MTH 465/565- Elementary Differential Geometry - Fall 2016

Instructor: Xingru Zhang
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Lectures: TR 12:30 pm – 1:50 pm in Math 150

Office Hours: by appointment.

Textbook: Elementary Differential Geometry, Revised second edition, by Barrett O'Neill.

Prerequisite: MTH 241 (Multi-Variable Calculus), MTH309 (Linear Algebra), MTH 311 (Introduction to Higher Mathematics). It's better if you have taken some 400 level course in analysis or algebra or multi-variable calculus or topology.

Course Description and Material to Be Covered: Comprehensively introduces the theory of curves and surfaces in $\mathbb{R}^3$. Moves toward the goal of viewing surfaces as special concrete examples of differentiable manifolds, reached by studying surfaces using tools that are basic to studying manifolds. Topics include curves in $\mathbb{R}^3$, differential forms, Frenet formulae, patch computations, curvature, isometries, intrinsic geometry of surfaces. Serves as an introduction to more advanced courses involving differentiable manifolds. We will cover most of Chapters 1, 2, 4, 5 and parts of Chapters 3, 6, 7 of the book.

Homework, Exams and Grading Scheme: Homework will be assigned along lectures, and collected every two weeks. You are strongly encouraged to typeset your homework solutions using LaTeX.

There will be one midterm exam tentatively scheduled on Oct.18th and a cumulative final exam scheduled on December 15th, Thursday, 11:45am-2:45pm.

You final course grade will be calculated by: based on the total of 100 points, homework, midterm exam and final exam will count 40%, 25% and 35% respectively. Cutoffs for the final course letter grades are as follows:

90-100 points–A, 86-89 points–A_-, 82-85 points–B_+, 78-81 points–B, 74-77 points–B_-, 70-73 points–C_+, 66-69 points–C, 62-65 points–C_-, 58-61 points–D_+, 54-57 points–D, 0-53 points–F.

I reserve the right to modify these cutoffs if circumstances warrant.

Student Learning Outcomes:

At the end of this course a student will be able to: Familiar with some basic calculus tools on Euclidean spaces $\mathbb{R}^n$ (mostly $n = 3$), such as tangent spaces, directional derivatives, vector fields, covariant derivatives, differential forms and their exterior derivatives and integrations. Thoroughly understand the geometry of curves in $\mathbb{R}^3$, such as understand the geometric meaning of the curvature function, the torsion function and the Frenet frame field of a space curve and be able to calculate these quantities, know how to characterize a line, a circle, a plane curve, a cylindrical helix or a spherical curve. Understand the concept of a surface in $\mathbb{R}^3$ and understand how a calculus can be performed (defined) on such a surface, understand geometric properties of a surface in $\mathbb{R}^3$ such as the principal curvatures, the mean curvature and the Gaussian curvature at a point, know how to characterize a surface in $\mathbb{R}^3$ which is a part of a plane or a sphere, understand the concept of an abstract surface (as a two dimensional differentiable manifold) and know how a calculus can be performed (defined) on such a surface, understand the concept of a geometric surface and some of their intrinsic geometric properties, most importantly the Gaussian curvature and the Gauss-Bonnet theorem.

Assessment: Homework, Midterm Exam and Final Exam.

The list below indicates to what extent this course reflects each of the learning objectives of the undergraduate mathematics program. A description of learning objectives is available online at http://www.math.buffalo.edu/undergraduate/ undergrad_programs.shtml.

- **Computational Skills:** moderately
- **Analytical Skills:** moderately
- **Practical Problem Solving:** moderately
- **Research Skills:** moderately
- **Communication Skills:** moderately