UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

CONSIGLIO INTERCLASSE IN MATEMATICA

General information	**Academic year 2022-2023**
Academic subject	**Geometry 1**
Degree programme	Mathematics
Programme year	First
Term	First semester (October 3, 2022 –January 20, 2023)
European Credit Transfer and Accumulation System credits (ECTS)	8
Language	Italian
Attendance	Not compulsory

Lecturers		
Name and surname	Maria Falcitelli (instructor of record)	Amedeo Altavilla (exercises and tutoring)
E-mail	maria.falcitelli@uniba.it	amedeo.altavilla@uniba.it
Telephone	+39 080 544 2844	
Department and office	Department of Mathematics, room 9 third floor	Department of Mathematics, room 14 second floor
Virtual meeting room	Microsoft Teams code 7h8zrin	
Web page	https://www.dm.uniba.it/members/falcitelli	
Office hours	Days and times are arranged by email	Days and times are arranged by email

Syllabus	
Learning objectives	Acquiring basic concepts of linear algebra which will be used in several courses
Course prerequisites	Basic concepts in Mathematics taught in high school
Course contents	Algebraic structures Binary operations and algebraic structures. Groups, subgroups and elementary properties. Rings, integral domains, fields, subfields. Homomorphisms of groups and fields. The kernel and image of a homomorphism. Complex numbers and the field of complex numbers. The ring of polynomials over the field of complex numbers. Matrices and linear systems. Matrices with elements over field. Transpose of matrix. Diagonal, symmetric and skew-symmetric matrices. Sum and product of matrices. The group GL (n, k) and its subgroups. Rank of a matrix and properties. Determinant of a square matrix and its properties. Theorem of Binet. Laplace's rule. Cramer's rule. Theorem of Rouchè- Capelli. Systems of linear equations. Homogeneous systems. Vector spaces. Vector spaces over a field K: properties and fundamental examples. Polynomials in one indeterminate. Operations on polynomials and the vector space of polynomials. The vector space of matrices. Vector subspaces, examples. Intersection, sum, direct sum of vector subspaces. Supplementary subspaces. Vector space generated by n vectors. Finitely generated vector spaces . Linearly independent and dependent vectors. Bases of a vector space. Components of a vector with respect to a basis. Dimension of a vector space. Grassmann identity. Existence of a supplementary subspace of a vector subspace. Changes of bases. Orientations. Linear maps Linear maps: characterization and properties. Fundamental examples. The

	kernel and image of a linear map. Existence and uniqueness of linear maps. Characterization of monomorphisms and isomorphisms. Linear forms and dual space. Matrices associated to a linear map. Linear map associated to a matrix. Endomorphisms. Definition of endomorphism. Eigenvectors, eigenvalues and eigenspaces of an endomorphism. The characteristic polynomial . Algebraic and geometric multiplicity of an eigenvalue. Diagonalizable endomorphisms and matrices. Diagonalization criteria. Bilinear forms Definition of bilinear form. Symmetric and skew-symmetric bilinear forms. Matrices associated to a bilinear form. Congruent matrices. Orthogonal vectors. Orthogonal complement of a vector subspace. Fourier coefficient. Orthogonal bases. Diagonalization of a symmetric bilinear form. Symmetric bilinear forms on a complex vector space. Quadratic forms. Sylvester' s Theorem. Signature of real quadratic form: semidefinite, definite and indefinite forms.
Reference books	E. Sernesi, Geometria 1, Boringhieri A. Facchini, Algebra e Matematica discreta, Zanichelli E. Abbena, A.M. Fino, G.M. Gianella, Algebra lineare e Geometria analitica, Vol. I, II, Aracne. E. Schlesinger, Algebra lineare e Geometria, Zanichelli L. Mauri, E. Schlesinger, Esercizi di algebra lineare e geometria, Zanichelli.
Additional course materials	Notes available on Teams

Work schedule				
	Total	Lectures	Hands-on learning (recitations/laboratories /seminars/other)	Self-study
Hours	200	40	30+25	105
ECTS credits	8	5	2+1	

Teaching methods	
	Lectures and exercises

Expected learning outcomes	
Knowledge and understanding	Acquiring basic concepts, such as matrices, linear systems, vector spaces, linear maps, eigenvalues, bilinear forms
Applying knowledge and understanding	The acquired knowledge is useful in many branches of Mathematics, such as affine and projective Geometry, Analysis and Calculus
Making judgements	Ability to understand the consistency of a proof. Ability in problem solving
Communication skills	Acquiring mathematical basic language.
Learning skills	Acquiring suitable learning methods.

Assessment and feedback	
Assessment methods	Written and oral exam
Evaluation criteria	• *Knowledge and understanding: Acquiring basic concepts and standard*

	mathematical proof techniques. • *Applying knowledge and understanding: Students should be able to solve problems related with the subject of the course* • *Making judgment: Ability to analyse the consistency of the logical arguments used in proofs and problems* • *Communication skills: Students should be able to explain a concept and the methods uised in solving problems, ability in explaining the acquired knowledge* • *Learning skills: Ability in understanding texbooks dealing with the subject of the course.*
Grading policy	Exam consisting in a written part (exercises) and in an oral exposition (definitions, statements and proofs)

Additional information	