MATH 2310: CALCULUS III

LEONID PETROV
FALL 2024
SECTIONS 100 AND 200 (MONDAYS AND WEDNESDAYS)

1. *First things first*

1.1. **Overview.** How do you compute the value of π with a dart? How do you make the largest possible box out of a piece of paper? How do Google's Maps know all the distances between any two points? How do you find the direction if you are lost in the universe? Most importantly, how come these are all mathematical questions?

Mathematicians have worked for centuries to answer these and many other questions from various aspects of the real world. This course aims to introduce you to one of the most classic and powerful approaches: the Multivariable Calculus. It studies a wide range of topics involving functions in more than a single variable (two or three in most cases). This knowledge is a product of many generations of great mathematicians, and it is at the center of modern sciences and many areas of mathematics.

By the end of this course, you will be able to:

- Describe basic 3-dimensional objects, such as curves, surfaces, solids, and vector fields in various coordinate systems.
- Understand further the concept of differentiation, and adapt its algebraic and geometric interpretations to models in physics, chemistry, economics, and other disciplines you learned or are learning in other courses.
- Explain the mathematical meaning of infinitesimal and infinity, and implement these to study properties of 2- and 3-dimensional objects such as length, area, volume, etc.
- Relate differentiation and integration in various settings and explore how this can give us insights into real-world applications.
- Make concise mathematical arguments about the concepts of the course.

1.2. **Basic information.**

	Section 1	Section 2
Class times	MW TBD; TBD	MW TBD; TBD
Discussions	Tu TBD; TBD	Tu TBD; TBD
Final exam	TBD	TBD

Instructor: Leonid Petrov
Email: petrov@virginia.edu
Office: 209 Kerchof Hall
Office hours: Mon 11:30AM-12:30PM, Wed 10:30-11:30AM, or by appointment

Teaching Assistant: TBD
Office: TBD
Office hours: TBD

Grader: TBD

1.3. **About the instructor.** I am a professor in the Department of Mathematics at UVA, and I've been here since 2014. My research area is probability theory. More precisely, I am using exact formulas to study large random systems. I also like computer simulations of random systems, some examples are at this link or at my office door.

1.4. **Textbook.** *Calculus* or *Multivariable Calculus*, 9th edition, by James Stewart (earlier editions acceptable modulo confirming consistency with assigned material)

1.5. **Discussion sessions.** In addition to our in-class meetings on Mondays and Wednesdays, there will be 50-minute discussion sessions on Tuesdays led by the Teaching Assistant. These meetings are highly important for the success in the course, and will consist of:

- Group work on due homework (all homework will be due on Sundays). By this time you should have thought about most of the homework problems, and should have some questions. The TA will separate you into different study groups, randomly every session. It's a great opportunity to share thoughts and get to know your fellow students. Even if you have figured out all problems, take this chance to practice presenting your thoughts to your peers. In addition, you may get some different perspective on your solutions, which is always helpful. Also read Section 6.2 on collaboration.
- Discussion of past homework, to clear up things you didn't understand. Solutions to past homeworks will be made available to you.
- Occasional unannounced ("pop") quizzes (2-4 during the semester), to ensure you have the basic understanding of current topics.
- The 2 midterm tests will also be given during discussion sessions.

2. *Assessment*

Learning mathematics means *doing* mathematics.

2.1. **In-class work (5%).** This includes participation in class activities and discussions.

2.2. **WebAssign homework (20%).** Weekly online homework assignments to practice concepts and techniques.

2.3. **Written homework (20%).** Weekly written assignments to develop problem-solving skills and mathematical writing.

2.4. **2 midterm tests (15% each, 30% total).** The midterm tests will have similar taste as homeworks, and will test basic knowledge of the material. These 50-minute tests will be given during discussion sessions.

A two-sided letter size formula sheet, hand-written by yourself, will be allowed on each midterm test and the final exam. Preparing this formula sheet will help you review the material, and paint a systematic picture in your head. I encourage you to collaborate on test preparation, but needless to say that during tests and exams each student must work individually.

The use of calculators is not allowed on midterm tests and the final exam.

2.5. **Final exam (25%).** The final exam will be cumulative, but will emphasize topics covered after the last midterm.

3. *Communication*

We will use Canvas for course announcements, assignment submissions, and general communication. Please make sure you have access to our course Canvas page and check it regularly.

4. *Approximate course schedule*

The homeworks are usually due on Sundays at 11:59pm, and most of the time will be assigned at least a week before the due date. The midterm tests are given during discussion sessions, their solutions are discussed and questions on them are answered on Wednesdays the same week.

Week	Topics	Sections
1. 8/26	Curves Defined by Parametric Equations, Calculus with Parametric Curves	10.1–10.2
2. 9/2	Polar Coordinates, Three-Dimensional Coordinate Systems, Vectors	10.3, 12.1–12.2
3. 9/9	The Dot Product, The Cross Product	12.3–12.4
4. 9/16	Equations of Lines and Planes, Cylinders and Quadric Surfaces	12.5–12.6
5. 9/23	Vector Functions and Space Curves, Derivatives and Integrals of Vector Functions	13.1–13.2
6. 9/30	Arc Length and Curvature, Motion in Space: Velocity and acceleration	13.3–13.4
7. 10/7	Function of Several Variables, Limits and Continuity	14.1–14.2
8. 10/14	Partial Derivatives, Tangent Planes and Linear Approximations	14.3–14.4
9. 10/21	The Chain Rule, Directional Derivatives and the Gradient Vector	14.5–14.6
10. 10/28	Maximum and Minimum Values, Lagrange Multipliers	14.7–14.8
11. 11/4	Double Integrals over Rectangles, Double Integrals over General Regions	15.1–15.2
12. 11/11	Double Integrals in Polar Coordinates, Applications of Double Integrals	15.3–15.4
13. 11/18	Surface Area, Triple Integrals	15.5–15.6
14. 11/25	Triple Integrals in Cylindrical and Spherical coordinates	15.7–15.8
15. 12/2	Change of Variables in Multiple Integrals, Vector Fields	15.9, 16.1
16. 12/9	Review and Final Exam Preparation	

Note: The schedule is approximate, and the time spent on various topics/sections can change during the semester (however, the schedule will then be updated). Midterm dates will be announced at least two weeks in advance.

5. *Important dates*

- August 27, 2024: Courses begin
- September 2, 2024: Labor Day (classes held)
- October 12-15, 2024: Fall Reading Days (no classes)
- November 27-December 1, 2024: Thanksgiving recess
- December 6, 2024: Courses end
- December 9-17, 2024: Final exams

6. *How to succeed in the course*

6.1. **Resources.** Here are some things to keep in mind which will help you succeed in the course:

- Textbook has a lot of nice examples, and great pictures which will help you visualize the things you learn.
- In addition, there are multiple web resources (Wikipedia, Khan Academy, just Google up!) which can complement the textbook's material and style of exposition.
- Math tutoring center provides free tutoring for the Calculus III course. Location and schedule will be announced at the beginning of the semester.
- Discussion sessions are highly important for the success in the course, with a chance to collaborate on due homeworks, and ask any questions you might have.
- Canvas is a great online tool to ask and answer questions about the course and collaborate with your fellow students.

6.2. **Collaboration.** Group work on homework problems is allowed and strongly encouraged (unless otherwise stated for a particular assignment). Discussions are in general very helpful and inspiring. Nevertheless, before talking to others, get well started on the problems, and contribute your fair share to the process.

When completing the written assignments, everyone must write up his or her own solutions in their own words, cite any reference other than the textbook and class notes. Quotations and citations are part of the Honor Code for both UVa and the whole academic community.

It is very important that you truly understand the homework solutions you hand in, otherwise you may be unpleasantly surprised by your in-class test results.

If you work together on homework, please write the names of your collaborators on the front.

7. *Policies*

7.1. Late/make up work. Each assignment will have due date and time. Late assignments are not accepted. There will also be no make up midterm tests. However, if you have special needs, emergency, or unavoidable conflicts, please let me know as soon as possible, so we can arrange a workaround.

7.2. Honor Code. The University of Virginia Honor Code applies to this class and is taken seriously. Any honor code violations will be referred to the Honor Committee.

7.3. Special needs. All students with special needs requiring accommodations should present the appropriate paperwork from the Student Disability Access Center (SDAC). It is the student's responsibility to present this paperwork in a timely fashion and follow up with the instructor about the accommodations being offered. Accommodations for test-taking (e.g., extended time) should be arranged at least 5 business days before an exam.