Course: Analysis on Manifolds

Teacher(s): Sanja Konjik

Course status: elective

ECTS: 12

Prerequisites: None

Goal: Acquiring knowledge and skills from selected topics of differential geometry on manifolds

Outcomes: Student is able to independently follow the achievements in the field of differential geometry on manifolds and to apply the acquired knowledge and skills to specific problems

Contents

Theoretical lectures

Submanifolds of R^n, immersion, local parametrization, equivalent conditions (local zero set and local graph), smooth maps between submanifolds, chart, differentiable manifolds, maximal atlas, manifold topology, smooth maps between manifolds, topological properties of manifolds, partition of unity, tangent space, tangent map, tangent vector, differentiation, tangent bundle, local vector bundles, vector bundles, sections of vector bundles, vector field, Lie bracket, flow of vector field, integral curve, product of manifolds, submanifolds, embedding, tensors in vector spaces, tensor product, tensor bundle and tensor fields, local representation of tensor fields, alternator, exterior product, exterior algebra, volume element, pullback and push-forward, differential forms, orientation of manifolds, manifolds with boundary, integration on manifolds, Stokes‘ theorem, symplectic vector spaces, symplectic manifolds, Darboux‘s theorem, Hamiltonian vector field, Hamiltonian system, Poisson brackets, Noether‘s theorem, hypersurfaces, Gauss‘ map, Weingarten‘s map, fundamental forms, Riemannian metrics, principal curvatures, Gaussian and mean curvatures, Theorema Egregium, covariant derivative, Cristoffel symbols, intrinsic geometry, parallel transport, geodesics

Recommended bibliography

1. Kunzinger, M., Analysis on Manifolds, Lecture notes, University of Vienna, 2022.
2. Abraham, R., Marsden, J.E., Foundations of Mechanics, 2nd edition, Addison-Wesley Publishing Company, lnc., USA, 1978.
3. Abraham, R., Marsden, J.E., Ratiu, T., Manifolds, Tensor Analysis, and Applications, 2nd edition, Springer-Verlag, New York, 1988.
4. Boothby, W.M., An Introduction to Differentiable Manifolds and Riemannian Geometry, Revised 2nd edition, Elsevier Science, USA, 2003.
5. Dragović, V., Milinković, D., Analiza na mnogostrukostima, Matematički fakultet, Beograd, 2003.

Number of classes per week	Theoretical: 5	Practical:

Methods of teaching:

Theoretical lectures and individual work of students during practical hours

Knowledge estimation: **(max 100 points)**

Mini-project 20 points, oral exam 80 points