Differential Geometry

PhD program in Mathematics

IST - Fall 2024/25

João Pimentel Nunes

SYLLABUS

Foundations of Differentiable Manifolds: Manifolds. Submersions, imersions, submanifolds. Whitney Theorem. Foliations.

Lie Theory: Lie brackets, Lie derivative. Distributions and Frobenius Theorem. Lie groups, Lie algebras. Actions on manifolds.

Differential Forms and Topology: Tensor and exterior algebras, differential forms. Cartan's formula, de Rham cohomology, Poincaré's lemma. Orientation, integration over manifolds, homotopy. Stokes theorem. Mayer-Vietoris sequence.

Fiber Bundles: Vector bundles, connections, curvature. Parallel transport, Riemannian manifolds, geodesics. Characteristic classes, Chern-Weil theory. Gauss-Bonnet Theorem. Principal bundles and Ehresmann connections.

BIBLIOGRAPHY

"Differential Geometry", R.L. Fernandes (available in pdf on the course webpage)

"Foundations of Differentiable Manifolds and Lie Groups", F.W.Warner, Springer

"Differential Forms in Algebraic Topology", R.Bott and L.W.Tu

"Foundations of Differential Geometry" (2 vols.), S.Kobayashi and K.Nomizu, John Wiley and Sons

EVALUATION

Homework sets, approximately every two weeks (50% of the final grade) and a 2 hour written exam (50% of the final grade). The written exam may be replaced by an oral exam upon agreement of the class.

COURSE WEBPAGE

`http://www.math.tecnico.ulisboa.pt/~jpnunes/DG/dg-2425.html`