UNIVERSITA' DEGLI STUDI MEDITERRANEA DI REGGIO CALABRIA

Subject Code	**56T047**
Subject Name	**Mathematical Analysis I**
Professor	**Pasquale Candito**
Department:	**DICEAM**
Degree course:	**Civil and Environmental Engineering**
Class:	**L-7**
Type of educational activity:	**Basic**
Disciplinary Area:	**Mathematical Analysis**
Scientific-Disciplinary Sector:	**MAT/05 Mathematical Analysis**
Compulsory preliminary exams:	**None**
Course Year:	**I**
Semester:	**I**
ECTS:	**9**
Hours:	**72**

Synthetic description:
This course provides a rigorous treatment of the fundamental concepts of differential and integral calculus for real functions of a single variable, as well as aims to introduce students to a correct writing and communication of mathematics. Topics include: real numbers, limits, sequences and series of real numbers, continuity, compactness. The fundamental theorems on continuous functions, differentiation, and the mean value theorem. Riemman Integral.

Acquisition of knowledge on:
The aim of the course is to introduce the Students to the main topics of the Mathematical Analysis for functions of a single real variable as: limits, derivatives and integrals.
The Students will be supported in order to reach a suitable ability in:

- the understanding of the theoretical aspects
- the use of the elementary tools of the calculus.

After successfully completing this course the Students should be able to communicate in an appropriate scientific language the notions learned, as well as to make a critical synthesis of them, when they are required to solve problems and exercise of different type.

Evaluation method:
A written test and an oral

Student's independent work
During the period of the lessons will be proposed to the students questionnaires and themes for further exploration of the topics covered in the class. In this way, we intend to drive student's independent work in order to facilitate learning, consolidating and deepening of the topics studied. In addition, this activity helps the student to successfully completing the course.

Detailed course program

I. Sets and operations on them. Sets of numbers. Upper and Lower Bounds. Completeness. Complex numbers. The concept of a function. Real functions and basic properties. The graph of a function. Operations on functions and elementary operations on the graphs. Elementary functions.

II. Limit of a real function and basic properties. Theorems on limits: uniqueness and sign of the limit. Comparison theorems. Limits of monotone functions. Algebra of limits and indeterminate forms. Fundamentals limits. Asymptotes. Infinitesimal and infinite functions.

III. Continuous functions. Points of discountinuity. Properties of the continuous functions. Global properties of continuous functions: Intermediate value theorem. Zeros of a function. Roots of a numerical equation. Weierstrass Theorem. Uniform Continuity.

IV. Derivative of a function of one real variable and its geometric and kinematic meaning. Tangents. Derivatives of elementary functions and basic rules of derivation. Derivability and continuity. Extrema and critical points. Fermat's Lemma, Rolle's Theorem. The theorems of Cauchy and Lagrange and their geometrical meaning. Monotony and derivability. Functions with zero derivative. Nondifferentiable functions: cups and points of vertical tangency.

V. Differential and linear approximations. Higher-order derivatives. L'Hôpital rule. Taylor and McLaurin formulas. Approximation of functions by polynomials. Limits and Taylor's formula.

VI. Convex and concave functions. Inflection points. Basic properties of Lipschiz functions. Qualitative study of a function. Maxima and minima problems.

VII. Definition of Reimann integral. Geometric meaning. Properties of definite integrals. Integral mean value. Indefinite integral and its properties. Antiderivatives. The Fundamental Theorem of integral calculus. Rules of indefinite integration. Integrating rational maps. Integration by part. Table of primitives.

VIII. Improper integrals. Unbounded domains of integrations. Unbounded integrands. Basic examples. Comparison theorems. Asymptotic comparison test.

IX. Limit of a sequence. Uniqueness and sign of the limit. Relationship between limit of a function and limit of sequences. Fundamentals limits. Existence of the limit of a monotone sequence. Numerical series. Basic examples: geometric series, Mengoli's series, generalized armonic series. Cauchy's criterion. The necessary condition for the convergence. Positive-term series. Comparison test. Asymptotic comparison test Ratio test. Root test. Absolute convergence. Convergence of alternating series. Leibniz's Criterion*.*

Resources and main references

- M. Bertsch, R. Dal Passo, L. Giacomelli, Analisi Matematica, McGraw-Hill, Milano 2007.
- M. Bramanti C. D. Pagani S. Salsa, Analisi Matematica I e II, Zanichelli, 2009 Bologna.
- N. Fusco, P. Marcellini, C. Sbordone, Elementi di Analisi Matematica uno, Liguori Editore, Napoli 2001.

- Ajroldi Vasconi, E. Grassini Raffaglio, F. Buzzetti, Esercizi di Analisi Matematica I, Masson, 1993, Milano.
- Claudio Canuto, Anita Tabacco, Mathematical Analysis I, Springer 2008.
- Vladimir A. Zorich, Mathematical Analysis I, Springer 2008.

Further insights

- C. D. Pagani S. Salsa, Analisi Matematica, vol. I e II, Masson, 1993 Milano.