# GEOMETRY & TOPOLOGY

PROF. DR. A. S. CATTANEO

## HS 2021

### Program

Part I: Point set topology [1, Ch. 1–6]

(1) Metric spaces; topological spaces; neighborhoods. Continuity. Connectedness. Separation axioms.
(2) Product topology. Quotient topology. Topological manifolds.
(3) Nets, filters, ultrafilters.
(4) Compactness. Tikhonov's theorem.
(5) Urysohn's lemma, Tietze's theorem, Stone–Weiestrass theorem (without proofs).

Part II: Elements of algebraic topology [2, Ch. 3, 4, 11, 12, 13, 14, 17]

(1) Winding number. Homotopy and reparametrization of paths. Dog-on-a-leash. Varying the point. Degree.
(2) The fundamental theorem of algebra. Fixed points and retractions. Brouwer's fixed point theorem. Antipodes, Borsuk theorem, Borsuk–Ulam theorem.
(3) Covering spaces. Liftings. G-coverings. Deck transformations.
(4) The fundamental group and its properties. Homotopy of maps. Homotopy type.
(5) Fundamental group and coverings. The universal covering. Coverings and subgroups of the fundamental group.
(6) G-coverings from the universal covering. Patching coverings. The van Kampen theorem.
(7) Triangulations of surfaces. Fundamental group and classification of compact oriented surfaces.

### References

[1] S. Waldmann, *Topology: An Introduction*, Springer, 2014.
[2] W. Fulton, *Algebraic Topology: A First Course*, Springer, 2007.