MATHEMATICS 563 A1
Introduction to Differential Geometry
Fall Semester 2001
Instructor: Takashi Kimura
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Lectures: MWF 10:00-11:00pm in MCS 148

Text: *Differential Geometry and Its Applications*, by John Oprea, ISBN 0-13-340738-1, Prentice-Hall, 1997.

My Office Hours: MF 1-2, W 2-3.

Class Web Page: `http://math.bu.edu/people/kimura/Fall01/563/`

Content: Geometry is the study of objects such as lines and surfaces as well as their higher dimensional analogs. Differential geometry is an application of the ideas from calculus to characterize geometric objects. An example of a question which differential geometry addresses is, for example, "What is the proper notion of the curvature of a surface?" This subject is an active area of research and has various applications in science and engineering, *e.g.* computer graphics and Einstein's theory of gravitation (general relativity) to name a few.

In this class, we will primarily focus upon the geometry of curves and surfaces in $\mathbf{R}^3$. Topics covered include regular curves, Frenet frames and Frenet formulas, curvature and torsion. We will also cover regular surfaces, normal, Gaussian, and mean curvatures, Gauss' Theorem Egregium, minimal surfaces, geodesics, isometries and conformal maps, the Gauss-Bonnet theorem, and variational problems. If time permits, we will cover constant negative curvature surfaces and soliton equations.

We shall also be using the computer algebra package Mathematica to help perform algebraic manipulations and to help visualize curves and surfaces. Mathematica is available on the ACS UNIX machines in the computer room in the basement of the Math/Computer Science Building.

Prerequisites: The material in the course is nontrivial so it is important that you satisfy the prerequesites. The prerequisites of this course are multivariate calculus and some linear algebra. A knowledge of analysis or topology is useful but is not necessary. We will introduce these ideas as necessary. Some knowledge of Mathematica will also be useful although we will introduce this in class.

Homework: Generally, homework will be assigned on a weekly basis and will be due the following week. Late homework will not be accepted. Students may discuss homework with each other (and are encouraged to do so) but all written work must be prepared independently.

Exams: There will be a take home midterm and a take home final exam.

Grades: Your final grade is determined by three categories – the midterm, the homeworks, and the final. Grades are based upon the formula:

$$\text{Final Grade} = \frac{1}{3}(\text{Exam Average}) + \frac{1}{3}(\text{ Homework Average}) + \frac{1}{3}(\text{Final Exam})$$

Cheating: Plagiarism and cheating will not be tolerated and anyone suspected of such academic misconduct will be referred to the Dean's Office as per the provisions of the CAS Academic Conduct Code.