Math 546 **Topology and Geometry of Manifolds** **Spring 2002**

SUGGESTIONS FOR FURTHER READING

Please choose a different book from the one you read during winter quarter. See the Math 545 list for additional comments about [1]–[9].

[1] M. Spivak, *A Comprehensive Introduction to Differential Geometry, Volume 1*, Publish or Perish, 1979. The topics that we will cover in Math 546 are in Chapters 4–11.

[2] F. Warner, *Foundations of Differentiable Manifolds and Lie Groups*, Springer–Verlag, 1983. The last part of Chapter 1 and most of Chapters 2–4 will be covered in Math 546. If you decide to study the proof of the de Rham theorem (Chapter 16 in [ISM]) on your own, Warner's Chapter 5 gives a very different proof, based on the theory of sheaves.

[3] W. M. Boothby, *An Introduction to Differentiable Manifolds and Riemannian Geometry, Second Edition*, Academic Press, 1986. The Math 546 material is mostly in Chapters 4-6.

[4] S. Sternberg, *Lectures on Differential Geometry*, Prentice–Hall, 1964. As some of you found out last quarter, this book covers a lot of ground, but is *very* challenging to read. The Math 546 material is mostly found in Section II.8 and Chapters III and V.

[5] S. Lang, *Fundamentals of Differential Geometry*, Springer–Verlag, 1999. Chapters IV–VI correspond roughly to Math 546. Much of the same material can also be found in the earlier incarnations of this book: *Introduction to Differentiable Manifolds*, Interscience, 1962; *Differential Manifolds*, Addison–Wesley, 1972, or Springer-Verlag, 1985.

[6] T. Aubin, *A Course in Differential Geometry*, AMS, 2000. Most of the Math 546 material is the second half of Chapter 2 and Chapter 3.

[7] M. W. Hirsch, *Differential Topology*, Springer–Verlag, 1976. Chapter 1 contains a treatment of the Whitney immersion and embedding theorems, and Chapter 2 presents a number of variations on the Whitney approximation theorems. You might also want to look at Chapter 3 for a complete proof of Sard's theorem.

[8] S. S. Chern, *Complex Manifolds Without Potential Theory, Second Edition*, Springer–Verlag, 1979. Chapters 1–3 give an introduction to the theory of complex manifolds.

[9] R. O. Wells, Jr., *Differential Analysis on Complex Manifolds*, Springer–Verlag, 1980. See Chapter I for another introduction to complex manifolds.

[10] S. Kobayashi and K. Nomizu, *Foundations of Differential Geometry*, Volumes 1 and 2, Wiley, 1963 & 1969. A standard reference work for researchers in the field, which I like to think of as the "Encyclopædia Brittanica" of differential geometry. Not very useful for learning the material for the first time, but once you've been exposed to the concepts this is a very concise and complete summary of basic differential geometry, including a great deal of information on complex manifolds, Riemannian manifolds, and bundle theory. You'll probably want this on your shelf if you decide to do research in differential geometry or any related area. Much of the subject matter of Math 545 and 546 is covered (very tersely) in Chapter I of Volume I.

[11] S. Helgason, *Differential Geometry, Lie Groups, and Symmetric Spaces*, Academic Press, 1978. Although the main goal of this book is to study symmetric spaces (a particular kind of Riemannian manifold with lots of symmetry), it begins with a rather thorough though somewhat unconventional treatment of basic differential geometry and Lie group theory. Sections 1-5 of Chapter II cover the material on Lie groups that we will see in Math 546.

[12] V. S. Varadarajan, *Lie Groups, Lie Algebras, and Their Representations*, Prentice–Hall, 1974. Probably the most important standard reference for the theory of Lie groups.

[13] R. Bott and L. W. Tu, *Differential Forms in Algebraic Topology*, Springer-Verlag, 1982. This book goes much deeper into de Rham cohomology than we will have time for. If you're interested in algebraic topology, this will give an excellent perspective on the ways that smooth manifold theory are applied there.

[14] R. I. Bishop and S. I Goldberg, *Tensor Analysis on Manifolds*, MacMillan, 1968. This is a classic introduction to smooth manifold theory with emphasis on the role of tensors, vector fields, and differential forms. The Math 546 material is in Chapters 2–4.