<table>
<tr><td colspan="5">Academic subject: Geometry 4</td></tr>
<tr><td colspan="2">Degree Class: L-35</td><td colspan="2">Degree Course:
Mathematics</td><td colspan="2">Academic Year:
2020/2021</td></tr>
<tr><td colspan="2"></td><td colspan="2">Kind of class:
mandatory</td><td>Year:
2</td><td>Period:
2</td></tr>
<tr><td></td><td></td><td colspan="2"></td><td colspan="2">ECTS: 8
divided into
ECTS lessons: 5
ECTS exe: 3</td></tr>
<tr><td colspan="6">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</td></tr>
<tr><td>Language:
Italian</td><td>Compulsory Attendance:
No</td><td colspan="4"></td></tr>
<tr><td>Subject Teacher:
Maria Falcitelli</td><td>Tel: 39 0805442844
e–mail:
maria.falcitelli@uniba.it</td><td>Office:
Department of Mathematics
Room 9, Floor 3</td><td colspan="3">Office days and hours:

By appointment.</td></tr>
</table>

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.
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. The Möbius band.

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. Relation between continuity and sequential continuity. 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: https://sites.google.com/site/amedeoaltavilla/

Assessment methods: If possible, written and oral exam in classroom. Otherwise on-line on Microsoft Teams.

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.