UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Mathematics II

2425-1-E2702Q075

Aims

To describe the simplest characteristics of functions of several variables and their use and operations most useful in applications
Knowledge and understanding After the class the student knows:
- the main definitions related to linear systems and to the methods to treat them
- the definitions of continuity, differentiability and stationary points for functions of several variables and the main criteria to find and characterize the stationary points
- the definition of line integrals and the definition and properties of conservative vector field
- the main types of ordinary differential equations

Applying knowledge and understanding After the class the student is able to:
- study linear systems with m equations and n unknown, homogeneous and inhomogeneous; he/she is able to study existence and uniqueness of solutions and to write explicitely the solutions whenever possible
- to study points of maximum, minimum, or saddle points of functions of two variables
- to compute line integrals and to establish if a vector field is conservative or not
- solve simple examples of first order equations and of linear second order equations

Making judgements To be able to find the most suitable methods to treat the various proposed problems
Communication skills To describe in written form as clearly as possible and in synthetic and precise form the goals, procedure and results of the mathematical techniques learned
Learning skills To apply the learned knowledges to different applied contexts and to further deepen the topics treated by means of new bibliographical tools

Contents

Elements of linear algebra. General characteristics of fucntions of several variables. Partial differentiation. Optimization. Free extremes. Constrained extremes (Lagrange multiplier method). Vector fields and integration along curves. Elementary differential equations.

Detailed program

Vectors: algebraic and geometric. Main operations with vectors: sum, multiplications with scalars, scalar product and metric properties. Cartesian coordinates, lines and planes in three and higher dimensional space.

Vector spaces in general. Vector subspaces. Linear dependence and linear independence of vectors. Dimension of a vector space. Matrices and linear operators. Kernel and range of linear transformation. Inverse and transpose. Determinants. Rank of a matrix. Applications to systems of linear equations. Cramer theorem. Eigenvalues and eigenvectors.

Differential calculus for functions of two and several variables. Graph of a functions, domain, limits and continuity. Partial derivatives and differentiability. Geometric interpretation. Taylor formula. Optimization. Free and constrained extrema.

Curves in R^n, line integrals, vector fields and differential forms. Irrotational vectro fields and their meaning.

Differential equations. Main properties and integration techniques for first order equations and linear second order equations with constant coefficients.

Prerequisites

Mathematics I

Teaching form

42 hours of in-person, lecture-based teaching (6 ECTS)
24 hours of in-person, lecture-based exercises classes (2 ECTS)

This course will primarily use lecture-based teaching to deliver the fundamental concepts of Dynamical Systems and Classical Mechanics. The active interaction between teacher and students will take place through questions, discussions and answers during the lessons and exercise classes.

Textbook and teaching resource

Main text:
Marco Bramanti, Carlo D. Pagani, Sandro Salsa "Matematica. Calcolo infinitesimale e Algebra lineare", Editore Zanichelli

Corresponding exercises:
M.Bramanti, Esercizi di Calcolo infinitesimale e Algebra lineare, Editore Esculapio

Other text:
A. Guerraggio “Matematica per le Scienze”, Editore Pearson

J. Stewart, “Calcolo: Funzioni di più variabili”, Editore Apogeo
M. Bertsch, R. Dal Passo, L. Giacomelli “Analisi Matematica” Editore McGraw-Hill

Further material will be provided by the instructor during the lectures

Semester

II semester 2023-2024

Assessment method

Written examination with optional oral colloquium. Intermediate written exams will be proposed. Students are not committed to do them, but in case they do they are allowed to skip the final complete written examination. 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. In particular, to have a correct assessment, in evaluating the written examination completeness, accuracy and clarity will be taken into account.

Graduation of marks.

18-19: Scarce knowledge, limited to a reduced part of the program.
Exposition and language competence sometimes incorrect, limited ability of critical elaboration of the material.
20-23: Preparation on a limited part of the course with practical ability but limited autonomus elaboration of the material. Language essentially correct but exposition sometimes unclear.
24-27: Preparation on the majoity of the topics of the course with autonomous argumentation and critical analysis. Satisfying ability in the application of the concepts and techniques and correct and clear exposition and use of language.
28 – 30/30L: Preparation complete on the topics of the course. Autonomous ability of treatment and development of the subjects, and of critical analysis of the problems proposed. Ability in establishing connections between different topics, complete control of the language and of the exposition also in case of complex problems and questions.

Office hours

By appointment

Sustainable Development Goals

QUALITY EDUCATION