**Mathematical Analysis I**

Prof. Marco Degiovanni

***COURSE AIMS AND INTENDED LEARNING OUTCOMES***

To teach students the main elements of topology and one-dimensional infinitesimal calculus.

At the end of the course, students will know the basic structure of the real number set, and will be able to calculate limits, derivatives and integrals of real functions of a real variable and study its graph.

***COURSE CONTENT***

- Rudiments of logic. Propositions and connectives. Predicates and quantifiers. Essential elements of set theory.

- Supremum and infimum. Natural numbers, integers and rational numbers. Archimedean property and density of rational numbers. Newton's binomial formula.

- Continuity of real functions of one real variable. Neighbourhoods and their properties. Limits of real functions of one real variable. Overview of upper and lower limits. Sequences. Zero point existence theorem, inverse function theorem and Weierstrass's theorem. Uniform continuity. Exponential and trigonometric functions. Series of real terms. Series of positive real terms. Comparison, root and ratio criteria. Absolutely converging series. Leibniz criterion. Complex numbers. Extensions to the complex case.

- Derivative of real functions of a real variable. Rolle's theorem, Cauchy's theorem and Lagrange's theorem. Applications to the study of function. L’Hôpital's theorems. Taylor's formula. Convex functions. Extensions to the complex case.

- Riemann's theory of integration. Integrability of monotone and continuous functions. The fundamental theorem of integral calculus. Primitives. Formulas for integration by substitution and integration by parts. Improper integrals and relation with series. Extensions to the complex case.

- First-order linear differential equations. Second-order linear differential equations with constant coefficients. Separable differential equations.

***READING LIST***

E. Acerbi & G. Buttazzo, *Primo corso di Analisi matematica*, Pitagora Editrice, Bologna, 1997.

J.P. Cecconi & G. Stampacchia, *Analisi matematica I: Funzioni di una variabile,* Liguori, Naples, 1974.

C. Citrini, *Analisi matematica I,* Boringhieri, Turin, 1991.

G. Gilardi, *Analisi Uno,* McGraw-Hill Italia, Milan, 1992.

E. Giusti, *Analisi matematica I,* Boringhieri, Turin, 1984.

C. D. Pagani & S. Salsa, *Analisi matematica volume 1,* Masson, Milan, 1990.

G. Prodi, *Analisi matematica,* Boringhieri, Turin, 1970.

Lecture notes are also handed out on the various course subjects.

***TEACHING METHOD***

Lectures and supplementary teaching in class.

***ASSESSMENT METHOD AND CRITERIA***

The exam takes place in two parts, both of which are compulsory for all students:

. a written exam (partial test);

. an oral exam; to be allowed to take the oral exam, students must have passed the written test.

The written exam will include some exercises aiming to verify the candidate’s acquisition of the elementary skills concerning Mathematical Analysis I, and their ability to apply them to situations similar or identical to those illustrated during the integrated learning hours. The assessment of the written test will take into account the accuracy of the results and of the procedures to elaborate them, together with the quality of their exposition.

The oral test aims to verify the student’s level of assimilation of the concepts, results and procedures illustrated throughout the Mathematical Analysis I course. Students will be thus asked to expose and discuss some of the points of the syllabus; they may also be asked to identify any connections between the several parts of the syllabus itself.

The assessment of the oral test will take into consideration the following aspects: the accuracy of the illustrated procedures, their logical and methodological rigour, the explanatory efficacy and accuracy. The final evaluation will also reward the candidate’s assimilation of the concepts and their own personal elaboration.

***NOTES AND PREREQUISITES***

Since this is an introductory course, there are no specific prerequisites.

Further information can be found on the lecturer's webpage at http://docenti.unicatt.it/web/searchByName.do?language=ENG or on the Faculty notice board.