

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

General information	
Year of the course	Second
Academic calendar (starting and ending date)	First semester (September 18, 2023 – December 22, 2023)
Credits (CFU/ETCS):	6
SSD	Mathematical Analysis – MAT/05
Language	Italian
Mode of attendance	Not mandatory

Professor/ Lecturer	
Name and Surname	Monica Lazzo
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Department and address	Department of Mathematics (fourth floor, room 6)
Virtual room	Microsoft Teams, code 5y3piw0
Office Hours	By appointment, to be scheduled by e-mail

Work schedule			
Hours			
Total	Lectures	Hands-on learning (recitations)	Self-study hours
150	32	30	88
CFU/ETCS			
6	4	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 and II; 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-iii
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	<ul style="list-style-type: none"> • Making informed judgments and choices <ul style="list-style-type: none"> ○ 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 <ul style="list-style-type: none"> ○ Mastery of the mathematical language and syntax necessary to communicate the acquired knowledge and to describe, analyze and solve problems • Capacities to continue learning

	<ul style="list-style-type: none"> ○ Ability to study independently and to consult and make use of relevant literature
Syllabus	
Content knowledge	<p>Metric spaces Basic topology in metric spaces. Convergence in metric spaces. Cauchy sequences; completeness. Contraction mapping theorem. Normed spaces; Banach spaces. Series in normed spaces.</p> <p>Sequences and series of functions Pointwise and uniform convergence. Uniform convergence and boundedness, continuity, integration, differentiation. Completeness of some metric spaces of bounded, continuous, or differentiable functions. Power series. Interval of convergence and radius of convergence. Properties of power series: continuity, integrability, differentiability. Taylor series. Analytic functions. Applications of power series: estimation of definite integrals, power series solutions of linear differential equations. Fourier series. Pointwise and uniform convergence. Bessel inequality and Riemann-Lebesgue theorem.</p> <p>Differential equations Local existence and uniqueness for differential equations in normal form. Continuous dependence on data. Continuation of solutions; maximal solutions; global solutions. Global existence and uniqueness for sublinear differential equations. Solution methods for some classes of nonlinear first-order differential equations: separable equations, homogeneous equations, Bernoulli equations; exact differential equations and integrating factors. Qualitative analysis of some differential equations.</p> <p>A more detailed description of the course contents will be available before the end of the semester on the course homepage.</p>
Texts and readings	<ul style="list-style-type: none"> • 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	<p>Written test and oral exam; passing the written test is a prerequisite for taking the oral exam.</p> <p>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 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.</p> <p>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.</p>
Assessment criteria	<ul style="list-style-type: none"> • Knowledge and understanding <ul style="list-style-type: none"> ○ The student must be able to explain definitions and theoretical results, including some proofs.

	<ul style="list-style-type: none"> • Applying knowledge and understanding <ul style="list-style-type: none"> ○ The student must be able to solve problems and to independently construct simple arguments of proof. • Autonomy of judgment <ul style="list-style-type: none"> ○ The student must be able to select the theoretical and practical tools most appropriate for the given problems. • Communicating knowledge and understanding <ul style="list-style-type: none"> ○ The student must be able to explain theoretical results clearly and completely, using precise mathematical language and syntax. • Capacities to continue learning <ul style="list-style-type: none"> ○ The student must know the specific terminology of the course material and must be able to identify the context of each concept.
Final exam and grading criteria	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.
Further information	