MATH 425: Differential Geometry I

Course Material and Topics: This course covers the basic theory of differentiable manifolds. A differentiable manifold is a topological space that is locally similar enough to Euclidean space to allow one to do calculus. The tools of manifold theory are indispensable in most major subfields of mathematics, and outside of mathematics they are becoming increasingly important to scientists in such diverse areas as economics, computer science, and physics. This course covers basic core material that would be useful for many fields of mathematics.

Topics to be covered:

- **Manifolds**
  - Definition, examples
  - Tangent and cotangent vectors
  - Submanifolds, immersion and embedding
  - Frobenius theorem
- **Vector bundles**
- **Tensors**
  - Tensor and exterior algebras
  - Tensor fields and differential forms
- **Integration on manifolds**
  - Orientation of manifolds
  - Integrals of forms
- **Other topics, like Sard's theorem, basics of Lie Groups, de Rham theorem**

Prerequisites: It will be assumed that the student has had the usual undergraduate training in analysis (for example, MATH 320) and linear algebra.

Evaluation: The instructional format for the course will consist of lectures of 3 hours per week. The course mark will be based on problem sets; there will be no final exam.

Textbook: J. M. Lee, *Introduction to Smooth Manifolds*

[*Note:* The entire e-book can be viewed online via the UBC Library website.]

References:

- F. Warner, *Foundations of Differentiable Manifolds and Lie Groups*
- W. M. Boothby, *An Introduction to Differentiable Manifolds and Riemannian Geometry*
- M. Spivak, *A Comprehensive Introduction to Differential Geometry, Vol. 1, 3rd Edition*