

MA 430 Differential Geometry

Instructor: Lia Vas

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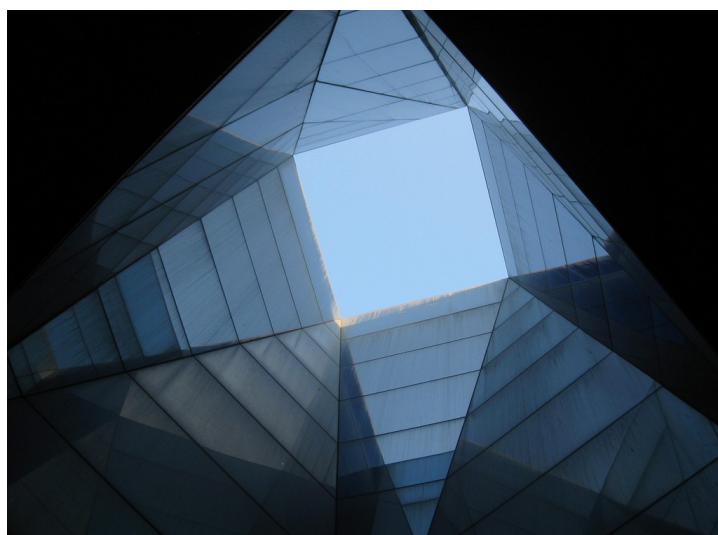
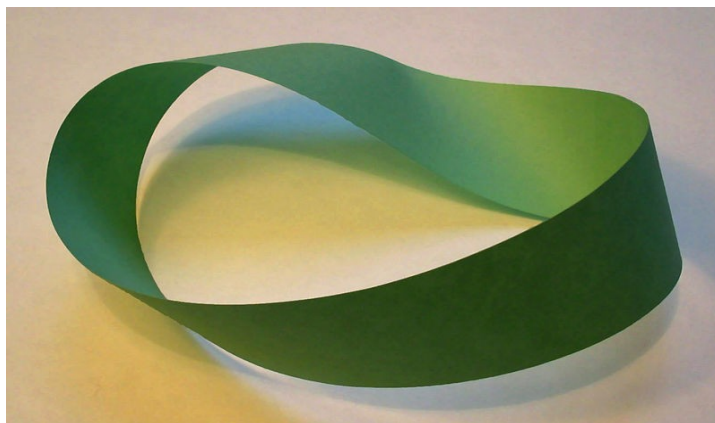
Office Hours: Monday 3-4, Thursday 4-5, Friday 2-4 (no appointment necessary). Feel free to make an appointment if you cannot come to my regular office hours.

Text: No textbook is required. Handouts with new material and practice problems will be distributed for each teaching unit. The textbooks used for the class preparation include the following.

- **Richard L. Faber**, Differential Geometry and Relativity Theory
- **Richard Milman, George Parker**, Elements of Differential Geometry.

Topics covered:

1. Curves: parametrization, tangent (velocity) vector, arc length, acceleration vector, curvature, normal and binormal vector, torsion, Frenet-Serret apparatus.
(Exam 1)
2. Surfaces: tangent plane, curvature, Theorema Egregium.
3. Surfaces: coordinate patches, the First Fundamental Form.
(Exam 2)
4. Surfaces: the Second Fundamental Form, the Gauss curvature, geodesics, curvature tensor, manifolds.
(Exam 3)



Grading:

Exam 1	26%
Exam 2	26%
Exam 3	26%
Project	22%
TOTAL	100%

Grades are computed according to the following system:

grade	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-	F
number grade	97 to 100	93 to 96	90 to 92	87 to 89	83 to 86	80 to 82	77 to 79	73 to 76	70 to 72	67 to 69	63 to 66	60 to 62	0 to 59

Course Requirements:

1. **Prerequisites:** Calculus 3 or permission of instructor.

2. **Attendance:** Since the course is mostly based on material covered in class handouts, it is imperative that students attend all classes. Students are responsible for all material covered in class, even if attendance is not checked or assignments collected.

3. **Exams and assignments:** There will be **three exams** and **one student project** during the semester. Exams turned in after their due date will receive an automatic reduction in grade. No exam grade will be dropped.

4. **More on course topics:**

- The course will start with a review of Multivariable Calculus. The course can be considered a continuation of Calculus 3 course and the next step in deepening the students understanding of calculus and its use.
- The review of multivariable calculus will morph into the study of differential geometry - a mathematical discipline that uses methods of multivariable calculus to study geometrical features, such as shape and curvature, of objects. The **curvature** measures the extend of bending of a curve, a surface, a space or their generalizations to any dimension, the manifolds. Studying ways of describing such an extent of bending is one of the central ideas of the course and enables one to understand concepts like the expansion rate of the universe.
- Differential Geometry is used in natural sciences, especially in physics and computational chemistry.
- The course provides the students interested in continuing their education at a graduate level with mathematical techniques that certain graduate programs use.

5. **Course Objectives.**

- Identify situations that require the use of vector calculus and differential geometry.
- Solve certain classes of problems related to vector calculus and differential geometry.
- Understand and write mathematical proofs using formal mathematical reasoning.
- Present solutions on a computer or in a written form.

6. **Learning outcomes.** Students will:

- acquire knowledge and understanding of basics of differential geometry,
- know how to use formal mathematical reasoning and write mathematical proofs when necessary,
- be able to understand and solve problems which require the use of differential geometry,
- demonstrate ability to cover a topic independently and present their results in a written report.

7. **Academic integrity:** Academic integrity is at the center of the educational experience at USciences. Students are therefore expected to uphold the highest standards of academic integrity and not engage in or tolerate academic dishonesty. Academic dishonesty includes, but is not limited to, fabrication, cheating or plagiarism. Any violation of academic integrity will be investigated and, where warranted, the student will receive appropriate sanctions through the University's Student Conduct Process. Please familiarize yourself with the current USciences Student Handbook. Adherence to the Student Conduct Policy and Academic Integrity Policy will help to ensure that your learning and living experiences are founded on integrity.

8. **Americans with Disabilities Act (ADA) Compliance Statement:** USciences supports the educational endeavors of all students, including students with disabilities. ADA defines a disability as a mental or physical impairment that substantially limits one or more major life activities. If you believe that you have a disability that may impact your ability to fulfill your course or degree requirements, and you would like more information on applying for an accommodation under ADA, please contact the Administrator of Student Accommodations at 215-596-8758.