UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

DIPARTIMENTO INTERUNIVERSITARIO DI FISICA

General information		
Academic subject	**Mathematical Analysis III**	
Degree course	Physics (L-30)	
Academic Year	second	
European Credit Transfer and Accumulation System (ECTS)	6	
Language	Italian	
Academic calendar (starting and ending date)	September 19 – December 16, 2022	
Attendance	recommended	

Professor/ Lecturer	
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Department and address	Department of Mathematics (fourth floor, room 6)
Virtual headquarters (Microsoft Teams code)	Microsoft Teams, code 5y3piw0
Tutoring (time and day)	By appointment, to be scheduled by e-mail

Syllabus	
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
Contents	**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. **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. **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. **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. A more detailed description of the course contents will be available before the end of the semester on the course homepage (**https://www.dm.uniba.it/members/lazzo/homepage/analisi-matematica-iii**)
Books and bibliography	• 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 • W. Rudin, Principles of Mathematical Analysis, McGraw-Hill
Additional materials	Slides, lecture notes, problem sheets, etc posted on the course homepage

Work schedule			
Total	Lectures	Hands on (Recitations)	Out-of-class study hours/ Self-study hours
Hours			
150	32	30	88
ECTS			
6	4	2	

Teaching strategy	
	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.

Expected learning outcomes	
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

Assessment and feedback	
Methods of assessment	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 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.
Evaluation criteria	• **Knowledge and understanding** ○ The student must be able to explain definitions and theoretical results, including some proofs. • **Applying knowledge and understanding** ○ The student must be able to solve problems and to independently construct simple arguments of proof. • **Autonomy of judgment** ○ The student must be able to select the theoretical and practical tools most appropriate for the given problems.

	• **Communicating knowledge and understanding** ○ The student must be able to explain theoretical results clearly and completely, using precise mathematial language and syntax. • **Capacities to continue learning** ○ The student must know the specific terminology of the course material and must be able to identify the context of each concept.
Criteria for assessment and attribution of the final mark	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.
Additional information	