UNIVERSITÀ DI PAVIA

Anno Accademico 2022/2023

MATHEMATICAL ANALYSIS 3

Enrollment year	2021/2022
Academic year	2022/2023
Regulations	DM270
Academic discipline	MAT/05 (MATHEMATICAL ANALYSIS)
Department	DEPARTMENT OF MATHEMATICS "FELICE CASORATI"
Course	MATHEMATICS
Curriculum	PERCORSO COMUNE
Year of study	2°
Period	1st semester (29/09/2022 - 13/01/2023)
ECTS	9
Lesson hours	84 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	VITALI ENRICO (titolare) - 9 ECTS
Prerequisites	It is necessary to master the main notions and tools of Mathematical Analysis and Linear Algebra dealt with in the courses of the first year, in particular: differential and integral calculus for scalar and vector-valued functions, differential forms, matrices and linear transformations.
Learning outcomes	Expected learning outcomes: (first part) - knowledge of the main basic results about initial value problems for ordinary differential equations, both for scalar and for vector-valued functions. Particular attention will be paid to the case of linear systems; - ability in explicitly solving a few standard types of equations; - ability in applying the theoretical results to the analysis of qualitative features of the solutions of nonlinear differential equations or, more generally, to the analysis of problems involving differential equations; (second part) - knowledge of the main basic results about holomorphic functions;

- ability in facing exercises and problems on the basis of the previous theoretical results.

Course contents

The course consists of two parts: the first one is devoted to the theory of ordinary differential equations and systems; the second part presents the elementary notions of convergence for sequences of functions and introduces to the theory of functions of one complex variable. More extensively:

First part. Models and examples of ODE's. General results concerning existence, uniqueness and continuation of a solution; comparison results; continuous dependence on initial data. Elementary techniques for solving simple differential equations. Linear systems of ODE's: structure of the solutions, exponential matrix. Asymptotic behaviour of dynamical systems, stability (linearisation and Lyapunov method).

Second part. Power series. Complex differentiability and power expansion. Contour integrals. Holomorphic functions and primitives. Cauchy's Theorem. Meromorphic functions and singularities. Complex logarithm. Winding number. Residue theorem and application to the evaluation of integrals. Further elementary properties of holomorphic functions.

NOTE
The course "Equazioni differenziali e sistemi dinamici" (for Physicists) shares 6 CFU from the course "Analisi Matematica 3". Taking the differences between the two degree courses into account, for Physics students an alternative way, with respect to the standard one, will be available for the exam. The exam will consists only of the oral part, the student will be requested to master the statements of the main theoretical results and to elaborate on a specific topic, agreed with the teacher, according to his interests. A list of possible topics will be made available; depending on the needs of the students, suitable tutoring activities will be organized.

Teaching methods

Teaching will be mainly carried out through traditional classes. Supporting tutoring activities will be organized outside the official teaching hours and according to an agreed timetable.

Reccomended or required readings

Some useful references.

(Differential equations)
- C.D. Pagani, S. Salsa: Analisi matematica 2. Zanichelli.
- S. Salsa, A. Squellati: Esercizi di analisi matematica Vol. 2. Zanichelli.
- M. W. Hirsch, S. Smale, R. L. Devaney: Differential equations, dynamical systems, and an introduction to chaos. Pure and Applied Mathematics, Vol. 60. Elsevier/Academic Press, Amsterdam, 2004.

(Complex Analysis)
- E. Stein, S. Shakarchi: Complex Analysis. Princeton University Press, 2003
- R. Narasimhan, Y. Nievergelt: Complex Analysis in One Variable, Birkhauser, 2000

	- R. E. Rodríguez, I. Kra, J. P. Gilman: Complex Analysis: In the Spirit of Lipman Bers (Graduate Texts in Mathematics, 245), Springer - G. Gilardi, Analisi Matematica 3. McGraw- Hill Italia. Lecture notes will be also provided.
Assessment methods	The exam consists in a written test and in an oral part. The first one mainly aims to check the level of knowledge of the principal methods dealt with in the course for the study of ordinary differential equations or for the resolution of some types of problems in Complex Analysis. A threshold mark is needed to pass to the oral part. This latter intends to verify the global understanding of the theoretical framework. NOTE The course "Equazioni differenziali e sistemi dinamici" (for Physicists) shares 6 CFU from the course "Analisi Matematica 3". Taking the differences between the two degree courses into account, for Physics students an alternative way, with respect to the standard one, will be available for the exam. The exam will consists only of the oral part, the student will be requested to master the statements of the main theoretical results and to elaborate on a specific topic, agreed with the teacher, according to his interests. A list of possible topics will be made available; depending on the needs of the students, suitable tutoring activities will be organized.
Further information	Further information on the course and the exam will be made available on the Kiro page of the course.
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile