Math 549 **Geometric Structures** **Spring 2008**

SYLLABUS

Lectures: MWF 1:30–2:20
Padelford C-401

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Course Web site: *www.math.washington.edu/~lee/Courses/549-2008*
(or from the Math Department home page,
Class Web Pages → Math 549)

Reading:

There will be no required textbook for this course. I will be handing out a list of recommended references, most of which will be on reserve in the Math Research Library.

Prerequisites:

Prerequisites: Math 547 *and* Math 548. In addition, for the last part of the course, familiarity with the basic properties of Lebesgue integration on $\mathbb{R}^n$, Hilbert spaces, and the Fourier transform will be very helpful.

General description:

This course will be an introduction to the geometry of vector bundles and principal bundles, including the following topics:

- Connections on vector bundles and principal bundles
- Curvature of arbitrary connections, Bianchi identities
- Flat connections and representations of π_1
- Chern-Weil theory and the general Gauss-Bonnet theorem
- Some basic ideas of gauge theories
- Fundamentals of elliptic PDE theory on compact manifolds
- Fredholm theorem for elliptic operators
- The Hodge theorem
- Statement of the Atiyah-Singer index theorem

Homework:

Problem sets will be assigned at irregular intervals, usually every week or two. When you write them up, please follow the guidelines on the handout titled *Conventions for Writing Mathematical Proofs*, and also the following specific expectations:

- **Collaboration:** I strongly encourage you to work with other students on the homework. Discussing problems and ideas with your classmates is one of the best ways to learn the material. But when writing up solutions to hand in, please *write your own solutions in your own words.* If you collaborate to a significant degree on any assignment, list the names of any people with whom you collaborated on that assignment.
- **Citing results:** You may freely cite any result stated and/or proved in class, unless it's what you're being asked to prove. You may also use anything from my books *Introduction to Topological Manifolds*,*Introduction to Smooth Manifolds*, and *Riemannian Manifolds*, including problems and exercises. If you look up and use something proved in any other book, be sure to state the result completely, and say where you found it. I discourage you from looking up solutions to the assigned problems.
- **Problem Statements:** You need not copy the entire problem statement, but be sure to state clearly what you are proving. I prefer that you state each result in the form of a theorem.
- **Assembly:** Arrange your solutions in numerical order, just as they appear on the assignment sheet, with *each problem starting on a new page.* Problems that are out of order might not get credit. Please staple the pages of each assignment together.
- **Identification:** Make sure the first page of each homework packet is clearly labeled with your name and the assignment number.
- **Typesetting vs. handwriting:** If you are comfortable doing so, I encourage you to submit computer-typeset assignments. I highly recommend LaTeX, since that has become the de facto standard in mathematics; but any typesetting system will do. I'm also happy to accept handwritten assignments, as long as they are neat and legible (see below).
- **Legibility:** If you write by hand, write your answers neatly and legibly, not too small, with as few erasures or crossouts as possible. Be sure to distinguish clearly between similar symbols, such as a/α, $b/6$, $C/\subseteq$, $\in/\varepsilon$, $g/q/9$, h/n, $I/l/1$, p/ρ, r/γ, $s/5$, $t/+$, $u/v/\nu$, $U/\cup$, $x/\times/\chi$, $y/4$, $z/2$, ζ/ξ, and uppercase/lowercase letters. Unless mathematical ideas spring fully and impeccably realized from your pen, your first draft is not acceptable.
- **White space:** Don't be stingy with white space. *Leave one-inch margins on all sides of your pages.*

Grading:

Your grade will be based on homework; there are no exams. Roughly speaking, the cutoff for a 4.0 will be somewhere around 80%, and the cutoff for a 3.0 somewhere around 50%.

If you wish, you may register for this course on an S/NS basis (for example, if you have passed prelims and chosen a PhD committee, and are therefore no longer required to register for graded courses). In this case, if you attend regularly and hand in at least one or two written problem solutions, I will record your grade as a 2.7, which will be converted by the registrar to S (satisfactory).