

Academic subject: Mathematical Analysis 2			
Degree Class: L-35- Scienze Matematiche		Degree Course: Mathematics	
		Academic Year: 2019/2020	
		Kind of class: mandatory	
		Year: 1	Period: 2
		ECTS: 8 divided into ECTS lessons: 5 ECTS exe: 3	
Time management, hours, in-class study hours, out-of-class study hours lesson: 40 exe: 30 in-class study: 70 out-of-class study: 130			
Language: Italian		Compulsory Attendance: no	
Subject Teacher: Silvia Romanelli (in collaboration with Dr. Sandra Lucente)		Tel: +390805443616 e-mail: silvia.romanelli@uniba.it	
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		Office days and hours: Tuesday, Thursday 1.0 p.m. - 2:00 p.m. for appointment via email	
Prerequisites: Mathematical knowledge acquired in the course of Mathematical Analysis 1.			
Educational objectives: Acquiring basic notions of Mathematical Analysis, in particular concerning continuity, differential calculus and integration for one variable real functions.			
Expected learning outcomes (according to Dublin Descriptors)		<p>Knowledge and understanding: Acquiring fundamental concepts and results of Mathematical Analysis. Acquiring main tools and proof techniques.</p> <p>Applying knowledge and understanding: The acquired theoretical knowledge is the essential background for understanding and using the techniques necessary in the mathematical applications.</p> <p>Making judgements: Ability to analyze the consistency of the logical arguments used in a proof, problem solving skills and ability to choose suitable mathematical tools consistent with the theoretical knowledge.</p> <p>Communication: Acquiring mathematical language and formalism necessary to read and understand textbooks, to explain the acquired knowledge, and to describe, analyze and solve problems.</p> <p>Lifelong learning skills: Acquiring suitable learning methods, supported by consultation of texts and by solving exercises and problems related to the contents of the course.</p>	
Course program			
<p>1. Continuous functions (Part 2): Points of discontinuity and their classification. Continuity of the inverse function of a continuous function defined on an interval, or in a bounded and closed set. Lower semicontinuous functions, upper semicontinuous functions. Generalized version of the Weierstrass theorem. Hoelder functions.</p> <p>2. Differentiation: Derivative of a real function. Geometrical and cinematic examples. Theorems on differentiation, continuity of differentiable functions. Chain rule. Derivative of the inverse function. Elementary functions and their derivatives. Tangent line to a function graph. Local minimum, maximum of a function. Stationary points. Properties of differentiable functions in an interval: Rolle, Cauchy, Lagrange theorems. Monotonicity criteria. Functions with vanishing derivative. De l'Hospital theorems. Taylor approximation formula with Peano remainder and with Lagrange remainder. Sufficient conditions for existence of local minimum, maximum. Taylor polynomials for elementary functions. Relations between Taylor polynomials and the sum of Taylor series (short notes). Convex functions in</p>			

intervals. Regularity of convex functions. Differentiable convex functions and their properties. Study of a function graph.

3. Integration: Riemann integrability of real functions. Pluri-rectangles, area of a rectangloid. Integrability of monotonic functions. Integrability of continuous functions. Properties of Riemann integrals. Mean value theorem. Definite integrals. Integral functions. Primitives and indefinite integrals. Existence of primitives of a continuous function. Fundamental theorems of calculus and their applications. Integration methods for rational functions. Integration by parts. Integration by substitution. Taylor formula with the integral remainder. Improper integrals: integration on the half-line, or of an unbounded function on a bounded interval. Comparison tests. Integral criterion for numerical series. Convergence and absolute convergence. The Euler Gamma function (short notes).

4. Numerical series: Definition of series and generalities. Mengoli series. Telescoping series. Geometric series. Applications to the decimal representation of real numbers. Harmonic series. Necessary condition for the convergence of a series. Cauchy criterion for the convergence of a series. The character of a series is invariant with respect to the change of a finite number of terms. Series with nonnegative terms. Comparison tests. Asymptotic comparison test. Generalized harmonic series. Infinitesimal comparison test. Root test, ratio test. Absolutely convergent series. Alternating series. Leibnitz test for alternating series. Harmonic alternating series. Integral test. Cauchy product of series (short notes). Rearrangements for absolutely convergent series (short notes). Infinite products (short notes). Sequences and series of complex numbers (short notes).

Teaching methods:

Lectures and exercise sessions

Auxiliary teaching:

Didactic material available at

<http://www.dm.uniba.it/~lucente/didattica/appuntiA12/appuntiA12.htm>

Assessment methods:

Written and oral exam. Joint exam with Mathematical Analysis 1

Bibliography:

P. Marcellini, C. Sbordone, *Analisi Matematica uno*, Liguori Editore

E. Acerbi, G. Buttazzo, *Primo corso di Analisi Matematica*, Pitagora Editore

P. Marcellini, C. Sbordone, *Esercitazioni di Matematica*, vol. I Parte 1, Parte 2, Liguori Editore

A. Alvino, L. Carbone, G. Trombetti, *Esercitazioni di Matematica I/1,2* Liguori Editore