UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

CONSIGLIO INTERCLASSE IN MATEMATICA

General information	**Academic year 2022-2023**
Academic subject	**Introduction to the mathematical language**
Degree programme	Mathematics
Programme year	First
Term	First semester (September 12, 2022 – September 30, 2022)
European Credit Transfer and Accumulation System credits (ECTS)	2
Language	Italian
Attendance	Compulsory

Lecturers	
Name and surname	Margherita Barile
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Department and office	Department of Mathematics, room 23 second floor
Virtual meeting room	Microsoft Teams: https://teams.microsoft.com/l/meetup-join/19%3a4b62fc7a7ab141a98e3496452f9018f8%40thread.tacv2/1632299006072?context=%7b%22Tid%22%3a%22c6328dc3-afdf-40ce-846d-326eead86d49%22%2c%22Oid%22%3a%225ee1ce70-f7bd-45a4-b8eb-efa569f45c50%22%7d
Web page	https://www.dm.uniba.it/members/barile
Office hours	By appointment: a virtual meeting on Microsoft Teams can be requested by e-mail.
Name and surname	Amedeo Altavilla
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Department and office	Department of Mathematics, room 14 second floor
Virtual meeting room	Microsoft Teams (see above)
Web page	https://www.dm.uniba.it/members/altavilla
Office hours	Thursday 15:00 – 16:00 or by appointment via e-mail
Name and surname	Gabriele Mancini
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Telephone	+39 080 544 2676
Department and office	Department of Mathematics, room 30 second floor
Virtual meeting room	Microsoft Teams (see above)
Web page	https://www.dm.uniba.it/members/mancini
Office hours	Monday 14:30– 16:30 (presential or online meeting)

Syllabus	
Learning objectives	Completing prerequisites for the first-year university courses
Course prerequisites	High school mathematics
Course contents	**Logic and set theory** Logical connectives and truth tables. Conjunction, disjunction, negation. The implication: the principle of explosion (*ex falso quodlibet*), necessary condition and sufficient condition. The double implication or equivalence. Equivalent propositional forms. Negation of conjunctive and disjunctive propositional forms. Negation of an implication. Tautologies and contradictions. Universal and existential quantifier. Negation of universal and existential propositions. The form and the role of definitions. General form of the statement of a

	theorem: hypothesis and conclusion. Examples of proofs and refutations, counterexamples. Direct and indirect proofs, *reductio ad absurdum*. The form and the role of characterizations. Sets defined by properties. Set membership. Inclusion and equality by double inclusion. Strict inclusion. Distinct sets. Union, intersection, set difference. Complement sets. The empty set. Disjoint sets. Eulero-Venn diagrams. Proving some simple set-theoretical relations and properties. The well-ordering principle, the principle of induction and their applications to some arithmetical propositions. The relevance of the induction basis. Cardinalities of finite sets. Infinite sets. The Cartesian product of sets. The cardinality of the Cartesian product of a finite family of finite sets. Permutations of n elements. The recursive formula for $n!$. Dispositions without repetitions and combinations of n elements k by k. The power set of a set and its cardinality in the finite case (proof of the formula by induction). Pascal's triangle. The combinatorial role of the binomial coefficients in Newton's binomial theorem. Binary arithmetic (a sketch). **Mathematical analysis** The real numbers. The algebraic and order axioms for real numbers. Dedekind's Axiom. Consequences of the axioms: uniqueness of zero, of the unity, of opposites, of reciprocals; zero-product property; sign properties of opposites and reciprocals; positivity of the unity. Representation of the real numbers on a line. Intervals and half-lines. The set **N** of natural numbers and its properties. The set **Z** of relative numbers and its properties. The set **Q** of rational numbers and its properties. **Q** does not fulfil Dedekind's Axiom. The incommensurability of the diagonal of the square with its side. Density of rational numbers in real numbers (without proof). Countable sets. **N**x**N** is countable. **Q** is countable. [0,1] is not countable. Representation of the real numbers by decimal expansion. Representation of the rational numbers by decimal expansion. An example of non-periodic decimal expansion. Approximation and rounding. Powers, monomials and polynomials with real coefficients. Operations on polynomials. Polynomial division. Roots of a polynomial and Ruffini's Rule. Polynomial factorization. Reminders on rational equations and inequations. The absolute value. Equations and inequations with absolute values. Irrational equations and inequations with one or two radicands. Elements of trigonometry. Trigonometric equations and inequations. Exponential and logarithmic equations and inequations. **Geometry** Relations between the elements of two sets. Binary relations on a set. Reflexive, symmetric, antisymmetric and transitive relations. Order and equivalence relations. Equivalence classes and their properties. Partitions. The quotient set as a partition. The equivalence relation determined by a partition. Functional relations and functions; graph of a function. Fundamental examples: identity functions and constant functions. Direct image and inverse image of a subset; properties. Injective functions and their characterizations. Canonical injection. Surjective functions: definition and characterizations. Examples: the canonical surjection onto the quotient set. Bijective functions and their characterizations. The composition of functions and its properties. Invertible functions. Inverse functions. Characterization of invertible functions. The Cartesian plane and its one-to-one correspondence with the set of

	ordered pairs of real numbers. Geometric loci and examples. Distance between two points and their midpoint. The Cartesian equation of a (straight) line; explicit equation of a line: geometric meaning of the slope. The Cartesian equation of the line through two given points. Parallel lines and their characterizations. Perpendicular lines and their characterizations. Generalities on conic sections and their equations. Elementary properties of binary operations: commutativity, associativity, distributivity, neutral element.
Reference books	Any textbook referring to the "precorso di matematica"
Additional course materials	Additional material will be uploaded to the Microsoft Teams platform and to the teachers' homepages.

Work schedule				
	Total	Lectures	Hands-on learning (recitations/laboratories /seminars/other)	Self-study
Hours	50	50		
ECTS credits	2	2		

Teaching methods	
	Lectures

Expected learning outcomes	
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 skills	Expressing mathematical contents orally
Learning skills	Reading a mathematical text

Assessment and feedback	
Assessment methods	Final test (written, with multiple choice questions)
Evaluation criteria	• *Knowledge and understanding*: Understanding the symbolic language • *Applying knowledge and understanding*: Explaining a mathematical content in one's own words • *Making judgements*: Establishing the truth or falsity of a proposition • *Communication skills*: Presenting clear argumentations • *Learning skills*: Memorizing and reproducing statements
Grading policy	Final test (written, with multiple choice questions)