

**MATH 6950, TOPICS IN ALGEBRAIC TOPOLOGY,  
SPRING 2016**

The main purpose of this course is to develop the theory of characteristic classes and to study some of its applications. This theory has three classical sources, with deep applications to all of them: algebraic geometry, differential geometry, algebraic topology. Topics not strictly belonging to algebraic topology (for example, connections and curvature) will be discussed. Other topics in algebraic topology (for example, spectral sequences) that are helpful to the main topic, could also be covered

The following is a tentative list of topics. It may be modified, if needed, to reflect the interests of the audience.

- (1) Fibrations, some basic obstruction theory.
- (2) Stiefel-Whitney classes and Euler class as obstruction classes.
- (3) Universal bundles, classifying spaces, universal characteristic classes.
- (4) Chern classes.
- (5) Pontrjagin classes.
- (6) Connections, curvature, Chern-Weil theory of characteristic classes.
- (7) Various “Index Theorems” and their applications: Hirzebruch’s Signature Theorem and Riemann-Roch Theorem, perhaps the Atiyah-Singer Theorem.
- (8) Spectral sequences and applications: fibrations, homotopy theory.
- (9) Other applications: Exotic spheres (Milnor, Brieskorn), non-smoothable manifolds, vector fields, foliations, Bott vanishing theorem, 4-manifolds and their intersection forms, ...

**Books:** I will not follow any textbooks, but the following books are classics that contain clear expositions of much relevant material.

- J. W. Milnor and J. D. Stasheff, *Characteristic Classes*, Annals of Math. Studies **76**, Princeton Univ. Press.
- R. Bott and L. W. Tu, *Differential Forms in Algebraic Topology*, Graduate Texts in Math. **82**, Springer.

Another good source for basic material in algebraic topology is the book (and notes) by Hatcher at <http://www.math.cornell.edu/~hatcher/#ATI> .

**Prerequisites** A basic course in algebraic and differential topology, such as Math 5510-5520.

**Grading** I will assign, from time to time, problems to be solved and handed in. The final grade will be based on these problems.