Math 4441 AU, AG Syllabus
Differential geometry Fall 2026

Course Information

- **Instructor:** Igor Belegradek ib@math.gatech.edu
- **Lectures:** TR 2-3:15pm in Skiles 311
- **Term:** Fall 2026
- **Course:** Math 4441 AU, AG, 3 credit hours
- **Office:** Skiles 240b
- **Office hours:** TBD

Course Description

- The main objective is to explore shapes of curves and surfaces in the 3-dimensional space. Specifically, the topics are local and global theory of curves and surfaces in 2D and 3D, Gauss map, parallel transport, holonomy and Gauss-Bonnet theorem. Calculus, linear algebra, and differential equations are the only tools.
- Even though training students to write and understand proofs (that is, mathematically convincing arguments) isn't the primary objective in this course, there will be a fair amount of proofs in lecture, homework and tests. These skills will come in handy if you take higher level math courses.
- Why proofs? Mathematical facts cannot be tested by experiment. A proof is a substitute. Checking its correctness is similar to testing a computer code. When dealing with not so intuitive objects, proofs serve as a safeguard. Once intuition is developed, proofs become less important, and one can transition to post-rigorous thinking. Some aspects of differential geometry may not seem intuitive, not until intuition is developed.

Course Learning Outcome

Upon successful completion of the course, the student will

- Explore the zoo of curves and surfaces.
- Become fluent in mixing multivariable calculus, linear algebra and differential equations.
- Learn the differential-geometric framework that is used to analyze curved spaces in 3D.
- Transition from calculus-like symbolic manipulations to geometric meaning.

Prerequisites

Formal prerequisites: Math 2401 or Math 2411 or Math 24X1 or Math 2551 or Math 2561 or Math 2X51. Here is what we will actually need

- a firm grip on calculus (including precalculus and multivariable calculus),
- basic linear algebra of two-by-two matrices.
- some differential equations, mostly linear systems of ODE and first order separable equations.
- some mathematical maturity to follow proofs, as in Math 2106. The students who have taken Math 4317 (Analysis I) will have an easier time. However, neither Math 2106 nor Math 4317 is a formal prerequisite and there won't be truly abstract proofs. Occasionally, we will mention compactness and uniform convergence but this won't appear on quizzes or the final.

Required Course Materials

There is no required text. The course will be taught from Instructor's notes. Optional resources:

- Famous curves and surfaces.
- Theodore Shifrin *Differential Geometry, A First Course in Curves and Surfaces* notes.
- Jason Cantarella Curves and Surfaces course page.
- Mohammad Ghomi's *Curves and Surfaces* notes, volume I.

Grading Policy

- Grading scale: A=85%, B=70%, C=55%, D=45%.
- Grades will not be "curved", that is, performance of your fellow students will have no effect on your grades. There is no set quota for the number of A's, B's etc, in particular, it is possible in theory that everybody will get an A.

Assignments

- Homework will be assigned weekly but not graded (AI can solve it).
- Bi-weekly quizzes will be based on homework and worth 65% of the final grade. A quiz with the lowest positive score will be dropped; thus a missed quiz cannot be dropped.
- The cumulative final is 30% of the final grade.
- Class participation 5% of the final grade. If you are not sufficiently participating in class, you will be asked to attend the office hours to discuss homework, which is how the participation grade will be determined.
- Rules for Quizzes and the Final: no use of outside resources or help, closed books and notes. A four page cheat sheet (letter size, two-sided if needed) will be allowed on the final (but not on the quizzes).

- How to succeed: do homework, internalize homework solutions, read class notes, and ask lots of questions. This is the best way to prepare for quizzes and the Final. The problems in Quizzes/Final will be similar in style to homework (except easier).

Attendance and Participation

- This will be an active classroom, where the students are expected to participate. The students who attend and participate usually learn more and get a better grade. However, the attendance won't be taken, and it is acceptable to miss a class for good reasons, e.g., illness, job interviews, GaTech approved events, etc.
- Quizzes can be made up (if missed for a valid reason). Another option would be to drop the quiz, which will make other quizzes worth more. To qualify email me promptly and we shall discuss the options.
- In accordance with Title II of the federal law, only accessible files can be posted on Canvas for student usage. Unfortunately, that means the instructor may not share the handwritten class notes. Thus you will need to attend the class, and take good notes yourself. The classes will not be recorded.

Collaboration, Group Work, and Use of Generative AI

- Working on homework in groups is encouraged. Feedback from other students will help you learn.
- Attending office hours is encouraged. The more you talk to me, the more you learn.
- Freely available AI can solve most differential geometry exercises at the level of this course. It is okay to use AI as a personal tutor and homework helper. I would not overdo it though, because you will need to develop enough independent understanding to perform well on quizzes and the final. Also don't forget that AI can make mistakes.
- I recommend that you make a serious attempt on every homework problem and then, if you choose to use AI, make sure you fully understand the solutions. In general, solving a harder math problem is a process and you should not expect to finish it in one sitting.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. Review Georgia Tech's Honor Code and the student Code of Conduct. Any student suspected of cheating or plagiarism on a quiz, exam, or assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations. Examples of cheating on a quiz or the final:

- use of unauthorized materials,
- getting outside help, be that from a person or an online resource,
- helping someone with their quiz or final.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services as soon as possible to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

Student-Faculty Expectations

At Georgia Tech, we believe that it is important to strive for an atmosphere of mutual respect, acknowledgement, and responsibility between faculty members and the student body. The Student-Faculty Expectations articulates some basic expectations that you can have of me and that I have of you. Additional information for research-related work is given in The Expectations of Advisors and Advisees. In the end, simple respect for knowledge, hard work, and cordial interactions will help build the environment we seek. Therefore, I encourage you to remain committed to the ideals of Georgia Tech while in this class.

Inclement Weather and Digital Learning Days

If a weather-related event affects campus operations, the class will take place in Zoom.

Undergraduate Student Academic Success Resources

A list of resources for undergraduate students' academic success and information about advising can be found at Success at Tech.

Student Well-Being:

At Georgia Tech, we are concerned about your overall physical, social, and mental well-being. A comprehensive list of wellness related resources has been compiled and maintained by the Office of the Vice President for Student Engagement and Well-being.