Elementary Functions and Calculus I

Course Syllabus

Autumn 2023 **Math 131**

§A. Key Information

- **Instructor:** Depends on the section in which you are enrolled. (See table 1 on page 2.)
- **Class Meetings:** Monday, Wednesday, and Friday at a regularly prescribed place and time for your section (also found in table 1 on page 2). The locations might get updated as late as the morning of Sep 27 - please check back.
- **Tutorial Sessions:** Tuesdays and Thursdays at a regularly prescribed place and time for your subsection (also in table 1 on page 2). Attendance and participation is mandatory and accounts for 5% of your grade. See Canvas for which tutorial you should be attending.
- **Canvas:** Our course Canvas page (https://canvas.uchicago.edu/courses/51908) will effectively function as a homepage for our course and contain all relevant information. It is recommended that you check Canvas daily for updates, announcements, and assignments.
- **Office Hours:** Please see Canvas for up-to-date office hours. This syllabus will eventually list the office hours for each section once they are finalized. Note that a student should only attend the office hours of the instructor of the section in which you are enrolled. *It is highly recommended to book a meeting ahead of time.*
- **Textbook:** Calculus, 9th Edition by Varberg, Purcell, Rigdon. ISBN-13: 9780131429246. Any version that you are comfortable using (hardback, PDF, etc.) will suffice. For any homework exercise assigned directly from the textbook, a pdf scan of the problems will be provided. Any other homework will be assigned through Canvas.
- **Weekly Exercise Sets:** Will be assigned weekly and graded for both completeness and correctness. Due dates will usually be Friday at 6pm, and the total weight of weekly exercise sets is 10%. Late Homework may receive a late penalty of up to 20% per day, and homework submitted more than 48 hours after the due date will receive no credit. Exceptions such as medical emergency will be handled on a case-by-case basis.
- **Suggested Exercises:** Announced in Canvas and will provide extra practice. Not for a grade, but some test questions may be selected from these exercises.
- **Tutorial Quizzes:** Will occur at the conclusion of Thursday tutorial sessions (except midterm weeks) and will combine to account for 5% of your overall grade.
- **Midterm Exams:** Will occur twice in the evening, once on *October 18* and another on *November 15*. Both will occur at 7pm (as per your registration schedule). Room assignments will be announced in due time. Each midterm will account for 25% of your overall grade (for a total of 50%).
- **Final Exam:** Will occur once at a common time (among all sections) during the final exam week (TBD). The final will be cumulative, run two hours, and account for 30% of your overall grade.

It is the policy of the Department of Mathematics that the following rules apply to final exams in all undergraduate mathematics courses:

- The final exam must occur at the time and place designated on the College Final Exam Schedule. In particular, no final examinations may be given during the tenth week of the quarter, except in the case of graduating seniors
- Instructors are not permitted to excuse students from the scheduled time of the final exam except in the cases of an Incomplete.

Section	Instructor	Class Meetings (MWF)	Tutorial Sessions (TR)	
10	Zoalroshd, Seyed	8:30-9:20am Ryerson Phys Lab 177	8-9:20am	(T1) Social Sciences Rsch Bldg 106 (T2) Social Sciences Rsch Bldg 107 (T3) Social Sciences Rsch Bldg 108
20	Nguyen, Hoan	9:30-10:20am Eckhart Hall 207A	8-9:20am	(T1) Gates-Blake Hall 211 (T2) Hinds Lab Geo Sci 180 (T3) Gates-Blake Hall 401
22	Sutton, Callum	9:30-10:20am Saieh Hall for Economics 247	8-9:20am	(T1) Gates-Blake hall 411 (T2) Gates-Blake Hall 502 (T3) Gates-Blake Hall 506
24	Zhang, Samanda	9:30-10:20am Pick Hall 022	8-9:20am	(T1) Harper Mem Library 141 (T2) Harper Mem Library 150 (T3) Wieboldt Hall 102
25	Gravel, Katherine	9:30-10:20am Saieh Hall for Economics 103	9:30-10:50am	(T1) Eckhart Hall 117 (T2) Gates-Blake Hall 211 (T3) Classics Building 313
28	Chowdhury, Subhadip	9:30-10:20am Ryerson Phys Lab 177	9:30-10:50am	(T1) Gates-Blake Hall 401 (T2) Gates-Blake Hall 411 (T3) Gates-Blake Hall 506
30	Olson, Mark	10:30-11:20am Ryerson Phys Lab 276	11-12:20pm	(T1) Gates-Blake Hall 211 (T2) Kent 106 (T3) Gates-Blake Hall 401
32	Bowman, David	10:30-11:20am Pick Hall 022	11-12:20pm	(T1) Gates-Blake Hall 502 (T2) Gates-Blake Hall 506 (T3) Harper Mem Library 141
34	Devlin, Charley	10:30-11:20am Eckhart Hall 207A	12:30-1:50pm	(T1) Eckhart Hall 117 (T2) Gates-Blake Hall 211 (T3) Cobb Hall 103
40	Li, Ray	11:30-12:20pm Eckhart Hall 207A	12:30-1:50pm	(T1) Gates-Blake Hall 401 (T2) Gates-Blake Hall 502 (T3) Gates-Blake Hall 506
44	Wilson, Christopher	11:30-12:20pm Eckhart Hall 117	11-12:20pm	(T1) Harper Mem Library 151 (T2) Stuart Hall 209 (T3) Psychology Green Hall 101
46	Su, Boyang	11:30-12:20pm Kent Chem Lab 106	12:30-1:50pm	(T1) Harper Mem Library 151 (T2) Stuart Hall 209 (T3) Gates-Blake Hall 411
50	Contreras Hip, Andres	12:30-1:20pm Ryerson Phys Lab 177	5-6:20pm	(T1) Wieboldt Hall 230 (T2) Wieboldt Hall 130 (T3) Cobb Hall 116
52	Yao, Yuhui	12:30-1:20pm Ryerson Phys Lab 276	5-6:20pm	(T1) Cobb Hall 219 (T2) Social Sciences Rsch Bldg 105 (T3) Social Sciences Rsch Bldg 106

Table 1: Instructors and Meeting Times

Registration Changes: Once we begin classes, if you wish to change your registration, you will need to contact mathadvising@math.uchicago.edu. Note that you have until Week 3 to finalize your math registration.

§B. Course Description

Calculus can be viewed broadly as the study of change. Some of the immediate questions to ask about any changing quantity could be: "how do we know if it is changing", "when is it increasing or decreasing", and perhaps more importantly, "how fast is the quantity changing?". We hope to answer these questions by interpreting mathematical quantities as functions that are represented graphically, numerically, analytically, or verbally; and interpret their derivative as their rate of change.

Math 131, along with the first couple of weeks of Math 132, covers the content of a typical differential calculus course. We will provides a careful but comprehensive treatment of limits, continuity, and differentiability of non-trigonometric algebraic functions, and applications of the derivative. Here is some general advice that may prove helpful moving forward. Start your homework assignments early, so that if you need help you have sufficient time to meet with me or the Junior Tutors. Begin studying for quizzes and exams well in advance. Put your good study habits into practice by reviewing formulas and working through extra suggested problems when necessary, so that you can identify weaknesses and seek help. Remember that part of doing real math is productive failure: you'll try things that don't work; learn something from that failure; try something new that works a bit better, and... after a while, you will figure it out, and come out with a much more robust understanding of the structure of mathematics.

Learning Goals

We will cover much of Chapters 0-3. Below is a rough outline of coverage, and a summary of our main learning goals.

- Ch 0 - Preliminaries, Sections 0.1-0.6 (6 lectures);
  - Define basics of Set theoretic concepts focusing on number sets.
  - Learn how to write down your arguments logically and about different techinues of proving a statement.
  - Solve inequalities with a focus on those relevant to $\epsilon - \delta$ proofs.
  - Use coordinate geometry to find equations of circles and staright lines.
  - Sketch and identify the graphs of elementary functions, specifically polynomials, power functions, absolute, and greatest integer function.
  - Describe different properites of function: domain, range, composition, translations, symmetry, odd/even, roots, asymptotes, etc.; and how they affect the graphs.
- Ch 1, Sections 1.1-1.3, 1.5, and 1.6 (5 Lectures);
  - Understand the intuitive concept of Limits graphically and numerically
  - Define Limits rigorously using $\epsilon - \delta$ and give proofs using appropriate justification and notation
  - Define and evaluate (using algebra) the limit of a function as the input approaches a point (possibly from just one side) or at infinity.
  - Learn to use Squeeze theorem as necessary.
  - Use infinite limits to provide a formal definition of asymptotes
  - Define and determine the continuity of a function at a point or in general, and correctly characterize types of discontinuities.
  - State and use the Intermediate Value Theorem.
- Ch 2, Sections 2.1-2.3 and 2.5-2.8 (8 Lectures);
  - Experiment in DESMOS with the tangent and velocity problem
  - Learn how to formally define derivative and recognize points where a function is (and is not) differentiable, with appropriate justification. Be able to match a function with the graph of its derivative function.
  - Compute derivatives correctly for sums, constant multiples, powers, and polynomials functions; their products and quotients; and correctly use the chain rule for function composition.

- Evaluate higher order derivatives and apply them to Physics in the context of velocity and acceleration.
- Learn to differentiate functions implicitly and find equation of tangent lines to a curve.
- Relate the rates of change of variables in an applied problem.

- Ch 3, Sections 3.1-3.4 (4 Lectures).
  - Identify relative and absolute extrema (maximum and minimum points) of a function graphically.
  - Use calculus to identify critical points and inflection points of functions and correctly apply them to identifying extrema.
  - Determine absolute extrema for a function on a closed interval.
  - Interpret monotonicity and concavity of a graph using derivatives and use information about f, f', and f'' to create examples of functions.
  - Interpret derivative as a rate of change in the context of statistics and economics.

§C. Details of each type of assignment and test

- **Active Participation:** You are expected to be an active participant in this course. Math is not a spectator sport! Math is best learned actively. During class, listen actively and think actively. Contribute your meaningful thoughts. There are many ways to participate in this course, including: attending class meetings and discussion, asking and answering questions in class, working with others both inside and outside of the classroom, and attending office hours.

> If you feel that you need to miss class for some reason, you are responsible for letting me know via email as soon as possible, as well as getting any material and announcements that you miss from fellow classmates. In particular, you should obtain and read the class meeting notes and do the corresponding reading in the textbook before seeking additional help with the material from that day.

- **Weekly Exercise Sets:** Usually 3-5 problems on the content covered in each lecture will be assigned as homework after the session. Wednesday, Friday, and Monday's problems will be due on Friday. You will be uploading a PDF of your work directly to Gradescope via Canvas. Your instructor will walk you through the process as necessary.
- **Tutorial Worksheets:** During each tutorial session, students will work in groups to complete a practice problem worksheet under the direction of the Junior Tutors. Note that these sessions have a set agenda and are not meant to be office hours. Participation is mandatory and counts towrards your grade.
- **Tutorial Quizzes:** Each Thursday tutorial session (that does not follow a midterm exam) will conclude with a quiz on topics encountered since the previous quiz (and/or exam). Quizzes may contain questions of the form of true-false, multiple choice, and/or free response. As per official department policy regarding Math 131, your two lowest quiz scores (this includes any quiz you miss) will be dropped.
- **Midterms:** Each Midterm will cover the content covered in class up to the week before. These will be cumulative. Requests for make-up midterms should be made directly to me and will be considered on a case-by-case basis by my discretion. If you anticipate needing to request a make-up exam, communicate with me as soon as possible.
- **Final Exam:** The final exam is comprehensive and every question will be graded and scored out of 100pts. That overall Final Exam score will remain worth 30% of your overall grade in our course.
  - Our Final will include questions from topics which directly relate to Sections 0.1-1.3 (namely, those on Midterm 1) as well as those relating to Sections 1.5-3.1 (namely, those on Midterm 2). Every student's performance on these questions (of the Final related to Midterm 1 topics) will be tallied separately from the over Final Exam score. Similarly for questions of the Final related to Midterm 2 topics.
  - If the percentage of the points earned on the questions of the Final related to Midterm 1 exceeds that of your Midterm 1 score, then your Midterm 1 subscore on the Final will replace your Midterm 1 grade. Similarly for Midterm 2.

Let's consider two examples.

1. Say you earned a 42% on Midterm 1, and on the questions of the Final relating to Midterm 1 you earned 75% of those points. Regardless of your overall Final Exam score, your new Midterm 1 score will be 75%.
2. Say you earned an 87% on Midterm 1, and on the questions of the Final relating to Midterm 1 you earned 75% of those points. Regardless of your overall Final Exam score, and your Midterm 1 score will remain an 87%.

Ultimately, your overall Final Exam score will always count. However, if you show (on the Final) that you have learned the Midterm 1 material better (than you knew it back a couple weeks ago), you can replace your Midterm 1 grade with that better performance from the questions of the Final relating to Midterm 1 (and similarly for Midterm 2).

§D. Collaboration Policy on Homework

Collaboration on written homework is encouraged; however, you need to carefully balance learning with your fellow students and finding your own path through the material. You must follow the collaboration guidelines below.

1. When you solve homework problems, outside materials are not allowed unless the instructor give explicit permission. (By outside materials, we mean materials like web pages and solutions that are not distributed by the instructor. If you are unsure, just ask!)
2. Unless otherwise specified, you may use mathematical software for written homework problems; if you do so, include a printout/screenshot that shows not only the answer but also the commands you used ("Show your work!"). Note that many of the computational problems demand that you show every step of an algorithmic process, so don't rely on software to skip any steps!
3. On your written homework, you must indicate who your collaborators are. (If you collaborate with different people on different problems, say so!)
4. Work on a problem by yourself until you have your own "idea" about the problem; after that, you may start collaborating. A valuable idea can be as simple as a sense of why you are stuck!
5. Keep written collaborative work separate from your written individual work. The same applies when you discuss problems with tutors or me.
6. Do the actual write-up of your homework assignment without collaboration notes so as to reflect your own understanding of the problem. If you cannot write the solution without referring to your collaboration notes, then you have not yet understood the solution. In that case, go back to step (4).

Note that the last guideline above means that while you are collaborating (including with me at Office Hours!), you cannot be simultaneously working on the final draft of your homework! To ensure productive collaborations, you should not work in groups larger than four people on any given problem at any given time. Large groups of people "working together" are not really working together! **If anything is unclear, ask the instructor!**

§E. How to determine your grade?

The weights of each differnet type of assignment are as follows:

Weekly E-Sets	10%
Tutorial Attendance and Participation	5%
Tutorial Quizzes	5%
Midterm 1 and 2	25% each
Final Exam	30%

Your numerical score will then be rounded to the nearest integer and converted into a letter grade for your overall course grade, taking into account the difficulty of the exams and the overall distribution of scores. The initial guideline for grade determinations will be the following: A 93-100%; A- 90-92%; B+ 88-89%; B 83-87%; B- 80-82%; C+ 78-79%; C 73-77%; C- 70-72%; D+ 68-69%, D 60-67%.

Note that it is the policy of the Department of Mathematics that Math 13100 cannot be taken with a Pass/Fail (P/F) grading scheme, regardless of your major or purpose in taking the course.

W and I grades: You may meet with your College Adviser (not the instructor) to request a "W" (withdrawal) grade until 5pm of Monday on Week 9.

"I" (Incomplete) grades are rarely given, and only to those who have done the majority of the work in the course of passing quality, who, because of illness or other good reasons, are unable to complete all the course work by the end of the quarter.

Final decision regarding any changes to these guidelines will be that of the Director and Co-Directors of Undergraduate Studies in the Department of Mathematics and will be communicated to all in Canvas. Any such changes can only (if anything) loosen the requirements from what is given above.

§F. Helpful Resources

Performing well in this course will be a function of your engagement and investment. A minimum requirement of yourself should be actively participating in class meetings and tutorial sessions, taking notes to support your studying, and successfully understanding all exercises that are assigned. Moreover, we encourage you to observe your thoughts related to classwork, homework, and other class documents. Calculus, a mathematical study of change, connects to many topics within a broad range of areas of study, so taking the time to explore connections between what we have studied and what you've studied previously will only enrich your experience in this course.

Office Hours

Please stop by office hours to ask questions! We have set aside this time specifically to help you learn and be successful in the course. Any and all questions are welcome in class or in my office. Big-picture questions beyond "How do I solve this problem?" are highly encouraged. (Even questions about math that aren't immediately about your next homework due. Gasp!) Over and over, the students in our courses that improve the most are the ones that most frequently attend office hours. If you are unable to make any of the office hours, please email the instructor to set up an appointment.

College Core Tutor Program

The College Core Tutor Program (https://college.uchicago.edu/academics/college-core-tutor-program) is a peer-based tutoring program for UChicago undergraduates designed to provide one-on-one assistance and small group support to undergraduate students in scientific and quantitative subjects, including chemistry, economics, mathematics, statistics, computer science, physics, and biology. Their tutors are upperclassmen in the College with exceptional academic records or graduate students — many of them former Teaching Assistants in the Core science courses.

It should be noted that these tutors are not affiliated with this specific section of the course or the math department in general, so they may explain things differently than or use different conventions to how they were discussed in class. Always be sure to double check with our authoritative sources: your notes from class, the textbook, and me, either in class or office hours.

No appointments are necessary; drop-in Sundays through Thursdays between 6 p.m. and 10 p.m. CST starting the third week of the quarter through the week of final exams.

Academic Accommodations

If you need any special academic accommodations, please provide your instructor with a copy of your Accommodation Determination Letter (provided to you by the Student Disability Services office) as soon as possible so that you may discuss how your accommodations may be implemented in this course. If you are in the process of obtaining accommodations, please inform your instructor as soon as possible. More information can be found here: https://disabilities.uchicago.edu/.

Religious Accommodations

The University of Chicago is home to students of all the world's major religions and, though firmly a secular institution, values the rich diversity of spiritual expression and practice found on campus. It is therefore the policy of the University that students who miss class, assignments, or exams to observe a religious holiday must be accommodated as follows: (i) absences may not be counted as a missed class in any course in which attendance is a measure of academic performance; (ii) reasonable extensions of time must be given, without academic penalty, for missed assignments; and (iii) exams must be reasonably rescheduled without academic penalty. Students must inform their instructors in writing of their need to observe a religious holiday reasonably well in advance of the absence, preferably at the beginning of the quarter. More information can be found at the following; https://provost.uchicago.edu/handbook/clause/policy-religious-accommodation-missed-classes-assignments-and-exams.

Wellness Resources.

Know that UChicago has counseling available both 24/7 and by appointment through http://wellness.uchicago.edu. Also know that medical care (beyond that related to Covid-19) is available, including 24/7 access to medical professionals to address your health care questions.

§G. Classroom Norms

'Growth', not 'Ability'

There is a very prevalent belief that you are either "good" or "bad" at math, and if you are "bad" at it, then you will always be bad at it no matter how hard you try. This is extremely false, and the mathematics community bears a lot of responsibility for perpetuating this myth. In reality, mathematics is just like any other discipline or skill: you can improve more and more with practice.

We are all capable of growth in mathematics. You should measure your success in this class by how much your understanding of the concepts have improved over the course of the quarter. Also, math is very hard, so you should expect to struggle with the material! When you struggle, you are learning and growing. Not all people show their struggle in equal ways, so you should always be wary of judging your progress based on your perception of your peers' struggle. You are probably doing better than you think.

Respecting Each Other

We are not all coming to this class with the same privileges, resources, time, and knowledge. It's really important to keep this in mind when working with each other on homework assignments and during class meetings. **It is our strong belief that as a community, mathematicians and scientists need to do a much better job of making our disciplines more accessible to people of all races, genders (including gender non-conforming folks), sexual identities, and class backgrounds.** While this is a priority for us in the classroom, we do not claim to know how to best honor this commitment, and so **we are very open to feedback from students when it comes to making the course more accessible and inclusive to all identities.**

It's also important to think about how to respect one another when working together in groups. It's not equally easy for all of us to speak up in a large group, and the voices of historically underrepresented/marginalized students are most easily drowned out in group work. So please keep this in mind when working together. Here are some concrete examples of positive collaborative behavior:

- Making sure everyone who wants it has the opportunity to speak frequently. This can mean checking in with each other to make sure everyone is following along and contributing when they have an idea.
- Respecting people's pronouns and other aspects of their identity.
- Making sure that everyone's ideas are acknowledged when writing up the final solution to a problem. When working in groups, solutions often evolve organically; an idea might pop into your head and you may think it's yours and yours alone, but perhaps you only arrived there because of something else that someone already said. Pay attention to what people are saying and try to learn from one another.

We will do our best to check in with folks periodically during the quarter. **If at any time in the quarter you want to be working in a group but do not have a group of students to work with, please let the instructor know and they will help you find a working group. If at any time in the quarter, you find yourself in a group of students for which the above behaviors aren't being practiced and people aren't feeling respected, please let the instructor know as well.**

§H. Policies and Protocols

Attendance and Absence

Attendance is *crucial* to success in this class. Your best chance to discuss new material, ask questions, and avoid confusion is during class. So, don't miss class! You are responsible for all material and announcements from class, even in case of absence. Much of this information will be available on Canvas. Please check in with your instructor and with your classmates when you are back.

That said, life happens. We get the flu (or COVID!). Relatives need your help. When this happens, do what you need to do. We trust that you are an adult and will make the best choices that you can. We appreciate it if you can notify the instructor in advance of an absence, if possible. While we do not track attendance during class, we will alert your course advisor in the event of multiple missed classes, missed homework assignments, etc.

Academic Integrity

Academic honesty is central to the spirit of a UChicago education. On individual work, take care to independently communicate your submissions (regardless of how many others you may have collaborated with along the way to developing a solution). On tests and the final, let your work be original to your mind and your thoughts.

Violations of academic integrity are serious and will be handled seriously. Resulting punishment could include (at least) taking a zero for an assignment where an instructor has probable cause that cheating or plagiarism has occurred. For more details, regarding academic honesty within the College, please visit the following link: https://college.uchicago.edu/advising/academic-integrity-student-conduct.

Technology in the Classroom

Encouraged for learning math; discouraged for distracting yourself or others! As a matter of courtesy, please turn off or silence cell phones, pagers, and other communication and entertainment devices prior to the beginning of class. At some points in the course, we may be explicitly using laptops or cell phones to better understand the mathematics we're studying. Please respect your fellow students by not using any of them in a way that is distracting or counterproductive to class.

UChicago Health Pact

All students on campus are required to adhere to the guidelines in the UChicago Health Pact in order to promote a safe environment in the classroom. For the most up-to-date information on University policies, visit: https://goforward.uchicago.edu. Any concerns over inappropriate PPE usage, physical distancing, cleaning or disinfection, or other COVID19 related public health concerns should be directed to UCAIR. If there is an emergency, call 773-702-8181 or dial 123 on any campus phone. If you were potentially exposed to COVID-19 or your COVID-19 test results come back positive, reach out immediately to: C19HealthReport@uchicago.edu Follow whatever subsequent instructions you receive from this team of medical professionals.

Sexual Misconduct Policy

The University of Chicago recognizes that members of the university community are responsible for ensuring that the community is free from discrimination and other forms of sexual misconduct based on sex or gender, including sexual harassment, sexual assault, stalking, domestic violence and dating violence. Faculty are considered "Individuals with Title IX Reporting Responsibilities" of the University and are obligated to report information to the Title IX Coordinator related to sexual misconduct. If you think your rights, or the rights of someone else in the university community, have been violated you can find information on resources and reporting at: https://umatter.uchicago.edu/.

Title IX Coordinator: Bridget Collier, Associate Provost & Director (bcollier@uchicago.edu, 773-702- 5671)

Recording and Deletion Policy

The Recording and Deletion Policies for the current academic year can be found in the Student Manual under Petitions, Audio & Video Recording on Campus.

- Do not record, share, or disseminate any course sessions, videos, transcripts, audio, or chats.
- Do not share links for the course to those not currently enrolled.
- Any Zoom cloud recordings will be automatically deleted 90 days after the completion of the recording.

Zoom Protocols

Whenever there is a virtual component to the course (such as during Office Hours), there is an expectation that students in this course will be actively engaged and on camera while on Zoom. If a student requires an exception, they will need to reach out to me directly.

The instructor reserves the right to make changes to this syllabus as necessary. Any changes will be announced in class and on Canvas in a timely manner.