<table>
<tr><td colspan="5">Academic subject: Mathematical Analysis 1</td></tr>
<tr><td colspan="2">Degree Class: L-35- Scienze Matematiche</td><td colspan="1">Degree Course:
Mathematics</td><td colspan="2">Academic Year:
2018/2019</td></tr>
<tr><td colspan="2"></td><td>Kind of class:
mandatory</td><td>Year:
1</td><td>Period:
1</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">ECTS: 8
divided into
ECTS lessons: 5
ECTS exe/lab/tutor: 3</td></tr>
<tr><td colspan="5">Time management, hours, in–class study hours, out–of–class study hours
lesson: 40 exe/lab/tutor: 55 in–class study: 95 out–of–class study: 105</td></tr>
<tr><td>Language:
Italian</td><td>Compulsory Attendance:
no</td><td colspan="3"></td></tr>
<tr><td>Subject Teacher:
Silvia Romanelli
(in collaboration with Prof. Enrico Jannelli and Dr. Sandra Lucente)</td><td>Tel: +390805443616
e–mail:
silvia.romanelli@uniba.it</td><td>Office:
Department of Mathematics
Room 9, Floor II</td><td colspan="2">Office days and hours:
Tuesday, Thursday
1:00 p.m. - 2:00 p.m. for appointment via email</td></tr>
<tr><td colspan="5">Prerequisites:</td></tr>
<tr><td colspan="5">Educational objectives:
Acquiring basic notions of Mathematical Analysis, in particular concerning generalities on real functions, sequences and series.</td></tr>
<tr><td>Expected learning outcomes (according to Dublin Descriptors)</td><td colspan="4">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.</td></tr>
<tr><td colspan="5">Course program

1. Preliminaries: Set theory preliminaries. Inclusion, union, intersection, complement set and Cartesian product. Injective, surjective, bijective functions. Function composition, invertibility and inverse function. Ordered sets, minimum, maximum, lower bound, upper bound, greatest lower bound, least upper bound and their properties. The set of natural numbers N, the set of integers Z, the set of rational numbers Q and their structures. The principle of induction. Ordered fields. Construction of the set of real numbers R. The complete ordered field of real numbers and its properties. Density of Q and its complement set in R. R is Archimedean. Finite, infinite, denumerable sets. Newton binomial. Bernoulli inequality. Absolute value, metrics and intervals of R. Connected sets. Cluster points and closed sets. Complex numbers. Bounded functions. Monotonicity, symmetry and periodicity of a function. Construction of some elementary functions, properties and graphs. Elementary operations on function graphs. Integer, rational, irrational, transcendental inequalities.</td></tr>
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2. Numerical sequences: Regular sequences and their limits. Operations with regular sequences and their limits. Every convergent sequence is bounded. Inequalities for sequences and for their limits. Squeeze/sandwich rule and comparison for sequences. Theorem on the limit of a monotonic sequence. Neper number. Subsequences and their limits. Minimum, maximum limit of a sequence and their properties. Limit points of a sequence. Theorem about the minimum, maximum limit point of a sequence. Bolzano-Weierstrass theorem about bounded numerical sequences. Compact sets of R and their properties. Cauchy sequences. Cauchy criterion for the convergence of sequences. Ratio test for limits of sequences. Cesaro criteria (arithmetic/geometric mean, n-th root). Recurrence definition for sequences.

3. Limits of functions: Limits of functions and first theorems on limits. Relations between limits of functions and limits of sequences. Left, right limits. Limits of monotonic functions. Theorem on locally boundedness of convergent functions. Theorem on inequalities between functions and their limits, applications. Squeeze/sandwich rule and comparison for series. Limits of elementary functions. Minimum, maximum limit of a function. Significant limits. Infinite and infinitesimals. Neglegible terms. Asymptotes.

4. Continuous functions: Continuous functions and their elementary properties. Points of discontinuity and their classification. Sequentially continuous functions. Weierstrass Theorem. Bolzano Theorem. Continuous functions on intervals and their image. 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. Uniform continuity and Cantor theorem. Lipschitz functions. Hoelder functions.

Teaching methods:
Lectures and exercise sessions

Auxiliary teaching:
Didactic material available at
http://www.dm.uniba.it/~lucente/didattica/appuntiA12/appuntiA12.htm
http://www.dm.uniba.it/~jannelli/didattica/analisi1/analisi1.htm

Assessment methods:
Written and oral exam. Joint exam with Mathematical Analysis 2

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