COURSE OF STUDY	**THREE-YEAR BACHELOR PROGRAMME IN PHYSICS**
ACADEMIC YEAR	**2023-2024**
ACADEMIC SUBJECT	**MATHEMATICAL ANALYSIS II**

General information	
Year of the course	First
Academic calendar (starting and ending date)	Second semester (March 4, 2024 – June 7, 2024)
Credits (CFU/ETCS):	8
SSD	Mathematical Analysis – MAT/05
Language	Italian
Mode of attendance	Not mandatory

Professor/ Lecturer	
Name and Surname	Monica Lazzo
E-mail	monica.lazzo@uniba.it
Telephone	+39 080 544 2503
Department and address	Department of Mathematics (fourth floor, room 6)
Virtual room	Microsoft Teams, code cr3atsa
Office Hours	By appointment, to be scheduled by e-mail

Work schedule			
Hours			
Total	Lectures	Hands-on learning (recitations)	Self-study hours
200	48	30	122
CFU/ETCS			
8	6	2	

Learning Objectives	Acquisition of knowledge and basic tools in Mathematical Analysis useful for the description of physical phenomena.
Course prerequisites	Contents of the courses Mathematical Analysis I; elements of Linear Algebra.

Teaching methods	Lectures and recitations are held in a classroom, using slides partly prepared in advance, partly generated in class. All these slides are made available on the course homepage: **https://www.dm.uniba.it/it/members/lazzo/homepage/analisi-matematica-ii**
Expected learning outcomes in terms of	
Knowledge and understanding on:	Knowledge of basic principles of Mathematical Analysis and theorem proving techniques.
Applying knowledge and understanding on:	Ability to solve problems by utilizing theoretical knowledge and selecting adequate strategies.

Soft skills	• **Making informed judgments and choices**
	  ○ Ability to assess the soundness of the logical reasoning used in a proof
	  ○ Ability to select the appropriate mathematical tools and techniques to deal with complex mathematical problems
	• **Communicating knowledge and understanding**
	  ○ Mastery of the mathematical language and syntax necessary to communicate the acquired knowledge and to describe, analyze and solve problems
	• **Capacities to continue learning**
	  ○ Ability to study independently and to consult and make us of relevant

	literature
Syllabus	
Content knowledge	**Linear differential equations** Linear differential equations. Initial value problems. Superposition principle. Structure of the general solution. Homogeneous equations. Fundamental systems of solutions; Wronski determinant. Variation of constants to to find particular solutions of nonhomogeneous equations. Linear differential equations with constant coefficients: determination of a fundamental system of solutions for a homogeneous equation; method of undetermined coefficients to find particular solutions of nonhomogeneous equations. Euler equations. **Functions of several variables** Elements of topology in euclidean spaces. Convex, star-shaped, polygonally connected, path-connected, simply connected sets. Real-valued and vector-valued functions of several variables. Continuous functions; global properties. Directional and partial derivatives. Total derivative. Tangent plane. Jacobian matrix. Hessian matrix. Schwarz theorem. Differentiation rules. Chain rule. Mean value theorem. Taylor’s formula. **Constrained and unconstrained optimization** Local extrema, stationary points. Fermat’s theorem. Necessary conditions and sufficient conditions for local extrema. One-dimensional and two-dimensional constraints. Implicit function theorem. Lagrange multipliers theorem. **Multiple integrals** Measurable sets in the sense of Peano-Jordan. Riemann integrable functions; Riemann integrals. Integration methods for double and triple integrals. Volume of solids of revolution. Change of variables formula. Polar coordinates; spherical and cylindrical coordinates. **Line integrals and surface integrals** Parametric curves. Change of parameters. Length of a curve. Line integrals of scalar functions and of vector fields. Differential forms. Closed and exact differential forms. Parametric surfaces. Surface area. Surfaces of revolution. Surface integrals. Flux of a vector field across a surface. Gauss-Green theorem in the plane. Divergence theorem. Stokes theorem. A more detailed description of the course contents will be available before the end of the semester on the course homepage.
Texts and readings	• G.C. Barozzi, G. Dore, E. Obrecht, Elementi di analisi matematica Volume 2, Zanichelli • V. Barutello, M. Conti, D.L. Ferrario, S. Terracini, G. Verzini, Analisi matematica Volume 2, Apogeo • N. Fusco, P. Marcellini, C. Sbordone, Analisi Matematica due, Liguori Editore • E. Giusti, Analisi Matematica 2, Boringhieri • C.D. Pagani, S. Salsa, Analisi matematica 2, Zanichelli • L. Recine, M. Romeo, Esercizi di analisi matematica Vol. II, Maggioli Editore • W. Rudin, Principles of Mathematical Analysis, McGraw-Hill
Notes, additional materials	
Repository	Slides, lecture notes, problem sheets, etc posted on the course homepage

Assessment	
Assessment methods	Written test and oral exam; passing the written test is a prerequisite for taking the oral exam. The written test (no more than three hours) consists of four to six problems. Instead of the written test, students can take two partial written tests, the first

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<tr><td></td><td>during the semester break (see “Manifesto degli Studi”), the second between the end of classes and the beginning of the exam session. The results of the written test are published on the course homepage.
The oral exam starts with the discussion of the student’s work on the written test, followed by the discussion of theoretical results, examples, counterexamples and short problems.</td></tr>
<tr><td>Assessment criteria</td><td>• Knowledge and understanding
o The student must be able to explain definitions and theoretical results, including some proofs.
• Applying knowledge and understanding
o The student must be able to solve problems and to independently construct simple arguments of proof.
• Autonomy of judgment
o The student must be able to select the theoretical and practical tools most appropriate for the given problems.
• Communicating knowledge and understanding
o The student must be able to explain theoretical results clearly and completely, using precise mathematial language and syntax.
• Capacities to continue learning
o The student must know the specific terminology of the course material and must be able to identify the context of each concept.</td></tr>
<tr><td>Final exam and grading criteria</td><td>The final grade is based on 30 points; the minimum passing grade is 18.
The final grade is determined by both the written test and the oral exam; for details see the course homepage.</td></tr>
<tr><td>Further information</td><td></td></tr>
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