Stampare su carta intestata del CdS

General information		
Academic subject	Mathematics for economics	
Degree course	Business Economics	
Academic Year	2021-2022	
European Credit Transfer and Accumulation System (ECTS)		10
Language	Italian	
Academic calendar (starting and ending date)	FIRST SEMESTER	
Attendance	No	

Professor/ Lecturer	
Name and Surname	Giovanni Villani
E-mail	giovanni.villani@uniba.it
Telephone	
Department and address	Department of Economics – Largo Abbazia Santa Scolastica, 53
Virtual headquarters	
Tutoring (time and day)	Tuesday 3.00 pm online mode

Syllabus	
Learning Objectives	The course aims to convey to students the formalism, terminology and logical tools of mathematics essential for a correct assimilation of many of the disciplines with economic, statistical and financial content that the student will have to deal with in the following. The formal treatment of the topics will be preceded by a heuristic and intuitive approach, and for many of them the possible applications for the description of economic, social and financial systems and processes will be indicated. Lessons of a more theoretical nature will be accompanied by exercises carried out in the classroom and by indications to guide students in carrying out independent exercises.
Course prerequisites	Basic knowledge of literal calculus; solving equations e first and second degree inequalities; elements of analytical geometry.
Contents	1) Elements of set theory. Logical symbols. Notions of equality, inclusion. Set of parts of a set. Union, intersection and complement operation. Partitioning of a whole. Cartesian product. FUNCTIONS. Direct image and reciprocal image. Injective, surjective, invertible functions. Restricted function and reduced function. Compound function. 2) Numeric sets. Natural, integer, rational and real numbers. Intervals. Major and minor, upper and lower extremes, maximum and minimum of a subset of R. Separate and contiguous sets. 3) Real functions of a real variable. Cartesian representation. Limited functions. Maximum, local and global minimum. Monotone function. Concave and convex functions. Flexed. Even function, odd and periodic function. Elementary functions. Succession. Monotonous successions. Nepero's number. 4) Limits of functions. Neighborhood of a point. Accumulation point. Definition of limit. Asymptotes. Boundary uniqueness theorem. First theorem of comparison. Theorem on the permanence of the sign. According to the comparison theorem. Obligation of convergence theorem (or of the carabinieri). Restriction limit theorem. Theorem on the limit of monotone functions. Theorem on the limit of a compound function. Limit operations: theorem on the limit of the sum, of the product, of the reciprocal function, of the quotient. Limit theorem for the

	indeterminate form 1/0. Around left and right. Accumulation point left and right. Limit left and right. Limits of successions. Fundamental theorem for calculating limits. 5) Continuous functions. Continuity. Continuity of elementary functions. Discontinuity points. The Weierstrass theorem. Existence theorem of zeros. Bolzano theorem. Fixed point theorem. 6) Differential calculus. Derivative and its geometric meaning. "Economic" meanings of the derivative. Continuity of derivable functions. Right derivative and left derivative. Angular and cuspidal points. Derivatives of higher order than the first. Elasticity of a function. Operations on derivable functions: sum, product, quotient. Derivation theorem of compound functions. Derivative of elementary functions. Derivatives of compound functions. Differential. Differential calculus application. Necessary conditions for increase and decrease. Relative maxima and minima. Necessary conditions and sufficient conditions for the relative maximums and minimums. Fermat's theorem. Lagrange's theorem. First consequence of Lagrange's theorem. Second consequence of Lagrange's theorem. Third consequence of Lagrange's theorem. Taylor formula. De L'Hopital theorems. Concave and convex derivable functions. Search for the minimum and absolute maximum of a function. 7) Elements of linear algebra. Fundamental definitions on matrices and vectors. Operations between matrices. Linearly independent vectors. Determinant and rank of a matrix. Added and inverse matrix. Linear systems. Cramer's rule. Rouchè-Capelli theorem. Vector space. Transactions between carriers. Standard of a carrier. Eigenvalues and eigenvectors. Characteristic polynomial. Positive, negative and undefined definite matrices. Quadratic forms. Diagonalization of a matrix. Economic applications. 8) Real functions of several real variables. Level curves. Partial derivability. Partial derivatives of higher order. Schwarz's theorem. Gradient. Hessian matrix. Conditions for the existence of relative maximums and minimums. Northwest minors rule (Sylvester criterion). Functions implicitly defined. Dini's theorem. Maximum and minimum constraints. The Lagrange multiplier method. Applications to the economy. Unconstrained optimization in economics. Cobb-Douglas production functions. Homogeneous functions. Returns to scale. Marginal replacement rate. Constrained optimization in economics. The consumer problem. 9) The indefinite integration. Primitive and indefinite integral. Immediate and almost immediate integrals. Integration by parts. Integration of rational functions. Integration by replacement. 10) Integration according to Riemann. Integrals defined according to Riemann. Existence theorem of primitives. Average theorem. The fundamental theorem of integral calculus.
Books and bibliography	L. Maddalena – Matematica – Giappicchelli 2009; Support material provided in class.
Additional materials	Web page of professor.

Work schedule			
Total	Lectures	Hands on (Laboratory, working groups, seminars, field trips)	Out-of-class study hours/ Self-study hours
Hours 270.	**70**	**20**	**180**
ECTS 10			

Teaching strategy	Frontal Lesson
Expected learning outcomes	
Knowledge and understanding on:	*Knowledge and understanding*: the student must have acquired the knowledge and understanding of the main parts of the program.
Applying knowledge and understanding on:	*Applied knowledge and understanding*: the student must be able to apply the mathematical tools described in the program to solve problems and exercises, as well as the ability to mathematically translate real-world situations, especially in the economic field, develop simple models mathematicians and graphs to illustrate the relationships between variables
Soft skills	• *Autonomy of judgment*: the student must have the ability to connect the knowledge acquired during the course and to deal with complex problems using the logical and formal tools made available by mathematics. • *Communication skills*: the student will have to acquire clear and effective communication skills, thanks to a good command of the vocabulary concerning the topics covered during the course. • *Ability to learn*: the student must have developed good learning skills, which allow them to autonomously deepen the knowledge acquired during the course by tackling subsequent personalized study paths

Assessment and feedback	
Methods of assessment	Written exam and oral exam
Evaluation criteria	The written test consists in carrying out some exercises on the main topics of the course. For example: study also graphical of the properties of a function, search for zeros of functions (third degree polynomials, exponentials, logarithms), search for local and / or global maxima and minima of functions, study of concavity (convexity of functions of a or more variables, application of Taylor's formula, integrals, classification of critical points for a function of several variables, solution of systems of linear algebraic equations, matrix algebra. The oral part of the exam can be taken by the student who will have reported, in the written test, an evaluation of at least 18/30. The oral part of the exam will ascertain the level of overall preparation on all the topics of the program. For a sufficient evaluation, the student will have to show knowledge of concepts (through their definitions) theorems and connections between the various topics, as well as an understanding of mathematical reasoning and proofs.
Criteria for assessment and attribution of the final mark	• <18 Fragmentary and superficial knowledge of the contents, errors in applying the concepts, lack of exposure; • 18-20 Knowledge of sufficient but general contents, simple exposition, uncertainties in the application of theoretical concepts; • 21-23 Appropriate but not in-depth knowledge of contents, ability to apply theoretical concepts, ability to present contents in a simple way; • 23-26 Appropriate and broad knowledge of contents, fair ability to apply knowledge, ability to present contents in an articulated way. • 27-29 Broad, complete and in-depth knowledge of contents, good application of contents, good ability to analyze and synthesize, safe and correct exposure, • 30-30L Very broad, complete and in-depth knowledge of contents, well-established ability to apply contents, excellent ability to analyze, synthesize and

	interdisciplinary connections, mastery of exposure.
Additional information	