

COURSE OF STUDY	TWO-YEAR MASTER OF SCIENCE PROGRAMME IN MATHEMATICS
ACADEMIC YEAR	2023-2024
ACADEMIC SUBJECT	COMPLEMENTARY MATHEMATICS

General information	
Programme year	Second
Term	First semester (September 25, 2023 – December 22, 2023)
European Credit Transfer and Accumulation System credits (ECTS)	7
SSD	MAT/04 – Complementary Mathematics
Language	Italian
Mode of attendance	Not mandatory

Lecturers	
Name and surname	Eleonora Faggiano
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Department and office	Department of Mathematics, room 4 second floor
Virtual meeting room	
Web page	https://www.dm.uniba.it/it/members/faggiano
Office hours	

Work schedule				
	Total	Lectures	Hands-on learning	Self-study
Hours	175	56		119
ECTS credits	7	7		

Learning objectives	
	The course aims to provide some basic knowledge of mathematics, framing them in the historical context of origin and development, as well as tools for critical reflection in a didactic perspective. In particular, it intends to deal with some themes, drawn from different fields of mathematics, fundamental for the development of mathematical thought, chosen for their cultural interest and their possible connections with the themes taught in the school.

Course prerequisites	
	Knowledge that is generally acquired in the courses of an L-35 class degree.

Syllabus	
Course contents	<ol style="list-style-type: none"> 1) The numerical sets: the extensions from \mathbb{N} to \mathbb{R}; the introduction of real numbers. The parallelism between the extension of numerical sets and the transition from arithmetic to algebra. 2) Diophantine equations: definition; compatibility theorem; Euler's method. Pythagorean triples. 3) The equations of the third and fourth degree: some possible methods of resolution. 4) Lattices and Boolean Algebras: order relations; definition, characterization and properties of lattices; definition of Boolean Algebra and Boolean Ring;

	<p>link between Boolean Algebra and Boolean Ring.</p> <p>5) Elements of graph theory: planar graphs; connected graphs; trees; oriented graphs; applications.</p> <p>6) The classical problems of geometry: squaring the circle, duplication of the cube and trisection of the angle.</p> <p>7) The role of geometry in teaching mathematics. Euclidean geometry and Hilbert's axioms for geometry. Klein's Erlangen Program. The history of the fifth postulate and non-Euclidean geometries.</p> <p>8) Definitions, conjectures, argumentations, proof and proving, examples and counter examples in mathematics and mathematics education.</p> <p>9) Introduction to dynamic geometry.</p> <p>10) The fundamental notions of mathematical analysis for teaching in secondary schools: successions and functions; notion of limit; continuity and differentiability of a function.</p>
Reference books	<p>- Courant R., Robbins H., Che cosa è la matematica?, Bollati Boringhieri</p> <p>- Ore O., I grafi e le loro applicazioni, Zanichelli, Bologna.</p> <p>- Agazzi E., Palladino, D., Le geometrie non euclidee e i fondamenti della geometria, ed. La Scuola.</p> <p>- Villani V., Cominciamo da zero, Pitagora Editrice, Bologna.</p> <p>- Villani V., Cominciamo dal punto, Pitagora Editrice, Bologna.</p> <p>- Villani, Bernardi, Zoccante, Porcaro, Non solo calcoli, Springer Verlag Italia, Milano.</p>
Additional course materials	Indications relating to the reference texts and any additional supporting materials will be provided during the course.
Repository	

Expected learning outcomes	
Knowledge and understanding	<ul style="list-style-type: none"> ○ Expand the basic knowledge of the Bachelor's Degree, developing abstraction skills and mastery of the scientific method ○ Acquire a theoretical and historical-cultural preparation necessary for teaching mathematics ○ Critically analyse the course contents
Applying knowledge and understanding	<ul style="list-style-type: none"> ○ Be able to describe specific topics of study and popular expositions ○ Develop autonomously examples of didactic activities for secondary school ○ Discuss different points of view on educational applications of course content
Soft skills	<p><i>Making judgements:</i> Reflect on the change in mathematical methodologies and tools throughout history. Initiate research activities on specific issues and investigate new problems in groups and independently.</p> <p><i>Communication skills:</i> Ability to present mathematical arguments with clarity and accuracy and in forms appropriate to the recipients.</p> <p><i>Learning skills:</i> Develop a flexible and analytical mentality that allows to independently identify which knowledge to deepen and to be acquired for the management of a problem in the mathematical field, in the teaching of mathematics and also in other working areas</p>

Teaching methods	
	The course will be delivered in frontal teaching. Group work will be organized in some moments dedicated to the critical analysis of some contents.

Assessment	
Assessment methods	Learning assessment will take place by means of an oral interview.

Evaluation criteria	<ul style="list-style-type: none"> • <i>Knowledge and understanding:</i> <ul style="list-style-type: none"> ○ Knowledge of the contents and of the specialized vocabulary ○ Critical reasoning skills on the course contents • <i>Applying knowledge and understanding:</i> <ul style="list-style-type: none"> ○ Ability to correctly and adequately expose the topics to the addressees ○ Ability to design teaching applications related to the course contents • <i>Making judgements:</i> <ul style="list-style-type: none"> ○ Ability to analyse the change in mathematical methodologies and tools over the course of history ○ Ability to analyse didactic applications related to the course contents • <i>Communication skills:</i> <ul style="list-style-type: none"> ○ Quality of exposure with respect to different types of addressees and in terms of competence in the use of the specialist vocabulary • <i>Learning skills:</i> Ability to independently identify which knowledge to deepen and to acquire for the management of a problem in the mathematical field, in the teaching of mathematics and also in other work areas
Grading policy	<p>The final mark will be awarded taking into account the assessment criteria at the end of the oral interview on the course content. The examination is passed if the final mark is greater than or equal to 18/30. The student must show mastery of language, methodological rigour and that he/she has acquired the fundamental notions and concepts of the course. Assessment is based on the achievement of the intended learning aims. To achieve a high grade the student must have developed autonomy of judgement and adequate argumentation and exposition skills.</p> <p>Honours may be awarded in the case of further study of some topics in the programme.</p>

Further information	