

University of Texas at Austin
Math 427L: Advanced Calculus for Applications II
Fall 2022

Time/Classroom: MWF, 2-3 pm / ETC 2.108

Discussion Time/Classroom: TuTH, 4- 5 pm / CPE 2.214

Professor: Dr. Heather Wilber

Office/Office Hours: PB 3.420 / W 9:30-11:30am, F 3:15-4:15 pm, or by appointment.

Textbooks: Vector Calculus, Marsden & Tromba, 6th edition. Purchasing the textbook is not strictly required, but you will need to access the textbook in some way in order to complete some assigned homework problems/access practice problems. You will not need any supplementary materials associated with this book. I may incorporate some ideas from an old classic, Div, Grad, Curl, and all that, by H.M Schey. You are welcome to purchase this book, but you do not need to, as I will provide handouts when needed.

Calculator: You will be allowed the use of a four function calculator only. During exams and quizzes, you will not be allowed access calculator apps on electronic communication devices.

Canvas: Canvas will be important for this course. Please be sure to check our canvas page regularly for assignments, announcements, and course updates.

Course Description: Matrices, elements of vector analysis and calculus of functions of several variables, including gradient, divergence, and curl of a vector field, multiple integrals and chain rules, length and area, line and surface integrals, Green's theorems in the plane and space, and, if time permits, complex analysis. Five class hours a week for one semester. Prerequisite: Mathematics 408D, 408L, or 408S with a grade of at least C-.

Software/programming: No specific software package or programming experience is required for this course. We may discuss some connections to linear algebra and computational mathematics, but these will never be needed to complete coursework and you will never be evaluated on your ability to program. That said, you might find programming resources useful for visualization purposes, checking your work, etc. I recommend Mathematica and the [Chebfun package](#), which is written in MATLAB.

Course Grade Calculation: Your grade will be composed of

Grade will be determined by	Percent of Grade
Average of homework	10%
Average of quizzes and in class assignments	10%
2 Exams (25% each)	50%
Final Exam	30%

Plus/minus grades will be used for the final grade as follows: A (100-93), A- (92-90), B+ (89-87), B (86-83), B- (82-80), C+ (79-77), C (77-73), C- (72-70), D+ (69-67), D (66-63), D- (62-60), F (59-0).

Communication: Communicating with me and your TA is an important part of your success and well-being as a student, and it is equally important to our success as instructors. Please reach out if you have questions or concerns about materials, grades/policies, or other issues. You can come visit during office hours, send an email, or set up an appointment (in person or on Zoom). **Be aware that I try not to check my email or respond to queries over the weekend.**

POLICIES ON EXAMS AND ASSIGNMENTS:

Exams: There will be no makeup exams. If you miss an exam with a valid excuse (medical, emergency, etc.), your score will be replaced by your score on the final examination. Documentation must give the reason you were absent and dates and times for the absence. It must also have a contact number so that I can verify the absence if necessary.

Quizzes: Quizzes will be delivered approximately every other week during discussion sessions (usually on Tuesdays). Your lowest quiz score will be dropped and not counted toward your grade. If you miss a quiz with a valid excuse (medical, emergency, etc.), you will be excused from that quiz. This documentation must give the reason you were absent and dates and times for the absence. It must also have a contact number so that I can verify the absence if necessary.

Homework: You will have approximately one homework assignment/week. All homework assignments must be completed on time. No late homework will be accepted. However, your two lowest homework scores will be dropped and not counted toward your grade.

Quest Homework: Most of our homework assignments will be completed using a web-based content delivery and homework server system called Quest, maintained by the College of Natural Sciences. This homework service will require a \$30 charge per student per class for its use, with no student being charged more than \$60 a semester. This goes toward the maintenance and operation of the resource. Please go to <http://quest.cns.utexas.edu> to log in to the Quest system for this class. After the 12th day of class, when you log into Quest you will be asked to pay via credit card on a secure payment site. Quest provides mandatory instructional material for this course, just as is your textbook, etc. For payment questions, email quest.billing@cns.utexas.edu.

Handwritten Homework: Occasionally, I may assign homework to be done by hand and turned in during class. This homework will be checked for completeness and correctness, but it will not be graded carefully. Solution sheets will be made available after the due date, and you are welcome to ask about these problems during office hours. You can use tablets to complete this work, but I require handwritten solutions; no LaTeX documents.

IMPORTANT DATES: ([click here for Academic Calendar](#))

Midterm exams 1 and 2: TBA

Last day to drop without permission: Sept 7

Last day for Q-drop/withdraw: Oct 25

Fall break; no classes: Nov 21-26

Last class day: Dec 5

Final exam: Thursday, December 8, 1:00 pm-3:00 pm

COURSE GOALS: SOFT SKILLS

The two big “soft skills” I hope to impart with you are as follows:

- 1) **Persistence.** In most STEM-related environments, you will eventually be expected to work on problems that don’t have straightforward or known solutions available. Math class is a good time to practice being comfortable with not knowing an answer, and not being able to quickly verify, look up, or easily work out solutions. Let yourself get comfortable with the fact that when you tackle a problem, you might have to be wrong, lost, confused, etc., for a while before you make a breakthrough. Be persistent!
- 2) **Build up problem-solving navigation tools.** The course material we are covering is widely available online. If you can resist the urge to look up answers online or have a friend immediately offer you the solution, you’ll find that over time you build up a set of muscles and tools for navigating your way toward solutions with ever-greater effectiveness, elegance, and efficiency. **This navigation process is what the central work of “doing mathematics” often is.** Don’t cheat yourself out of a good math workout, and pay attention to the skills you are developing/skills you see others using to think through challenges. For extra practice, write up good notes about your work: try to explain how the problem works as if you were teaching someone else, and try to link ideas from past work to your current work and make sense of how they work together/how they differ.

COURSE GOALS: HARD SKILLS (approximately)

This is a tentative list of topics I intend to cover, and they are not necessarily listed in the order we will encounter them. An up-to-date and detailed agenda will be published “on the fly” in Canvas as we work through material.

Chapter I THE GEOMETRY OF EUCLIDEAN SPACE

- 1.1 Vectors in two- and three-dimensional space
- 1.2 The inner product, length, and distance
- 1.3 Matrices, determinants, and the cross product
- 1.4 Cylindrical and spherical coordinates
- 1.5 n-dimensional Euclidean space

Chapter 2 DIFFERENTIATION

- 2.1 The geometry of real-valued functions
- 2.2 Limits and continuity
- 2.3 Differentiation
- 2.4 Introduction to paths
- 2.5 Properties of the derivative
- 2.6 Gradients and directional derivatives

Chapter 3 HIGHER-ORDER DERIVATIVES

- 3.1 Iterated partial derivatives
- 3.2 Taylor's theorem
- 3.3 Extrema of real-valued functions
- 3.4 Constrained extrema and Lagrange multipliers
- 3.5 The implicit function theorem

Chapter 4 VECTOR-VALUED FUNCTIONS

- 4.1 Acceleration and Newton's Second Law
- 4.2 Arc length
- 4.3 Vector fields
- 4.4 Divergence and curl

Chapter 5 DOUBLE AND TRIPLE INTEGRALS

- 5.1 Introduction
- 5.2 The double integral over a rectangle
- 5.3 The double integral over more general regions
- 5.4 Changing the order of integration
- 5.6 The triple integral

Chapter 6 THE CHANGE OF VARIABLES FORMULA

- 6.1 The geometry of maps
- 6.2 The change of variables theorem
- 6.3 Applications of double, triple integrals

Chapter 7 INTEGRALS OVER PATHS AND SURFACES

- 7.1 The path integral
- 7.2 Line integrals
- 7.3 Parametrized surfaces
- 7.4 Area of a surface
- 7.5 Integrals of scalar functions over surfaces
- 7.6 Surface integrals of vector functions

Chapter 8 THEOREMS OF VECTOR ANALYSIS

- 8.1 Green's theorem
- 8.2 Stokes' theorem
- 8.3 Conservative fields
- 8.4 Gauss' theorem

RULES AND EXPECTATIONS:

- Any student suspected of cheating on a graded assignment will receive a zero for the assignment and the incident will be reported to the university. Students who violate university rules on scholastic dishonesty are subject to disciplinary penalties, including the possibility of failure in the course and/or dismissal from The University. Since such dishonesty harms the individual, all students, and the integrity of The University, policies on scholastic dishonesty will be strictly enforced. See: http://deanofstudents.utexas.edu/sjs/acint_student.php
- You will not be permitted to share calculators during or after a quiz or exam. A cell phone, laptop, tablet, or other communication device will never be permitted as a calculator.
- No student will be allowed to start an exam after another class member has left the room.
- Undirected use of cell phones, mp3 players, headphones, laptops, tablets or other communication/electronic devices during class is disruptive and prohibited. If you are disruptive, you will be asked to leave the class.
- If you believe there has been a grading error, I will happily offer a re-grade if you submit to me a typewritten letter detailing the error along with the graded item in question. Such a request must be made within one week from the time the item was returned to the class.
- I will not respond to email requests for grade updates because of privacy concerns. You are welcome to come to my office at any time to discuss your grade in the course.
- It is recommended that you attend all classes. Missing class will likely have a negative impact on your performance in this course. However, the fact of your absence will not be used directly in computing your final grade. Note that if you miss a quiz during recitation, this could affect your grade (see Quiz policies).
- Lecture material will not be documented in any recordings or posted notes from the professor or TA. If you miss class (excused or unexcused absence) it is your responsibility to catch up on the material. I suggest meeting with another student in class to copy the notes. If you have questions after you have reviewed the material presented during your absence, please see me or the TA during office hours as soon as possible so you do not get behind in the course.
- Taking audio and/or video recordings during the lecture/recitation is prohibited. This is primarily because your classmates have not consented to be actively or passively recorded. Please respect this preference.

CAMPUS RESOURCES:

Students with Disabilities: The University of Texas at Austin provides upon request appropriate academic accommodations for qualified students with disabilities. For more information contact Services for Students with Disabilities. <http://ddce.utexas.edu/disability/>

Mental Health: To help with stress, study habits, crises, or any personal matters, please look for assistance at the Counseling and Mental Health Center on Campus www.cmhc.utexas.edu

Religious Holidays: If you are unable to participate in a required class activity (such as an exam) because it conflicts with your religious traditions, please notify me IN ADVANCE and I will make accommodations for you. Typically I will ask you to complete the required work before the religious observance begins.

Campus Safety: Please familiarize yourself with the Emergency Preparedness instructions provided by the university's Campus Safety and Security office. In the event of severe weather or a security threat, we will immediately suspend class and follow the instructions given. You may wish to sign up with the campus alert programs.

Computers: There is a 40-seat undergrad computer lab in RLM 7.122, is open to all students enrolled in Math courses. Students can sign up for an individual account themselves in the computer lab using their UT EID.

Counseling: Students often encounter non-academic difficulties during the semester, including stresses from family, health issues, and lifestyle choices. Please reach out if you need help. Though I am not trained to help you with this, I can chat with you and direct you to available resources. You can also take advantage of the Counseling and Mental Health Center, Student Services Bldg (SSB), 5th Floor, open M-F 8am-5pm. (512 471 3515, or www.cmhc.utexas.edu)

Emergency Evacuation Policy: Occupants of buildings on The University of Texas at Austin campus are required to evacuate buildings when a fire alarm is activated. Alarm activation or announcement requires exiting and assembling outside. Familiarize yourself with all exit doors of each classroom and building you may occupy. Remember that the nearest exit door may not be the one you used when entering the building. Students requiring assistance in evacuation shall inform their instructor in writing during the first week of class. In the event of an evacuation, follow the instruction of faculty or class instructors. Do not re-enter a building unless given instructions by the following: Austin Fire Department, The University of Texas at Austin Police Department, or Fire Prevention Services office.