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# MATHEMATICAL ANALYSIS I M - Z

MAT/05 - 9 CFU - 1° Semester

## Teaching Staff

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## LEARNING OBJECTIVES

The course aims to provide the basic knowledge of the infinitesimal differential and integral calculus of functions of one variable.

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## DETAILED COURSE CONTENT

**Numerical sets.** The system of natural numbers and its extensions. Real numbers.

Bounded and unbounded numerical sets. Least upper bound and greatest lower bound.

**The concept of function.** Domain and range of a function. Graphical representation. Injective, surjective functions. The composite function. Inverse function. Monotonic functions.

The elementary functions: rational, algebraic, trigonometric, exponential and logarithmic functions.

**Limits of functions. Continuous functions.** The topology of the real line. Limits of functions. Operations with limits. Some special limits. Continuous functions. Theorems on continuous functions. The intermediate value theorem. The Weierstrass theorem.

**Numerical sequences and series.** Sequences of Real Numbers. Definitions of convergence and divergence. Some special sequences. The monotone sequences theorem. The number  $e$ . Subsequences. Series. Series with nonnegative terms. The harmonic series. The geometric series. The comparison, root and ratio tests. The asymptotic comparison test. Alternating series. The Leibnitz's criterion.

**Derivatives and differential calculus of a real function.** The derivative of a real function. The geometrical and mechanical significance. Rules for the derivation. The chain rule. The derivative of inverse function. Local extrema. The Fermat, Rolle, Lagrange's theorems and their consequences. The

L'Hopital's rule. Higher derivatives. Convex functions. Inflection points.

**Indefinite Integrals and the Riemann integral.** The concept of anti-derivative of a real function. Indefinite integrals. Integration by substitution and by parts. Integration of rational functions. Upper and lower sums. The Riemann integral. Functions Riemann integrable. The geometrical significance of the Riemann integral. The mean value Theorem. The fundamental theorem of the Calculus. Improper integrals.

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## **TEXTBOOK INFORMATION**

1. M. Bertsch, R. Dal Passo, L. Giacomelli, *Analisi Matematica*, Mc Graw Hill
  2. G. Fiorito, *Analisi Matematica 1*, Spazio Libri
  3. P. Marcellini, C. Sbordone, *Analisi Matematica 1*, Liguori
  5. M. Bramanti, *Esercitazioni di Analisi Matematica 1*, Esculapio
  6. T. Caponetto, G. Catania, *Esercizi di analisi Matematica 1*, Culc.
  7. P. Marcellini, C. Sbordone, *Esercitazioni di Matematica*, Vol.1, Parte I e II, Liguori
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