Academic subject: Geometry 3			
Degree Class: L-35		**Degree Course:** Mathematics	**Academic Year:** 2018/2019
		Kind of class: mandatory	**Year:** 2 / **Period:** 1
			ECTS: 8 divided into **ECTS lessons: 5** **ECTS exe: 3**
Time management, hours, in–class study hours, out–of–class study hours lesson: 40 exe: 30 in–class study: 70 out–of–class study: 130			
Language: Italian	**Compulsory Attendance:** no		
Subject Teacher: Maria Falcitelli	**Tel: 39 080 5442844** **e–mail: maria.falcitelli@uniba.it**	**Office:** Department of Mathematics Room 9, Floor 3	**Office days and hours:** Thursday 11-13. Other days by appointment.
Prerequisites: Mathematical knowledge which is usually acquired during the first year of the degree in Mathematics. Especially: linear algebra, affine and Euclidean spaces.			
Educational objectives: Acquiring basic concepts in projective Geometry and in the theories of conics, quadrics and their applications.			
Expected learning outcomes (according to Dublin Descriptors)	**Knowledge and understanding: Acquiring fundamental concepts and classical geometrical methods using a modern language.** **Applying knowledge and understanding: The acquired knowledge is useful in great part of Mathematics and in other scientific branches, such as computer vision.** **Making judgements: Ability in developing new methods which are useful in problem solving.** **Communication: Students should acquire the Mathematical language and formalism which are necessary to analyze and solve problems.** **Lifelong learning skills: Acquiring suitable learning methods and relating the main concepts occurring in various Mathematical disciplines.**		

Course program

Projective Geometry:

The projective space of dimension n $\mathbf{KP_n}$ over the field **K,** for **K=R** or **K=C.** The cases n=1, n=2. Subspaces of $\mathbf{KP_n}$. Homogeneous coordinates of a point. The concept of projective independence of m points. The subspace spanned by m points. Representation of subspaces, in particular of lines and planes. Homogeneous equation of a line in the preojective plane. Pencils of lines in $\mathbf{KP_2}$, pencils of planes in $\mathbf{KP_3}$. Projective transformation: definition, main properties and equation. The group Pro($\mathbf{KP_n}$). A more general concept of n-dimensional projective space: (S_n,K), S_n and $\mathbf{KP_n}$ being equipotent and K the set of coordinate systems. The projective completion of an affine space. The relationship between affine and projective subspaces. Projective transformations. The group Pro(S_n). The bilinear equation of a transformation between projective lines. Involutions. Cross-ratio: definition, computation and main properties. The complexification of S_n and its subspaces. Real points, real subspaces.

Projective conics:

Definition, homogeneous equation, rank of a conic in a projective plane ($\mathbf{S_2}$,K). Projective classification. The polar line of a point with respect to a conic: definition and properties. Conjiugate points. Pencils of conics and the five types of

pencils.
Affine conics:
Conics in an affine plane: definition and relationship with conics in the projective completion of the plane. Classification. Center, diameters, conjugate diameters.
Euclidean conics:
Conics in an Euclidean plane and relationship with conics in the projective completion of the plane. The cyclic points. Axis, vertex, focus of a conic: definition and properties.
Projective quadrics:
Definition, homogeneous equation of a quadric in ($\mathbf{S_3}$,K). Rank and classification. The polar plane of a point with respect to a quadric: definition and properties. Lines in a quadric. The main properties of a cone.
Affine, Euclidean quadrics:
The concept of a quadric in an affine space $\mathbf{A_3}$ and its relationship with quadrics in the projective completion of $\mathbf{A_3}$. Affine classification. Center, diametral planes and diameters. Quadrics in an Euclidean space. Principal planes.

Teaching methods:
Lectures and exercise sessions.

Auxiliary teaching:
Didactic material available at: www.dm.uniba.it/lotta

Assessment methods:
Written and oral Exam

Bibliography:
M. Beltrametti, E. Carletti, D. Gallarati, G. Monti Bragadin, Lezioni di Geometria analitica e proiettiva, Bollati Boringhieri.
M. Berger, Geometry II, Universitext, Springer-Verlag.
E. Fortuna, R. Frigerio, R. Pardini, Geometria proiettiva, problemi risolti e richiami di teoria, Springer.
E. Sernesi, Geometria 1, Bollati Boringhieri.