

Syllabus

MA822—Topics in Geometry and Topology – Spring 2008 Atiyah-Singer Index Theory in Commutative and Noncommutative Geometry

Time: TR 9:30-11

Instructor: Steve Rosenberg

Office Hours: W 11-1, 2-3 or by appointment in MCS248

Contact Info: sr@math.bu.edu, 353-9556.

Texts: Rosenberg, *The Laplacian on a Riemannian Manifold*, Cambridge U. Press, or available at <http://math.bu.edu/people/sr>

J. Gracia-Bondia, J. Varilly, H. Figueroa, *Elements of Noncommutative Geometry*, Birkhäuser.

This course will cover the Atiyah-Singer index theorem and its generalizations to noncommutative geometry. The first part of the course will cover the standard AS index theorem. We'll discuss the classical examples (Gauss-Bonnet theorem, Hirzebruch-Riemann-Roch theorem, Hirzebruch signature theorem, \hat{A} -genus), and cover enough of Hodge theory, characteristic classes, and heat flow methods to sketch a convincing proof. The second part of the course will cover elements of noncommutative geometry, focusing on the concepts of cyclic cohomology, spectral triples, and the Connes-Moscovici local index theorem. As a test case of our understanding of the material, let's try to see that the Connes-Moscovici theorem generalizes the Atiyah-Singer theorem.