The University of Western Ontario
Department of Mathematics

MATH 9161B - Differential Geometry - Winter 2014

Lectures: Tuesday 09:30 - 11:30 and Thursday 09:30 - 10:30, in room MC 108
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Course's website: Important announcements and documents will be posted on the MATH 9161B website that you can find on my personal pages under the "Teaching" tab. Please visit this page regularly for up-to-date information on the course.

Course Outline: The aim of this course is to provide an introduction to differential geometry with an emphasis on various structures on manifolds. After a quick review of de basic notions (smooth manifolds and maps, derivatives, tensors, etc), we will introduce bundles, connections, curvature, Lie groups, and Cěch cohomology. This will allow us to study geometric structures (Riemannian, Spin, complex, symplectic, etc) in a unified framework. In the last part of the course, we will cover the Chern-Weil theory of characteristic classes.

References: I will not follow any particular textbook and I will borrow freely from various sources. However, I encourage each student to review the material with the help of some standard text. There is now a plethora of introductory books on manifolds and differential topology. You can also find good lecture notes online (keep in mind however that those online texts may contain many typos and other inaccuracies). Here is a list of some of my favorite references, from elementary to more advanced expositions:

- "Introduction to Smooth Manifolds", by John Lee
  Covers the basics of manifolds with many examples. A good reference.
- "Manifolds and Differential Geometry" by Jeffrey Lee
  Similar to Jeffrey Lee's book with additional topics like connections and Riemannian Geometry. A very good reference for this course.
- "Foundations of Differential Manifolds and Lie Groups" by Frank Warner
  Neat, brief and concise, almost terse. Also more formal than the above references. Gives very few concrete examples, but covers sheaf cohomology.
- "Semi-Riemannian Geometry" by B. O'Neil
  Covers (Semi)-Riemannian Geometry with applications to General Relativity.
- "Riemannian Geometry and Geometric Analysis" by J. Jost
  Very good selection of topics. Nice discussion of some important differential operators.
- "Curvature and Characteristic Classes" by J. Dupont
  Introduction to classical Chern-Weil theory of characteristic classes.

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- "Characteristic Classes" by J. Milnor and J. Stasheff
  A classic on characteristic classes on manifolds.
- "Differential and Riemannian Manifolds" by Serge Lang
  More advanced, it is one of the few textbooks that covers infinite dimensional (Banach) manifolds.

Prerequisite: Introduction to smooth manifolds $\bigoplus$ introduction to algebraic topology.

Evaluation: The evaluation will be based on

- 3 homeworks: $\sim 60\%$
- 1 exam: $\sim 40\%$.

The homeworks are an integral part of the course and special attention must be paid on redaction. They will be evaluated both on correctness and clarity.