

Academic subject: Geometry 3			
Degree Class: L-35		Degree Course: Mathematics	
		Academic Year: 2017/2018	
		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	
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		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)		<p>Knowledge and understanding: Acquiring fundamental concepts and classical geometrical methods using a modern language.</p> <p>Applying knowledge and understanding: The acquired knowledge is useful in great part of Mathematics and in other scientific branches, such as computer vision.</p> <p>Making judgements: Ability in developing new methods which are useful in problem solving.</p> <p>Communication: Students should acquire the Mathematical language and formalism which are necessary to analyze and solve problems.</p> <p>Lifelong learning skills: Acquiring suitable learning methods and relating the main concepts occurring in various Mathematical disciplines.</p>	
Course program			
Projective Geometry:			
The projective space of dimension n \mathbf{KP}_n over the field \mathbf{K} , for $\mathbf{K}=\mathbf{R}$ or $\mathbf{K}=\mathbf{C}$. 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 projective plane. Pencils of lines in \mathbf{KP}_2 , pencils of planes in \mathbf{KP}_3 . Projective transformation: definition, main properties and equation. The group $\text{Pro}(\mathbf{KP}_n)$. A more general concept of n -dimensional projective space: (S_n, \mathbf{K}) , S_n and \mathbf{KP}_n being equipotent and \mathbf{K} the set of coordinate systems. The projective completion of an affine space. The relationship between affine and projective subspaces. Projective transformations. The group $\text{Pro}(S_n)$. 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 (S_2, \mathbf{K}) . Projective classification. The polar line of a point with respect to a conic: definition and properties. Conjugate 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 (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 A_3 and its relationship with quadrics in the projective completion of 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.