Riemannian Geometry
MMA
Fall Semester, 2020/21

Professor: Pedro M. Girão

Course Description

- Differentiable Manifolds: tangent space; differentiable maps; immersions and embeddings; vector fields; Lie brackets; Lie groups; differential forms. Riemannian Manifolds: isometries; affine connections, Levi-Civita connection; geodesics, minimizing properties of geodesics; Hopf-Rinow theorem. Curvature: curvature tensor, sectional curvature, Ricci tensor, scalar curvature; connection and curvature forms, Cartan's structure equations; isometric immersions of surfaces in euclidean space, Gauss map, mean and Gaussian curvature; Gauss Theorem; first and second fundamental forms. Applications: index of a vector field at a singularity; the Euler-Poincaré characteristic; the theorem of Gauss-Bonnet.

Readings

- *An Introduction to Riemannian Geometry*, L. Godinho and J. Natário, Springer, 2014 (Main text).

- *An Introduction to Differentiable Manifolds and Riemannian Geometry*, W. Boothby, Academic Press, 2003.

- *Notes on Differential Geometry*, N. Hicks, D. Van Nostrand Company, 1965.

- *Differential Geometry*, Will J. Merry, Lecture Notes.

- *Riemannian Geometry*, M. Perdigão do Carmo, Birkhäuser, 1992.

- *Differential Forms and Applications*, M. Perdigão do Carmo, Springer, 1994.

Evaluation

- Homework will be assigned every two weeks and is worth 30% of the final grade. There will be two tests, each one lasting 90 minutes and contributing 35% to the final grade. The 1st Test will take place on Friday, November 20, 2019, at 18:00, and the 2nd Test will take place on Friday, January 22, 2021, at 15:00. Students may repeat one or both tests on Thursday, February 4, 2021, at 11:30. **These are tentative dates, to be confirmed.** Final grades greater than or equal to 19 have to be confirmed in an oral exam.