MTH 635 - Spring 2022

SYLLABUS

Contact information

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Office: Math 117

Office hours: F 2:00 - 4:00 pm (Zoom and Discord links are on UBlearns.)

Lectures

Time: TR 2:00 - 3:20 pm

Place: Math 150

Course description: This is a first course in Riemannian geometry, a mathematical subject that has rich interactions with algebra, analysis, and topology. A Riemannian metric is a geometric structure on a smooth manifold that allows measuring angles and distances. After a brief review of smooth manifolds, the course will introduce Riemannian metrics, affine connections, geodesics, curvature, and isometries.

Topics:

(1) Review of differentiable manifolds: smooth manifolds, tangent spaces, smooth vector fields, Lie brackets, integral curves, flows, Lie derivatives, cotangent spaces, vector bundles, differential forms.
(2) Riemannian metrics, (local) isometries.
(3) Affine connections, covariant derivatives, parallel transport, the Levi-Civita connection.
(4) Riemannian curvature, sectional curvature, Ricci curvature, scalar curvature.
(5) Geodesics, metric structure on Riemannian manifolds, exponential map, geodesic normal coordinates, sectional curvature (revisited), Jacobi fields.
(6) Hopf–Rinow, Cartan–Hadamard, and Killing–Hopf theorems.

Prerequisities: Knowledge of differential topology to the extent covered in MTH627.

Grading: Your letter grade for the course will be based on biweekly homework assignments.

References

1. William M. Boothby, *Introduction to differentiable and Riemannian manifolds*. Pure and Applied Mathematics, 120. Academic Press, Inc., Orlando, FL, 1986.
2. Manfredo P. do Carmo, *Riemannian geometry*. Translated from the second Portuguese edition by Francis Flaherty. Mathematics: Theory & Applications. Birkhäuser Boston, Inc., Boston, MA, 1992.
3. Peter Petersen, *Riemannian geometry*. Third edition. Graduate Texts in Mathematics, 171. Springer, Cham, 2016.