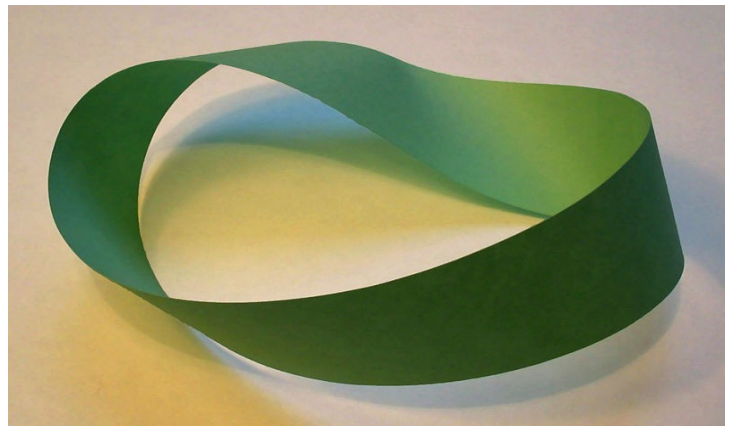


Differential Geometry

Instructor: Lia Vas

E-mail: lvas@sju.edu

Instructor's Website (with class handouts, review sheets, and class recordings): <http://liavas.net>



Class format, Fall 2021: The classes will be held on the UC campus.

Class times and place, Fall 2021: Mon 2:00–3:50 pm in STC 148, and Fri 1:00–1:50 pm in STC 337.

Office hours, Fall 2021: There will be two types of office hours:

In-person for short (15 min or less) questions, one student at a time, no appointment necessary on:

Mondays at 1 pm and 4 pm, on Thursdays at 4 pm, and on Fridays at 2 pm.

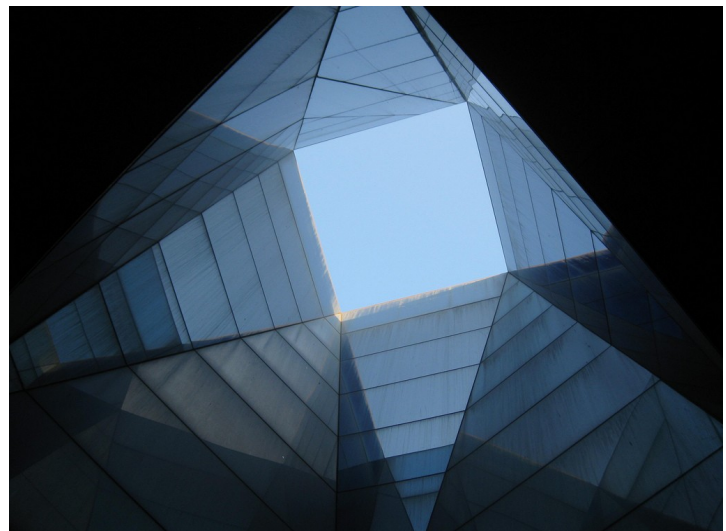
Online for any format (short or long questions, individual or in groups), by appointment: email me and I will find time for us to meet in a D2L Brightspace room. During these meetings, I will have a board behind me and you will be able to see what I write on it while I answer your questions. So, this format will be very similar to in-person meetings in my office.

Text: No textbook is required. Handouts with new material and practice problems are available on my website. The textbooks used for the class preparation include the following.

- **Richard L. Faber**, Differential Geometry and Relativity Theory
- **Richard Millman, 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)



Tentative Exam Schedule, Fall 2021:

Exam 1. During week 4 (09/24) Exam 2. During week 9 (10/29)

Exam 3. During week 14 or 15 (the last lecture week or the finals week)

Grading:

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

Grades are computed according to the following system:

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

Relevant Course Elements.

Number of Credits: 3

Prerequisites: Calculus 3 or permission of instructor.

Attendance: The class lectures will be delivered on campus (at the times listed above). To stay on track, it is highly recommended that students attend all classes. I will be available to any student who misses a class and has questions.

Students are responsible for all material covered in class, even if attendance is not checked or assignments collected.

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.

Response time: The assignments, projects and exams are typically graded in three days after they are turned in. Special circumstances like snow days, school closing or holidays, may occasionally delay the response time. Barring special circumstances, students' emails are usually responded to within one working day.

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.

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.

Learning outcomes. Students will:

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

Academic Integrity Statement: Saint Joseph's University encourages the free and open pursuit of knowledge; we consider this to be a fundamental principle and strength of a democratic people. To this end, SJU expects its students, its faculty, its administrators, and its staff to uphold the highest standards of academic integrity. The University expects all members of the University community to both honor and protect one another's individual and collective rights.

Students with Disabilities Statement: Reasonable academic accommodations may be provided to students who submit appropriate documentation of their disability. If students have need of assistance or questions with this issue, they are encouraged to contact the Office of Student Disability Services (SDS) at sds@sju.edu or by phone at 610.660.1774. The Office of SDS also provides an appeal/grievance procedure for complaints regarding requested or offered reasonable accommodations. More information can be found at: www.sju.edu/sds.

Health and Wellness Statement: Saint Joseph's University recognizes that physical and mental health strongly impact one's ability to do well in school and in life. As a result, there are many helpful campus resources designed to help students to care for their physical, mental, and spiritual health. Students may experience stressors that can impact both their academic experience and their personal well-being. These may include academic pressure and challenges associated with relationships, mental health, alcohol or other drugs, identities, finances, etc. All of us benefit from support during times of struggle and challenges. If you are experiencing concerns, seeking assistance sooner rather than later is a courageous thing to do for yourself and those who care about you. The resources at <https://sites.sju.edu/counseling/> can help you to cope with stress and to achieve your academic and personal goals.

COVID-19: SJU's Covid-19 policy is available at:

<https://www.sju.edu/hawk-hill-ahead/health-and-safety/monitoring>

In particular, it states that all faculty, staff, students and visitors are asked to carry a mask at all times while on campus and that they should wear it if asked to. Since my office is relatively small, please note that I ask you to wear a mask when you are in my office.