Academic subject: PRECORSO

Degree Class: L-35 - Scienze matematiche		**Degree Course:** Mathematics	**Academic Year:** 2020/2021
		Kind of class: mandatory	**Year:** 1 / **Period:** 1
			ECTS: 2 divided into **ECTS lessons: 2** **ECTS exe/lab/tutor: 0**

Time management, hours, in–class study hours, out–of–class study hours
lesson: 50 exe/lab/tutor: 0 in–class study: 50 out–of–class study: 50

Language: Italian	**Compulsory Attendance:** yes		
Subject Teacher: Margherita Barile	**Tel:** +39 080 5442204 **e–mail:** margherita.barile@uniba.it	**Office:** Department of Mathematics 2nd floor, room 23	**Office days and hours:** By appointment

Prerequisites:
High school mathematics.

Educational objectives:
Completing prerequisites for the first-year university courses.

Expected learning outcomes (according to Dublin Descriptors)

Knowledge and understanding:
Becoming familiar with the mathematical language.

Applying knowledge and understanding:
Translating mathematical statements from the verbal into the symbolic language, and conversely.

Making judgements:
Proving or disproving propositions.

Communication:
Expressing mathematical contents orally.

Lifelong learning skills:
Reading a mathematical text.

Course Program

General form of a theorem. Hypothesis, thesis, implication (truth tables, the "ex falso quodlibet" principle). Examples of proof and disproof. Indirect proofs (by contradiction and by contraposition). Negation of conjunctive and disjunctive propositional forms. Necessary and sufficient conditions. The double implication or equivalence.
Sets defined by properties. Inclusion and equality as a double inclusion. Strict inclusion. Distinct sets. Union, intersection, difference. The empty set. Disjoint sets. Euler-Venn diagrams. Proof of some simple set-theoretical relations and identities. The minimum principle and the induction principle and their application to arithmetical propositions. Relevance of the basis of induction.
Cardinalities of finite sets. Infinite sets. Countable sets. Cartesian product of sets. Cardinality of the Cartesian product of a finite family of finite sets. Permutations of n elements. A recursive formula for $n!$. Combinations of k elements out of n. The power set of a set and its cardinality in the finite case (formula proven by induction). The combinatorial role of the binomial coefficients in the binomial theorem. Elements of binary arithmetic.
Relations between the elements of two sets. Binary relations on a set. Reflexive, symmetric, antisymmetric and transitive relations. Equivalence relations and order relations. Equivalence classes and their properties. Partitions. The quotient set as a partition. The equivalence relation defined by a partition.
Functional relations and functions; the graph of a function. Basic examples: the identity function and constant functions. Direct and inverse image of a subset: properties. Injective functions and their characterization. The natural injection. Surjective functions: definition and characterizations. Examples: the natural surjection onto the quotient set. Bijective functions and their characterizations. Composition of functions. Properties of the composition of functions. Invertible functions. Inverse functions and their characterization.

The set **R** of real numbers and its one-to-one correspondence with the Cartesian line. The Cartesian coordinate system in the plane. The one-to-one correspondence between the Cartesian plane and the ordered pairs of real numbers. Geometric loci and examples. Distance between two points and their midpoint. Cartesian equation of a line; explicit equation of a line; geometric meaning of the slope.
Point-slope form of the equation of a line. Parallel lines and their characterizations. Perpendicular lines and their characterizations. The circle as a geometric locus. Equation of a circle with given center and radius. Positions of a line with respect to a circle. Geometric properties of a tangent line to a circle. The parabola as a geometric locus. Parabolas with a horizontal or a vertical axis.
Composition laws. The set **N** of natural numbers, the successor function, the zero and the unit. The properties of the sum and the product in **N**. Bases, divisors and prime numbers. The total order relation on **N** is a well-order.
The set **Z** of integer numbers. The additive group on **Z**. The total order relation on **Z** is not a well-order. The set **Q** of rational numbers expressed as fractions. **Q** is a field. The order on **Q** and its density in itself. The representation of rational numbers by their decimal expansions. Examples of non-periodical decimal expansions. An example of an equation not solvable in **Q**.
The axioms of ordered and complete field. There is a set fulfilling the field axioms and having **Q** as a subset. Representation of **R** by an isomorphism on the line.
Representation of **R** by means of decimal expansions. Approximation and rounding off. Powers, monomial, polynomials. Operations in the set of polynomials with real coefficients. Divisibility of a polynomial by a first-degree binomial. Ruffini's rule. Decomposition of a polynomial with real coefficients into the product of linear and quadratic polynomials with negative discriminant. Introducing the Fundamental Theorem of Algebra.

Teaching methods:
(Online) lectures.

Auxiliary teaching:
Material available on line:

- Lecture notes
- Additional material uploaded onto the web

Assessment methods:
Written test.

Bibliography:
Any textbook referring to the "precorso di matematica".