Academic subject: Mathematical Analysis 2				
Degree Class: L-35- Scienze Matematiche		**Degree Course:** Mathematics	**Academic Year:** 2020/2021	
		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: Prof. Silvia Cingolani (in collaboration with Dr. Biagio Cassano and Dr Marco Gallo)	**Tel:** +390805442660 **e–mail:** silvia.cingolani@uniba.it	**Office:** Department of Mathematics Room 11, Floor II	**Office days and hours:** Tuesday 3:30 p.m. - 6:30 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 Series, Continuous functions, Differentiation and Integration for one variable real functions.				
Expected learning outcomes (according to Dublin Descriptors)	**Knowledge and understanding:** Acquiring fundamental concepts and results of Mathematical Analysis. Acquiring main tools and proof techniques. **Applying knowledge and understanding:** The acquired theoretical knowledge is the essential background for understanding and using the techniques necessary in the mathematical applications. **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. **Communication:** Acquiring mathematical language and formalism necessary to read and understand textbooks, to explain the acquired knowledge, and to describe, analyze and solve problems. **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.			

Course program

1.Continuous functions (II)
Weierstrass theorem. Upper semicontinuous functions and lower semicontinuous functions. Generalized Weierstrass theorem. Uniform continuity and Cantor theorem. Lipschitz functions. Hoelder continuous functions.

2.Differentiation
Derivative of a real function. Geometrical and cinematic examples. Theorems on the continuity of differentiable functions. Algebraic operations and derivatives. 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 test for differentiable functions. The theorems of de l'Hospital. Functions with vanishing derivative. The Taylor' s approximation formula with Peano remainder and with Lagrange remainder. Sufficient conditions for existence of local

local minimum or local maximum of a function. Convex functions in intervals. Regularity of convex functions. Differentiable convex functions and their properties. The test of the second derivative for the of convexity of a function. Inflection points. Study of the graph of a function.

3.Numerical series

Definition of series and generalities. The character of a numerical series: convergent series, divergent series, irregular series. 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 remainder series of a numerical series and the relative theorem. Numerical 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). Relations between Taylor polynomials and the sum of Taylor series (short notes).

4.Integration

Riemann integration and Riemann integrals of real functions. Pluri-rectangles, area of a pluri-rectangle. 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).

Teaching methods:

Lectures and exercise sessions.

Auxiliary teaching:

Didactic material available at platform Microsoft Teams.

Assessment methods:

Written and oral exam. Joint exam with Mathematical Analysis 1.

Bibliography:

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

E. Giusti, Analisi Matematica 1, Bollati Boringhieri Editore

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

E. Giusti, Esercitazioni e complementi di Analisi Matematica 1, Bollati Boringhieri Editore

P. Marcellini, C. Sbordone, Esercitazioni di Analisi Matematica, Vol 1, (Parte 1, Parte 2), Liguori Editore