Math 732: Differential Topology
Syllabus, Spring 2013

Professor: **Dr. Jason Parsley**
Office: 330 Manchester Hall
Office hours: MTuW 10-11, Tu 3-4 (334/634), W 3:30-4 (in lounge), Th 3-5; also by appointment
Email: `parslerj AT wfu.edu`
Course website: `http://www.wfu.edu/~parslerj/math732/`

1. Course Time & Location: MWF 1, Manchester 124

2. Text: *Differential Topology*, by Guillemin and Pollack.

Supplementary Text: John Milnor, *Topology from the Differentiable Viewpoint*

3. Course description: This course is a sophisticated look at a very basic question: what are the properties of the sets of solutions of a system of simultaneous equations? If the equations are linear, this question is exhaustively studied in linear algebra, and the answer is very simple: if we have k linearly independent (homogenous) equations on an n dimensional vector space, then the set of solutions is a subspace of dimension $n - k$.

In this class, we consider the situation where the equations are nonlinear. The solution sets are generally curved & much more interesting and can have interesting topological and geometric properties as well. But surprisingly, almost all of the time, the set of solutions is still locally identical to a subspace of dimension $n - k$. Much of the course will be devoted to putting a rigorous foundation under these simple ideas.

This course is essential for students interested in graduate study in geometry and topology and is useful for many other disciplines. Smooth manifolds are the n-dimensional analog of surfaces. This course introduces their most important properties: embeddings and immersions, transversality, intersection theory, and integration, forms, and de Rham cohomology. Prerequisites for the course are linear algebra and vector calculus. You do not need the point-set topology course (MTH 731) for this course; some knowledge of analysis (MTH 311/611) is helpful, but not required. The word *differential* need not scare you. We won't be performing intense calculus computations, as one might in differential geometry. Rather this course examines the larger topological worldview of manifolds.

4. Topics: We will cover three of the four chapters of Guillemin and Pollack's book.

1. Manifolds and Smooth Maps (§ 1.1-1.6, and possibly 1.7, 1.8)
2. Transversality and Intersection
4. Differential Forms and Integration on Manifolds (§ 4.1-4.4, and possibly 4.5-4.7)

5. Assignments: Working problems, both individually and together, is fundamentally important in learning mathematics well.

Since this is a topics course, we require only a small baseline amount of work to be submitted. Each week I will assign three problems to be collected and several more not to be collected. My hope is that you will choose to work on additional exercises that are not required.

Assignments will be due on Wednesdays at the start of class. I will grade some or all of the collected problems, usually worth 5 points each. Late work will accrue penalties. (Everyone in the class gets one exception to this policy.) I'm willing to work with you – if there are circumstances which will not allow you to submit homework on time, let me know and we can work something out.

Academic integrity is something I take quite seriously. Here are my expectations: you may discuss course material freely with each other. The written assignments that you submit must be your original work, i.e., when writing your solutions, you should be working independently, not together, you should not have anyone's work or notes in front of you. You should cite any extra sources you use, even for homework. You should not discuss the solution to your favorite 5 problems (see below) with another student.

6. Favorite 5 problems: I will ask for you to write up 5 of your favorite optional problems from the semester. These should be written in LaTex; your solution should be as refined as possible. You will be graded not only on the correctness of your solution, but how well-written it is, the quality of the presentation (including figures), and the difficulty of the problems. We will post these on Google Docs. They are due by reading day, Thursday, May 2.

If you would like feedback on any problems, submit them by Friday, April 5.

7. Exams Two of the assignments will be designated as midterm exams; there will be a cumulative final exam. These will be open-book, open-notes take-home exams, possibly with an in-class component.

- 1st midterm: *Feb. 6-8*
- 2nd midterm: *Mar. 27-29*

8. Problem Sessions. We will hold weekly problem sessions to discuss each week's assignment. Tentatively, I would like to meet Thursdays at 10am.

9. Project: You will select a topic from differential topology, explore it using some external references, and write a 5-12 page report on it with significant mathematical content. You will also prepare a 15-minute presentation about your project. Project presentations will are tentatively slated for the weeks of April 8th and 15th. All project reports are due on Friday, April 19.

10. Grade Calculation:

Homework	15%
Participation	5%
Project	20%
Midterm Exam 1	18%
Midterm Exam 2	18%
Final Exam	24%

11. Gold Stars: Throughout the semester, I will award ‘gold stars’ to recognize achievements. These function as extra credit; the current exchange rate, which may fluctuate, is roughly

`20 gold stars` ≈ `1.00 point on your final average`.

You may earn these for things like going to relevant talks, finding errors in the text, finding errors on relevant Wikipedia pages (and fixing them), saying particularly insightful comments in class, solving difficult problems. I reserve the right to award these in many different, unspecified ways.

There is only one way in which you can lose stars – you must be respectful during other students’ presentations.

If you have a disability which may require an accommodation for taking this course, please contact the Learning Assistance Center (758 5929), then contact me, within the first 2 weeks of the semester.