:

- Stewart, Calcolo. Funzioni di più variabili, Apogeo.

-Analisi Matematica Vol. 2, Con elementi di geometria e calcolo vettoriale. Da Susanna Terracini, Gianmaria Verzini, Vivina Barutello, Monica Conti, Davide L. Ferrario, Apogeo (disponibile come ebook)

Second part:

-Linear algebra and its applications, Strang, Gilbert. (sara disponibile come e-book nella biblioteca. E gia disponibile cartaceo)

Semester

Second year, First semester

Assessment method

Written examination with **optional oral colloquium.**

The goal of the evaluation (partial, complete and oral colloquium) is to ascertain a correct assimilation of concepts and techniques studied during lessons and exercises sessions.

The written exam is passed ONLY if the vote is greater or equal to 18/30.

The written exam will consist of exercises (similar to those done in the classroom and/or proposed to the students in the lectures) up to 24 points. There will be a maximum of 6 points for questions relating the theory (basic definitions and theoretical results done in the lectures).

Oral exam (optional)

Oral exam is not compulsory and will be done typically after a couple of days of the written exam. It is only possible to take the oral exam if the mark in the written part is greater than 18/30.

Students who got a positive grade in the written part (i.e., at least 18/30) might choose to take an oral exam to try

to get a better grade if *they think that their preparation is good enough.* Needless to say, the oral exam can change the written grade in the positive, as well as in the negative direction. In particular, the minimal grade in the written part plus a poor oral part might end up in a failed exam.

The students who have not passed the written part, **might be admitted to the oral exam ONLY IF**

-the vote in the written exam is greater or equal to **17/30, or**

- the vote in the written exam is greater or equal to **16/30, having at least 6/8 points in the theoretical part.**

Partial exams (optional)

During the course there will be two partial exams. The that could allow the students to Students are not committed to do them, but in case they do they are allowed to skip the final complete written examination.

Number of exams

During the year there are 6 exam sessions in the following periods: one in January, one in February, one in April/May, one in either June or July, one in September and one in November. The final exam can be replaced by two intermediate written tests, the first of which will take place in November while the second one will take place at the end of the course.

Office hours