

Information Sheet for  
**Math 255, Topics in Geometry**

Fall 2011

*MWF 11, Johnson Chapel 21*

David A. Cox  
404 Seeley Mudd Building  
Phone: 2082  
Email: dac@math.amherst.edu

**Course Overview:**

The parallel axiom of Euclid asserts the existence of a unique line through a given line and parallel to a given line. This axiom is the foundation of much of the Euclidean geometry that you learned in high school, including the Pythagorean Theorem and the fact that the sum of the angles in a triangle sum to 180 degrees.

The “big idea” of Math 255 is to study what happens when we no longer assume this axiom. For Fall 2011, the main topics of Math 255 will be:

- Neutral Geometry, which is the study of what theorems in geometry are valid with no assumptions about parallel lines. We will see, for example, that the sum of the angles in a triangle is at most 180 degrees.
- Non-Euclidean Geometry, which is the geometry we get when we assume the existence of more than one parallel line. This wonderful geometry was discovered by Gauss, Bolyai, and Lobachevski. In this geometry, the sum of the angles in a triangle is strictly less than 180 degrees. Furthermore, this sum determines the area of the triangle, so that there are no similar triangles in Non-Euclidean geometry.
- Differential Geometry, which generalizes non-Euclidean geometry. The central notion here is Gaussian curvature. A sphere has constant positive curvature, and we will see that non-Euclidean geometry has constant negative curvature. The latter will enable us to construct some explicit models of non-Euclidean geometry.

One subsidiary topics we will explore briefly is:

- General relativity, which asserts that gravity warps space and makes it non-Euclidean. We will discuss Einstein’s 1912 thought-experiment which showed that the geometry of a rotating disk is not Euclidean! (Our treatment of relativity will not assume any previous knowledge of physics.)

**Textbook:**

*Geometry from a Differentiable Viewpoint*, by John McCleary. You can buy it at Amherst Books.

A copy of this book is on reserve in the Keefe Science Library. Another book on reserve is *Euclidean and Non-Euclidean Geometries* by Marvin Greenberg.

**Grading and Exams:**

There will be homework assignments (I'm not sure how frequently) which will count for 20% of the course grade. Two exams during the semester (probably take home) will count for 40% each. The first exam will be a midterm (sometime in late October) and the second will be a take-home final.

**Course Information:**

Information about the course can be found on CMS. In particular, homework assignments will be posted at this site.

The first assignment is due Friday, September 16. It is in the "Assignments" section of CMS web site.