Math 868 — Fall 2018
Geometry and Topology 1

MWF 9:10–10 am, C304 Wells Hall

Professor: T. Parker
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Office hours: M 2–3, T 1–2, Thurs 2–3
and by appointment.

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Class Webpage: math.msu.edu/~parker/868.

Goals: This course introduces the intuition and techniques used to study manifolds. Manifolds are the natural setting for calculus in its most appealing and flexible form, and are the primary objects of study in much of modern geometry and topology.

The course will start with a rapid introduction (which should be a review for most students) to metric spaces, linear algebra and calculus in $\mathbb{R}^n$. Then come the main topics of the course: differentiable manifolds and tangent spaces, vector bundles, transversality, calculus on manifolds, differential forms, tensor bundles, the deRham Theorem and cohomology groups. If time permits, we will cover the beginnings of Riemannian geometry.

The sequel, Math 869 (taught in the spring at the same time) is a first course on algebraic topology. It covers Fundamental groups, covering spaces, homology and cohomology, and Poincaré duality.

Background: The official prerequisites are a 400-level course on Abstract Algebra and one on Real Analysis. In reality, the main prerequisite is a solid knowledge of multi-variable calculus and linear algebra and some knowledge of basic point set topology (open sets, compactness).

Textbook: *Introduction to Smooth Manifolds* by John M. Lee.

Other reference books:

- *Differential Topology* by V. Guillemin and A. Pollack — Chapters 1-5 give an easy-to read introduction to manifolds.
- *A Comprehensive Introduction to Differential Geometry*, Vol. I by Michael Spivak.
- *An Introduction to Differential Manifolds* by D. Barden and C. Thomas.
- *Foundations of Differentiable Manifolds and Lie Groups* by Frank Warner.
- *Morse Theory* by John Milnor.
- *Lectures on the Geometry of Manifolds* by Liviu Nicolaescu. More advanced.

Expectations and Grades: Homework will be assigned (approximately) weekly. There will be two exams to help you prepare for the Geometry/Topology qualifying exam:

- a **Midterm Exam** given in class on Friday, Oct. 26, and
- a 2-hour **Final Exam** at a time to be arranged.

The course grade will be the weighted average: 20% Midterm + 25% Final + 45% homework + 10% student seminar (see below).

Student Seminar: We will schedule an extra hour (or two) a week for a "student seminar". During this time students will give informal talks on small topics related to the class material. You have a choice of either giving a talk, or doing a written alternative project (there may not be time for everyone in the class to give a talk). This will count 10% of the course grade.

Learning to give seminar talks is an important part of graduate education. I will help you decide on a topic and I will work with you on writing your lecture notes or your written project.

A list of possible topics is posted on the class webpage.