Academic subject: GEOMETRY 1

Degree Class: L-35-Scienze Matematiche		**Degree Course:** Mathematics	**Academic Year:** 2017/2018
		Kind of class: Mandatory	**Year:** 1 / **Period:** 1
			ECTS: 8 divided into **ECTS lessons: 5** **ECTS exe/lab/tutor: 3**

Time management, hours, in–class study hours, out–of–class study hours
lesson: 40 exe/lab/tutor: 55 in–class study: 95 out–of–class study: 105

Language: Italian	**Compulsory Attendance:** no		
Subject Teacher: Amici Oriella Maria	**Tel:** 085442691 **e-mail:** oriellamaria.amici@uniba.it	**Office:** Department of Mathematics Room 14, Floor III	**Office days and hours:** Thursday 11-13, other days by appointment.

Prerequisites: It suffices know those topics learnt at high school

Educational objectives: At the end of the course the student has a basic Knowledge of Linear Algebra, necessary for understanding other following courses

Expected learning outcomes (according to Dublin Descriptors)

Knowledge and understanding:
Acquiring fundamental concepts in Linear Algebra (matrices, linear systems, vector spaces, linear maps and bilinear forms)

Applying knowledge and understanding:
The acquired theoretical knowledge will be used in the most part of the following courses, in particular in Affine Geometry

Making judgements:
Ability to analyze the consistency of the logical arguments used in the proofs

Communication:
Acquiring the mathematical basic language and formalism

Lifelong learning skills:
Acquiring suitable learning methods by means of a series of theorems and their respective proofs, in parallel with important examples and exercises

Course program

Algebraic structures

Binary operations. Groups and subgroups. Rings, fields, subfields. Homomorphism of groups and fields. Kernel and image of homomorphism. Complex numbers and structure field.

Matrices and linear systems.

Matrices with elements over field. The transpose of a matrix. Diagonal, symmetric and skew-symmetric matrices. Matrix product. The group GL (n, k) and its subgroups. Rank of a matrix and properties. Determinant of a square matrix and its properties. Binet, Rouchè- Capelli, Cramer Theorems. Linear systems. Homogeneous systems.

Vector spaces.

Vector spaces: properties and fundamental examples. Vector subspaces, examples. Intersection, sum, direct sum of subspaces. Supplementary subspaces. Vector space spanned by n vectors. Finitely generated vector spaces and system generators. Linearly independent and dependent vectors. Bases. Components of a vector with respect to a basis. Dimension of vector space. Grassmann identity. Existence of a supplementary of a vector subspace. Change of basis matrix.

Linear maps
Linear maps between vector spaces.
Binary operations. Groups and subgroups. Rings, fields, subfields. Homomorphism of groups and fields. Kernel and image of homomorphism. Complex numbers and structure field.

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Linear maps
Linear maps between vector spaces, characterization and properties. Fundamental examples. Kernel and image of a linear map. Existence and uniqueness of linear map. Characterization of monomorphisms an isomorphisms. Dual and bidual space. Matrices associated with a linear map. Orientation of a real vector space. Similar matrices. Eigenvectors, eigenvalues and eigenspaces of an endomorphism. Characteristic polynomial . Algebraic and geometry multiplicity of an eigenvalue. Diagonalizable endomorphisms and matrices. Criterion of diagonalizability of endomorphism.

Bilinear forms
Bilinear forms. Symmetric and skew-symmetric bilinear forms. Matrices associated to bilinear form. Matrix congruence. Orthogonal vectors. Orthogonal complement of subspace Fourier coefficient. Orthogonal bases. Real quadratic forms. Sylvester' Theorem. Signature of real quadratic form: semidefinite, definite and indefinite forms. ector spaces, characterization and properties. Fundamental examples. Kernel and image of a linear map. Existence and uniqueness of linear map. Characterization of monomorphisms an isomorphisms. Dual and bidual space. Matrices associated with a linear map. Orientation of a real vector space. Similar matrices. Eigenvectors, eigenvalues and eigenspaces of an endomorphism. Characteristic polynomial . Algebraic and geometry multiplicity of an eigenvalue. Diagonalizable endomorphisms and matrices. Criterion of diagonalizability of endomorphism.

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Teaching methods:
Lectures and exercise sections

Auxiliary teaching:

tutorial activity

Assessment methods:
Written and oral exam, joint with Geometry 2

Bibliography:
E. Sernesi , Geometria I, Boringhieri.
M.I.Stoka ,Corso di Geometria , Cedam Padova
A. Facchini, Algebra e Matematica Discreta, Zanichelli
M. Abate C. De Fabritiis, Esercizi di Geometria, Mc. Graw-Hill.
De Bartolomeis, Algebra lineare, La Nuova Italia.