Math 545 **Topology and Geometry of Manifolds** **Winter 2000**

Suggestions for Further Reading

- M. Spivak, *A Comprehensive Introduction to Differential Geometry*, Volumes 1–5, Publish or Perish, 1979. This classic tome is a chatty and surprisingly enjoyable essay on many aspects of differential geometry. Volume 1 covers much of the material we will see in Math 545 and 546, and its conversational style makes it very useful for getting extra insights into the basic concepts. You should sit down with a beer or a cup of tea and read this book like a novel.

- F. Warner, *Foundations of Differentiable Manifolds and Lie Groups*, Springer–Verlag, 1983. Too dense and formal to be an ideal text for beginners, but good on Lie groups and de Rham theory, with an excellent selection of problems throughout.

- W. M. Boothby, *An Introduction to Differentiable Manifolds and Riemannian Geometry, Second Edition*, Academic Press, 1986. Covers most of the material in Math 545 and 546, although with some notable omissions (e.g., the Whitney approximation and embedding theorems and the global Frobenius theorem) and some odd choices of ordering (e.g., the rank of a smooth map is defined before the tangent space). Fairly easy to read, and good for an alternate perspective.

- S. Sternberg, *Lectures on Differential Geometry*, Prentice–Hall, 1964. Beginning with a treatment of linear algebra and smooth manifold theory, this text moves rapidly into some very advanced topics, including Sard's theorem, bundle theory, Riemannian geometry, Lie groups, homogeneous spaces, and G-structures. Can be rewarding, but not for the faint-hearted.

- G. E. Bredon, *Topology and Geometry*, Springer–Verlag, 1993. This beautiful new book covers nearly everything we will do in 544/5/6, in addition to a complete course in algebraic topology. Be warned that its main focus is the topology, so the smooth manifold theory is given rather short shrift. It is nice, though, for an example of how the study of topological and smooth manifolds can be melded together.

- 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.

- S. Lang, *Differential Manifolds*, Springer–Verlag, 1985. As in all of Lang's books, everything is done in the utmost generality and with great economy. Its most notable and useful feature is that it treats infinite-dimensional manifolds on an equal footing with finite-dimensional ones.

- 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.

- 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.

- M. W. Hirsch, *Differential Topology*, Springer–Verlag, 1976. This nice little book focuses on properties of smooth manifolds that are preserved by diffeomorphisms, and their applications to topology and to the classification of manifolds up to diffeomorphism. Its main tools are approximation and embedding theorems, Sard's theorem and transversality, Morse theory, and surgery.

- S. S. Chern, *Complex Manifolds Without Potential Theory, Second Edition*, Springer–Verlag, 1979. A good introduction to the theory of complex manifolds, a subject that is far deeper than just smooth manifold theory with the word "smooth" replaced by "complex-analytic." The odd title refers to the fact that the book does not use Hodge theory—the application of partial differential equations to the study of differential forms—which is a standard tool in most introductory complex manifold texts.

- R. O. Wells, Jr., *Differential Analysis on Complex Manifolds*, Springer–Verlag, 1980. Another introduction to complex manifold theory. This one uses quite a lot of sophisticated machinery, including sheaves, bundles, partial differential equations, and representation theory. Could be called "complex manifolds *with* potential theory."