

Announcement

Seminar “Differential Forms on Smooth Manifolds” in Summer Semester 2025 (ab 23.04.2025)

Preliminary meeting: Wednesday, 12.02.2025 at 14:00, SR 0.014 (Geb. 20.30)
Time (SS2025): Wednesday, 11:30-13:00
Place: SR 1.009, Geb. 20.30
Contact: Dr. Darya Sukhorebska, darya.sukhorebska@kit.edu

Content: The smooth manifolds are everywhere in Mathematics. They appear as Riemannian manifolds in differential geometry, spacetimes in general relativity, phase spaces in mechanics, and so on. On this seminar we will investigate extending the main ideas of calculus – differentiation and integration - to multidimensional smooth manifolds.

This seminar will cover the following key concepts: tangent and cotangent bundle, tensor algebra, differential forms, derivative and integration of forms on manifolds. This seminar will be based on the textbook *Smooth Manifolds*. The highlight of the seminar is the generalized Stoke’s Theorem and introduction to De Rham cohomology.

Prerequisites: Linear algebra I-II, Analysis I-III, understanding the basic notion of a smooth manifold

References: C. Gorodski, *Smooth Manifolds*, Springer, 2020

List of possible lecture topics:

1. Definition of Smooth Manifolds, Submanifold of Smooth Manifolds, Tangent and Cotangent bundle (Gor., 1.1, - 1.4)
2. Vector Fields, Flow, Lie Bracket (Gor. 1.6)
3. Distributions and Foliations, Frobenius' Theorem (Gor. 1.7)
4. Tensor Algebra, Exterior Algebra (Gor. 2.1)
5. Tensor Bundle, Differential Forms (Gor. 2.2)
6. Exterior Derivative, Lie Derivative of Tensors (Gor. 2.3, 2.4)
7. Integration of forms on manifolds, Stokes' theorem (Gor. 4.1, 4.2)
8. Definition and Properties of De Rham Cohomology, Cohomology of the Sphere (Gor. 4.3, 4.4)

References:

- [Gor]** C. Gorodski, *Smooth Manifolds*, Springer, 2020
- [GH]** V. Guillemin, and P. Haine, *Differential Forms*, New Jersey : World Scientific, 2019.
- [BG]** R. Bishop, S. Goldberg, *Tensor Analysis on Manifolds*, NY, 1968
- [Tu]** L. Tu, *Differential Geometry*, Springer, 2017