Academic subject: GEOMETRY 1			
Degree Class: L-35-Scienze Matematiche		**Degree Course:** Mathematics	**Academic Year:** 2018/2019
		Kind of class: Mandatory	**Year:** 1 / **Period:** I
			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:** Wednesday 11-13, other days by appointment.

Prerequisites: Basic notions in Mathematics taught in high school.

Educational objectives: Acquiring basic notions of linear algebra which will be used in most of the 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 is useful in great part of mathematics, in particular in affine geometry.

Making judgements:
Ability to analyze the consistency of the logical arguments used in a proof, under the formal and logical point of view.

Communication:
Acquiring mathematical basic language and formalism.

Lifelong learning skills:
Acquiring suitable learning methods supported by solving exercises and problems related to the contents of the course.

Course program

Algebraic structures

Binary operations and algebraic structures. Groups, subgroups and elementary properties. Rings, zero -divisors, integral domains, fields, subfields. Homomorphisms of groups and fields. The kernel and image of a homomorphism. Complex numbers and 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. 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.

Linear maps

Linear maps :characterization and properties. Fundamental examples. The kernel and image of a linear map. Existence and uniqueness of linear map. Characterization of monomorphisms and isomorphisms. Linear forms and dual space. Bidual space. Matrix associated to a linear map. Linear map associated to a matrix. Orientation of a real vector space. . Eigenvectors, eigenvalues and eigenspaces of an endomorphism. The characteristic polynomial . Algebraic and geometry multiplicity of an eigenvalue. Diagonalizable endomorphisms and matrices. Diagonalization criteria.

Bilinear forms

Bilinear forms. Symmetric and skew-symmetric bilinear forms. Matrix associated to bilinear form. Congruent matrices. Orthogonal vectors. Orthogonal complement of a vector subspace. Isotropic cone. Fourier coefficient. Orthogonal bases. Diagonalization of a symmetric bilinear form on an arbitrary field of characteristic different from 2 and on an algebraically field . Quadratic forms. Sylvester' s Theorem. Signature of real quadratic form: semidefinite, definite and indefinite forms.

Teaching methods:

Lectures and exercise sessions

Auxiliary teaching:

Tutorial activity

Assessment methods:

Written and oral exam. Joint exam 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.