LECTURE: MW 5:00 – 6:20 p.m. in GAB 473.

INSTRUCTOR: William Cherry

OFFICE: GAB 405
PHONE: 565-4303
E-MAIL: wcherry@unt.edu
WEB page: http://wcherry.math.unt.edu/diffgeom

OFFICE HOURS: MW 6:30-7:30 and TR 2:00-3:00.

Students unable to attend the above scheduled office hours or needing extra help are welcome to make an appointment with me at other times, including evenings and weekends.

PREREQUISITE(s): Math 2700 (linear algebra) and Math 2730 (multivariable calculus).


GRADES: There will be three components to your final grade, weighted as follows:

- Homework: 25%
- Midterm Exams (2): 50%
- Final Exam: 25%

IMPORTANT DATES:

FIRST TAKEHOME MIDTERM DUE: Wednesday, February 28.
SECOND TAKEHOME MIDTERM DUE: Wednesday, April 18.
FINAL EXAM: Wednesday, May 9, 5:00 – 7:00 p.m.

ATTENDANCE: Class attendance will not be taken, but experience shows that students who do not regularly attend class tend not to get good grades. **No late homework** will be accepted. **Students must plan to attend the final exam.** Makeup final exams will be given only in extremely exceptional circumstances, such as serious illness, and must be arranged in advance.

ACADEMIC DISHONESTY: Cheating on exams is a serious breach of academic standards and will be punished severely. Collaboration with others and working together is encouraged on weekly homework assignments, but work on both in-class and take-home exams must represent only the efforts of the individual student.

**Note:** It is the responsibility of students with certified disabilities to provide the instructor with appropriate documentation from the Dean of Students Office.
Tentative Course Outline

**Weeks 1–3 Curves**
Reading: Chapter 1.

We will warm up with a quick, but detailed, study of curves in space. This will allow us to review some concepts from multivariable calculus and see how calculus can help us study geometry. It will also give us a sense of what “curvature” is, although the curvature of a curve is an extrinsic property of the curve sitting in space and is thus very different from the intrinsic curvature we will discuss when we get to surfaces. The section on curves will end with some global theorems on curves to give us a sense of the difference between local and global geometry.

**Weeks 4–10 The geometry of Surfaces in Space**
Reading: Chapters 2–4.

We will begin our study of surfaces by examining examples of surfaces in space. We will talk about how to use calculus and linear algebra to measure distance, angles, area, and other geometric concepts and set up the machinery necessary to do calculus on surfaces. Next we will carefully study something called the Gauss map, which tells us how the normal vector to a surface in space changes as we move about the surface, and we will see what this tells us about the geometry of the surface. We will end this section by discussing what a being whose universe consisted only of the surface itself and unable to see outside into the surrounding space could learn about the geometry of the surface he or she lives on. In particular, we will see how curvature is an intrinsic property of the surface not depending on the ambient space and what consequences the curvature has for a mythical inhabitant of the surface.

**Weeks 11–12 Some global geometry and abstract surfaces**
Reading: parts of Chapter 5.

In this section of the course we will prove the Jordan Curve Theorem, a deceptively simple sounding theorem about curves in the plane, but surprisingly difficult to prove. We will also briefly discuss, without proof, some global theorems about surfaces in space. Then, we will study surfaces purely abstractly, without reference to any surrounding space.

**Weeks 13–15 Riemannian manifolds, Minkowski space, the Riemann curvature tensor, connections to physics**
Reading: Handouts or weblinks will be provided. More details can be found in Sean M. Carroll, *An Introduction to General Relativity, Spacetime, and Geometry*, Pearson Addison Wesley, 2004 or at [http://preposterousuniverse.com/spacetimeandgeometry/](http://preposterousuniverse.com/spacetimeandgeometry/)

Finally, we will introduce the basic set-up for studying higher dimensional spaces using the kinds of techniques developed in the course. This is the foundation for what is called Riemannian geometry. Next, we’ll take a quick look at a slight generalization called Minkowski space and discuss its connection to special relativity. We will conclude with a discussion of the Riemann curvature tensor and Einstein’s equations of general relativity.

**Final Exam.** The final will cover the material from the Do Carmo text. The higher dimensional material and connections to physics we discuss in the last few weeks will not be on the final.