

M4041: Differential Geometry

LECTURERS:

Dr Andrew Hammerlindl (Weeks 1-6)
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OFFICE HOURS: TBA.

WEEKLY LECTURES: Mon 10:00-11:30 and Fri 11:30-1:00 in M442

ASSESSMENT

Assignments: There will be 10 short assignments.

- (i) Each assignment will consist of 2 to 3 problems.
- (ii) Each assignment will be worth 4%.
- (iii) Due dates for the problems will be indicated on the problem set, and typically they will be due approximately 1 week from the date the problem sets are handed out.

Final Exam: There will be an in class final exam worth 60% of the final grade.

REFERENCES

Lecture Notes

Informal lecture notes will be provided.

Textbooks

- [AMR] R. Abraham, J.E. Marsden and T. Ratiu, *Manifolds, Tensor Analysis, and Applications*, 2nd ed., Springer, 1988.
- [AUB] T. Aubin, *A course in differential geometry*, AMS, 2000.
- [CAR] M. Do Carmo, *Riemannian geometry*, Birkhäuser, 1992.

[CON] L. Conlon, *Differentiable manifolds: a first course*, 2nd ed., Birkhäuser, 2001.

[LEE] J.M. Lee, *Introduction to Smooth Manifolds*, 2nd, Springer, 2013.

SYLLABUS

Weeks 1-2: Preliminary material, manifolds, manifolds with boundary, smooth maps, submanifolds, partitions of unity

Week 3: Tangent vectors and spaces, tangent bundles, tangent maps, submersions and immersions, vector bundles

Weeks 4: Vector fields, the push-forward and pull-back of a vector field, integral curves, flows, Lie derivative

Weeks 5-6: Multilinear algebra, cotangent spaces, cotangent bundle, tensors, tensor bundle, tensor fields

Week 7: Contractions, index manipulation, push-forward and pull back of a tensor field, tensor derivations, Lie derivative

Week 8: Metrics, connections, Levi-Civita connections, Christoffel symbols, covariant derivatives

Weeks 9-10: Exterior Algebra, bundle of alternating tensors, differential forms, exterior derivative, derivations, Lie derivative

Week 11-12: Orientation, integration of differential forms, Stokes' Theorem, applications