Academic subject: Geometry 4			
Degree Class: L-35		**Degree Course:** Mathematics	**Academic Year:** 2017/2018
		Kind of class: mandatory	**Year:** 2 **Period:** 2
			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 0805442844 **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 three semester of the degree in Mathematics. In particular: elementary set theory, affine and projective Geometry, basic concepts of classical Analysis, such as continuous functions.			
Educational objectives: Acquiring basic concepts in general Topology, in particular the main examples of topological spaces, the main properties of continuous maps and the properties of a topological space which are invariant under homeomorphisms.			
Expected learning outcomes (according to Dublin Descriptors)	**Knowledge and understanding:** Acquiring new fundamental concepts and new methods of proof. **Applying knowledge and understanding:** The acquired knowledge is useful in many Scientific branches, such as Topography and Graph theory. **Making judgements:** Ability in developing new methods which are useful in problem solving. **Communication:** Students should acquire the Mathematical language and the formalism which are necessary to analyze and solve problems. **Lifelong learning skills:** Acquiring suitable learning methods, relating the main concepts occurring in various Mathematical disciplines.		

Course program

Topological spaces.

A topology on a set: definition and examples. Bases for a topological space. The topology generated by a base. Neighborhoods of a point, neighborhoods systems. The topology generated by a neighborhood system. Axioms of countability.

Metric spaces.

Definition of a metric space and examples. Open balls. The topology induced by a metric. Metric spaces satisfy the first axiom of countability. Equivalent metrics. The distance from a point to a set.

Subsets of a topological space.

The interior, the exterior and the boundary of a set. Closed sets. The closure of a set. The link between the closure, the boundary and the exterior. Examples. Dense sets and separable spaces.

Continuous mappings.

Definition, characterization and examples of a continuous mapping. Open mappings. Homeomorphisms: definition, characterization and examples. The group of homeomorphisms of a topological space. Topological properties. The glueing lemma for continuous mappings.

Subspaces.

The topology induced on a subset. Subspaces of a topological space. Convex sets. Subspaces and continuous mappings.

Product, quotient spaces.

The product topology of n topologies. The canonical projections of the product space are continuous and open mappings. A characterization for continuous mappings taking values in a product space. The quotient topology on a set relative to a map and its universal property. Identifications. The equivalence relation associated with an identification.

The canonical topology of a real or complex projective space. Topological properties of non degenerate conics. The Möbius band. Topological groups.
Axioms of separation.
Frèchet spaces. Hausdorff spaces. Examples. Limit point of a sequence of points. The uniqueness theorem for the limit point in an Hausdorff space. Regular spaces. Normal spaces. Examples. Continuous mappings and the axioms of separation. A characterization theorem for Hausdorff quotient spaces. Real projective spaces are Hausdorff .
Compact spaces.
Open covers of a topological space. Definition and characterization of a compact space. Closed subsets of a compact space. Compact subspaces of a metric space. Continuous mappings whose domain is a compact space. Examples. The normality property of a compact, Hausdorff space. Examples.
Connected spaces.
Definition and characterization of a connected (disconnetted) space. Connected subspaces. The connected subsets of the real line. Continuous mappings whose domain is a connected space. The mean value theorem. The product space of n connected spaces. Examples. The connected component of a point: definition and properties. A characterization of connected spaces involving connected components. Examples.
Pathwise connected spaces.
Definition of a pathwise connected space. Pathwise connected spaces are connected. Continuous mapping whose domain is pathwise connected. Locally Euclidean spaces. The main examples of pathwise connected spaces: convex subsets of the Euclidean space, connected and locally Euclidean spaces, the product of n pathwise connected spaces.

Teaching methods: Lectures and exercise sessions.

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

Assessment methods: Written and oral exam.

Bibliography:

A. Loi - Introduzione alla Topologia generale, Aracne Editrice, 2013.
B. M. Manetti – Topologia, Springer-Verlag Italia, 2014.
C. E. Sernesi – Geometria 2, Bollati Boringhieri, 1994.
D. G. Campanella – Esercizi di topologia generale, Aracne Editrice, 1992.