Mathematical Methods in the Physical Sciences III

Syllabus

Autumn 2025 **Math 185**

§A. What is this class?

Math 18500 is the third in a sequence of four courses designed for students in the physical sciences, including physics, chemistry, statistics, and engineering, with a focus on differential equations. In Differential and Integral Calculus, we have seen that a function's *derivative* and *integral* relate to information about its change. For example, the derivative tells us the rate at which the function is changing. On the other hand, the integral, as a consequence of the Fundamental Theorem of Calculus, helps us determine the total change of a function over an interval from the function's rate of change. This should hopefully lead you to believe that many real-world phenomena that evolve over time can be effectively modeled using mathematical equations. In fact, as long as a system changes according to a fixed rule, we should be able to describe the process using functions and predict its future behavior using Math! This is the study of Differential Equations and Mathematical Modeling.

We will use three complementary toolsets to study differential equations.

- Solve a variety of DEs **by hand** (analytical techniques).
- Analyze and say something about DEs **without explicitly solving** them (qualitative techniques).
- **Approximate** solutions using algorithms implemented on a computer (numerical techniques).

While we will learn several analytical techniques, understanding their limitations, such as when closed-form solutions are unavailable or uninformative, should be one of the main takeaways of the course. This is why, when compared to more traditional courses on the subject, more emphasis will be placed on qualitative and numerical techniques and the use of computer software. Please make use of my office hours and plan to work hard. Begin studying for the checkpoint quizzes well in advance. Put your good study habits into practice by reviewing class notes and working through extra 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!

§B. Key Information

Class Meetings

MWF 12:30 PM - 1:20 PM (CST), KPTC 309

How to contact me

- **Email:** subhadip@uchicago.edu
- **Office:** Eckhart 120B

Office Hours

See Canvas for up-to-date hours. You can also email me to set up an individual meeting.

Required Study Materials

- **Textbook:** We will mainly use lecture notes and activities written especially for this class. I will post links to some Open-Source textbooks on Canvas. You do not need to purchase any textbooks, but you can use **Mathematical Methods in the Physical Sciences**, by Mary L. Boas, as a reference if you already own it.
- **Computing and Graphing Software:** One of the three main facets of this course is computer experimentation. We will use Mathematica for in-class demonstrations. You can get a free license using your CnetID. No prior programming knowledge will be assumed. Note that we will have regular homework and projects that will require the use of some computing software.

Class announcements

- **Available on:** https://canvas.uchicago.edu/courses/65656

  Check Canvas and your UChicago email at least once before and after each class.

§C. Learning Objectives

Upon completion of this course, you will be able to

- Explicitly solve a variety of 1st order ordinary differential equations (ODEs);
- Understand how ODEs arise in real-world biology, physics, chemistry, engineering, and finance problems; derive a DE model; pick the right tool to analyze it; and predict its long-term behavior;
- Understand the connections between solutions to ODEs and direction fields;
- Have a basic understanding of the role of linear algebra in the study of ODEs, and how to solve systems of linear ODEs;
- Find the steady-state solutions of a nonlinear system, analyze its stability, and linearize the system.
- Solve second-order ODEs, and interpret the results in terms of damped oscillators and resonance;
- Take a Laplace transform and use this to solve certain ODEs;
- Derive the Fourier series of a periodic function;
- Solve partial differential equations (PDEs), and recognize the differences between the heat, wave, and Laplace equations, as well as different boundary conditions.
- Explain in simple terms, e.g., to grandparents or to younger siblings, how differential equations are relevant to several familiar settings in your major.
- Gain skills in mathematical thinking, which includes problem solving, communicating, reading, and writing in the language of mathematics, and be well-prepared and confident to succeed in your upper-division math, science, or engineering courses.

§D. Using AI to enhance learning in Math

I am not banning the use of Generative AI tools, such as Phoenix AI, Google Gemini, ChatGPT, or Dall-E 2 in this class. To the extent that they are useful to you, you are welcome to use them, and I expect you to speak to that use in any classroom surveys or project reports. This class is designed to teach you skills that you will need regardless of the tools available now or in the future; skills such as

- how to ask intelligent questions,
- how to synthesize disparate pieces of information, and
- how to convince others of your expertise in a particular area.

None of these are skills that you can expect a LLM to take over for you. So I encourage you to practice with the tools you're familiar with, but be aware of their limitations. I will also model how I intend to use it myself during class.

Assignments in which AI tools are permitted will be clearly identified by me and noted in the assignment directions. You are not required to use AI tools, but if you choose to use them for any part of the assignment (from brainstorming to programming), I expect you to provide proper citation (any format is fine). I also might ask you to forego using AI tools on specific assignments, in which cases I'll explain why. Otherwise, assume you can use them.

I will provide more details on Generative AI policies in class.

§E. Components of the course

Our course employs a methodology known as the Mastery-Based Grading System, also referred to as Standards-Based or Learning-Based Grading, in which most graded work does not have a point value or percentage. Instead, you earn your grade by showing **appropriate engagement** with the course (including active participation and appropriate civil conduct in classes and tutorials, as described below) and **demonstrating evidence of skill on the course standards** that describe the major ideas covered by each quiz. These standards are listed in section L and may be updated throughout the quarter.

When you submit most work, I will evaluate it relative to the quality standards made clear on each question. If your work meets the standard, then you will receive full credit for it. Otherwise, you will get helpful feedback and, on most items, the chance to reflect on the feedback, revise your work, and then reassess your understanding.

This feedback loop represents and supports the way that people learn. Learning happens over time, as we revisit ideas and reflect on them. In this class, your final grade will reflect how well you **eventually** understand each topic. You can make mistakes without penalty, as long as you **eventually** demonstrate fluency in the topic.

E.1 Attendance and Engagement

In this class, **showing up is necessary but not sufficient**: true engagement means being present, prepared, and actively participating in your own learning and the learning of your peers. Your best chance to discuss new material, ask questions, and avoid confusion is during class – so, don't miss class!

Being Present

Please show up to class **on time** and ready to engage. **Attendance will be taken.** If you need to miss class for any reason, email me as soon as possible and make a plan to catch up. In particular, you should:

- Read through the class notes posted to Canvas;
- Review the corresponding content using a textbook or other resources;
- Try the relevant homework problems *before* seeking additional help from me with the material from that day.

Please do not miss class without contacting me. I don't care whether you think it's a good 'excuse' or not. Just send me an email or reply to mine! This isn't about enforcing perfect attendance; it's about keeping an open line of communication so I can support you effectively. Lack of communication about absences may affect your final grade.

Engaging Actively

We'll be learning together, and the participation of every student – whether in whole-class, small-group, or individual settings – creates the best learning environment for everyone. As a college student and future professional, full engagement is not optional; it's expected.

You can demonstrate your engagement in a number of ways:

- Giving constructive feedback during in-class discussions.
- Asking relevant questions in class, during office hours, or through email.
- Participating in collaborative group work when applicable.
- Creating an inclusive and welcoming class environment for peers.

Consistent effort is the baseline, not the bonus. So, please show up, speak up, and support each other.

E.2 Weekly Homework

Homework will be assigned via Canvas **after every lecture by 6 PM** on that day. Friday, Monday, and Wednesday's homework will be **due next Monday at 6 PM**. For example,

- the homework problems assigned on Week 1 Monday and Week 1 Wednesday will be due on Week 2 Monday.
- the homework problems assigned on Week 1 Friday, Week 2 Monday, and Week 2 Wednesday will be due on Week 3 Monday.
- Week 9 Monday and Week 9 Wednesday homework will be due on Week 9 Friday (with up to three days of allowed extension).

Please start working on the homework as soon as they are uploaded and utilize the office hours as necessary; do not wait until the due date to begin. The homework problems will be labelled as one of two types:

- The first type will be procedural practice problems. These problems will not be graded, but you can check the correctness of your solution during Office Hours.
- The second type will be conceptual problems that are usually a little more complex. These are designed for you to apply your in-class knowledge in novel contexts or further your understanding. This part will be graded by a course assistant. The solutions will need to be uploaded to Gradescope – more information on this will be posted to Canvas.

E.3 Projects

There will be four longer **projects** built around showcasing interesting applications of the study materials. These will require you to use a computer program to implement a numerical algorithm, analyze the limitations of computational software, and experiment with real-life DE models. You may choose to write the code yourself (Preferably Mathematica, but Python and Matlab are allowed) or use a GenAI to generate the code for you. I do not expect you to have any prior programming knowledge.

You may choose to work as a team of up to three students, but you must choose new team members for each project. Each team member must submit their own project report. Final submission should include a *Project Report Cover Sheet* (downloadable from Canvas) on which the names of all collaborators must appear, along with brief but substantive discussions of any issues confronted at your meetings, or any usage of GenAI.

In your report, you should include pictures and graphs of data and of solutions of your models **as appropriate.** Remember that one carefully chosen picture can be worth a thousand words, but a thousand pictures aren't worth anything. More details on how these are graded in section F.2.

Project Schedule

- Week 1 Friday (Take-home) - Project 1
- Week 3 Friday (Take-home) - Project 2

Each project will be due in approximately 2 weeks, with an optional check-in halfway through.

E.4 Checkpoint Quizzes

Rather than midterm or final exams, we will have five checkpoint quizzes (including a final 2-hour quiz during the exam week).

Each quiz will have questions that are directly associated with **all** the course standards (see section L) that have been introduced in class meetings up to that point (except S12-S16). Your goal will be to demonstrate your ability to complete each standard at least once throughout the course. If you complete a standard on an earlier test, you do not need to attempt it on later tests.

As such, each new quiz is another opportunity to show your proficiency in the course standards. If you initially struggle with a particular standard, you will have the time and opportunity to study, practice, and try again.

Quiz Schedule

- Week 2 Friday - Checkpoint Quiz 1 - Covers Standards S01-S04
- Week 4 Friday - Checkpoint Quiz 2 - Covers Standards S01-S07
- Week 6 Friday - Checkpoint Quiz 3 - Covers Standards S01-S11
- Week 8 Friday - Checkpoint Quiz 4 - Covers Standards S01-S13
- Finals Week 10 (TBA) - Checkpoint Quiz 5, a.k.a. the Fianl Exam - Covers Standards S01-S15

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 Ninth Week of the quarter.

- Instructors are not permitted to excuse students from the scheduled time of the final exam except in the cases of an Incomplete.

Missed Quiz

If you believe you will be missing a checkpoint quiz for some reason, you should inform me at least a week ahead of time. Depending on the reason, I might allow a make-up quiz. In most cases, there will be no make-up quiz since you will have the opportunity to complete the course standard again on subsequent quizzes.

§F. Assessment and Grading

Your course grade will be determined by three assessed components of the course: active participation, completion of course standards, and performance on conceptual exercise sets. The requirements to be successful in each component are outlined below, along with a description of how these components are used to determine your final grade.

F.1 Attendance and Engagement

Your participation will contribute to your final course grade as one of the graded components. At the end of the quarter, I will assess your attendance and engagement based on the following rubric:

Level	Description
Full	Attends at least 80% of class meetings (unless excused); regularly contributes during discussions; initiates help-seeking (email or office hours); collaborates positively with peers.
Good	Attends at least 70%; participates semi-regularly in class or team projects; completes assigned makeup work responsibly when absent; occasionally seeks help.
Satisfactory	Attends at least 60%; generally passive but not disruptive; communicates intermittently and completes most follow-ups.
Minimal	Attends less than 60% of meetings or has ongoing issues with participation or communication without explanation.

F.2 Course Standards

Each standard represents about one day of classwork. They are listed in section L approximately in the chronological order in which we will cover them.

I will maintain a record of your **completed** standards and periodically update Canvas. *Standards will appear on all tests after the corresponding topic has been introduced in class meetings.* If you answer a question incorrectly or do not complete it, it will be recorded as **Incomplete**. Only the total number of complete standards contributes to your final grade, regardless of whether they need revisions on multiple tests.

Note: You may sometimes get a **Can correct** grade on a standard in a Quiz. This grade indicates work that contains a minor error, and you have the opportunity to resubmit for a regrade. Submit a written report (including a rewritten solution) via the Google form link in Canvas **within the designated deadline** (usually 24-48 hours) after a graded exam is returned to you. If you can convince me that you understand what the error was and how to fix it, then I will update the **Can correct** to an **Complete** for free. If I don't hear from you within the deadline or I am not convinced, a **Can correct** automatically becomes a **Incomplete**.

You will receive helpful feedback on unsatisfactory work, the chance to reflect on the feedback, revise your work, and then reassess your understanding in the next quiz. My hope is that this method of grading will keep you clearly informed as to the expectations

of the class and how well you are meeting them, while also removing the (often distracting) elements of linear grading that use letters or total points. If you have questions or concerns at any time, please feel free to discuss them with me.

Note: One important thing to keep in mind during this class is that you should not be discouraged if you don't earn **Complete** on a standard the first time. That's normal. I'm only interested in what you can show me you can do by the end of the semester. However, do not put off finishing the standards; it will be hard to catch up if you fall too far behind.

Two Special Course Standards

The last two course standards in section L are regarding the projects. I expect you to submit a two- to three-page essay in the style of a lab report or a mathematical paper on the specific topic we explore in each project. The following three components will determine whether you receive a **Complete** grade on these standards.

- Accuracy and thoroughness of answers (including thoughtful discussion of why, not just what)
- Professionalism in the written document (academic tone, insightful, well-labeled graphs, pictures, etc.)
- Clarity & efficiency in usage of computational tools (documentation, no irrelevant code, etc.)

F.3 Weekly Conceptual Homeworks

Since these problems are designed to assess your deeper reasoning skills rather than procedural fluency, they are graded on a scale of 0 to 3 instead of a binary scale. The scale should be interpreted as follows:

- 0/3 - Question was not attempted, not completed, or had major errors.
- 1/3 - Question was complete. A reasonable effort, but with significant errors, or correctly completed but with insufficient work.
- 2/3 - Question was complete with only minor errors and reasonable working. A minor error can be seen as one that still allows you to demonstrate your relative understanding of the problem as intended.
- 3/3 - Question was completed accurately with clear explanations and work.

Your overall score will be calculated as your total score over all questions in all weekly homeworks. Notably, this means that a homework with more questions will contribute more toward your overall grade.

F.4 Final Grade

At the end of the quarter, I am required to submit to the college a letter grade that reflects your overall achievement in this course. Here is how that grade will be determined.

In order to achieve a given grade, you must complete **all three requirements** in that grade's corresponding column. Additionally, any student who completes all three requirements in a corresponding column is guaranteed at least that grade.

Category	A	B	C	D
Attendance and Engagement	Full	Good	Satisfactory	Minimal
Conceptual Homework Credits	At least 80% of maximum possible	At least 75% of maximum possible	At least 70% of maximum possible	At least 65% of maximum possible
Course Standards (out of 17)	At least 14 completed, including all core standards, and all project standards	At least 12 completed, including at least 4 core standards, and at least 1 project standards	At least 10 completed, including at least 4 core standards, and at least 1 project standards	At least 8 completed

Note: To get a passing grade ('C-' or higher) in this course, the core standards must be completed, in addition to other requirements. If you do not meet the **D** requirement for any of the four categories, your grade will be an **F**.

Your base grade is the minimum requirement met across the four categories. From there, your base grade will be increased by a +/- grade based on how close you are to the next higher letter grade. For example, a student with good participation, 13 standards (all core, 3 projects), and 75% on conceptual homework might earn a **B+**. Similarly, a student with full participation, 13 standards (all core, 3 projects) and 80% on conceptual homework might earn an **A-**. Please do not hesitate to contact me at any time during the quarter if you have any questions about the grading system or would like to review your current progress.

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

F.5 Tokens

Each student starts the quarter with 2 **tokens** (and can have a max of 2 tokens at any time), which can be used to purchase exceptions to the course rules. The token menu is below. To spend a token, send me an email with sufficient notice. Everything listed here costs 1 token:

- Reassess one Learning Target outside of the exam during my Office Hours or another time. You must email me at least 24 hours before you intend to reassess a target and schedule a time. **This can be purchased at most once a week.**
- Extend the deadline of a weekly homework or a project report by 24 hrs (if the original deadline was Friday, the new deadline would be Saturday, not Monday). You must email me before the deadline. You aren't allowed to spend 2 tokens and extend the deadline by 48 hours.

Note: Any leftover token at the end of the course has no value towards your scores.

§G. Collaboration Policy

Collaboration and cooperation are extremely helpful in the learning process, and we will have many such opportunities. However, it is often unclear what exactly "collaboration" means when working on assignments. The following section should clarify what my expectations are regarding this and give guidelines for avoiding plagiarism in assignments.

- **Weekly Homework:** On weekly homework problems, you are permitted to discuss big ideas and hints with your classmates, but every step of every solution should be one that you understand yourself and that you have generated on your own.

  Any collaboration should occur only when your collaborator is at essentially the same stage of the problem solution as you. In particular, if you have not yet started problem #4 and you ask a friend (who has already completed it), "How did you do problem 4 ?", this counts as **a violation of the university's academic integrity policy**.

  On your written homework, you must indicate who your collaborators are. (If you collaborate with different people on different problems, just say so!)

- **Quizzes:** These must be completed as individual assignments, and collaboration is not permitted.
- **Outside resources:** Unless explicitly permitted, copying outside materials such as solutions found online, web pages, videos, etc., is considered **a violation of the university's academic integrity policy**.
- **Past students or Peer tutors:** On any assignment, basing your work on the efforts of another student who previously completed this course or one like it, or a tutor not specifically approved by me, is considered **a violation of the university's academic integrity policy**.
- **Mathematical tools and software:** *Unless otherwise specified*, you may use a calculator or mathematical software (such as WolframAlpha or Mathematica), or AI tools (such as ChatGPT, Gemini, PhoenixAI). *You should treat software or LLM tools as a human collaborator: you may use it to motivate or check your computational work, give you ideas, suggest approaches, but not to generate complete solutions for you.* You will need to include all steps and details in your submitted work. Neither calculators nor the use of software will be permitted during the exams, so try not to rely too heavily on their use for assignments.

To ensure productive collaborations, you should not work in teams larger than three people on any problem at any given time. In any teams larger than that, you run onto the risk of unequal contribution or social loafing.

G.1 Consequences of academic dishonesty

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.

G.2 A positive note

Remember that I want you to be successful. That is, I want you to develop a deep, personal understanding of the material we study so that you become a better student of mathematics who can go on to do well in all of your future endeavors. Every part of this course structure - including both collaborative work and restrictions on collaboration - are intended to help you with this. You will often struggle, and that's intentional - struggle (and eventual success!) is essential to learning. Indeed, productively failing (and learning from it) is part of your final grade.

In all aspects of the course, please understand that I am generous with hints and am always willing to discuss problems with you. I will never simply give you an answer, but I will offer direction and guidance that will assist you in coming up with a solution on your own. This is by far the most satisfying way to solve a problem, and the difficulty is well worth it. You are always welcome to discuss your questions or concerns with me at any time.

§H. Classroom Norms

H.1 '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 has 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 struggles in equal ways, so you should always be wary of judging your progress based on your perception of your peers' struggles. You are probably doing better than you think.

Note: This is an Easter egg. The passphrase is 'DiffyQ' without the quotes.

H.2 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, but we are eager to listen, adapt, and learn. 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 find yourself in a group of students for which the above behaviors aren't being practiced and people aren't feeling respected, please let me know.

§I. Helpful Resources

I.1 Office Hours

Office hours are really Student hours! They are an opportunity for you to stop by your instructor's office and ask questions. I have specifically set this time aside in order to give personalized help to individual students. Any and all questions are welcome, whether you are working on a homework question, have questions on a broader concept discussed in class, or potentially even questions beyond the scope of the course.

Typically, students' misunderstandings in mathematics are initially small, but due to the constructive nature of math, a small misunderstanding can compound as concepts are utilized together. Students who frequently attend office hours and actively engage by asking questions are able to continually resolve their small misunderstandings, resulting in sustained improvement.

Email Responses

I do my best to reply to emails promptly and helpfully. However, I receive a lot of email. To help both you and me, here are some specific expectations about emails:

- If you email me between 8:00 AM and 5:00 PM on a weekday, I'll reply to you on the same day.
- If you email me in the evening or overnight (after 5:00 pm), I will reply to you the next weekday.
- If your email asks a question that is answered in the Syllabus or on Canvas (such as in an announcement or an assignment sheet), I may reply by directing you to read the appropriate document.

I.2 College Core Tutor Program

The College Core Tutors offer peer tutoring Sunday-Thursday, 6:00-10:00 pm, from week 3 of the quarter and through finals week in the North Reading Room (near Harper Cafe). Core Tutoring is a drop-in service available to undergraduate students enrolled in foundational scientific and quantitative courses during the Autumn, Winter, and Spring quarters. Tutoring is available for courses in the Biological Sciences, Chemistry, Economics, Mathematics, Physics, and Statistics.

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 or use different conventions than those discussed in class. Always double-check with our authoritative sources, including your class notes and the instructor, either during class or during office hours.

I.3 Academic Accommodations

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

I.4 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. You must inform me in writing of your 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.

I.5 Wellness Resources

UChicago has counseling available both 24/7 and by appointment through http://wellness.uchicago.edu. Additionally, you can access medical care, including 24/7 support from medical professionals to address your healthcare questions.

I.6 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://cares.uchicago.edu/.

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

§J. 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 with those not currently enrolled.
- Any Zoom cloud recordings will be automatically deleted 90 days after the completion of the recording.

§K. Disclaimer

I reserve the right to make changes to this syllabus if needed. Any changes will be announced to the class in a timely manner.

§L. Math 184 Course Standards

The five ⊛ marked learning targets are considered the most important ("Core") learning targets. To get a passing grade ('C-' or higher) in this course, these standards must be completed. The last four standards are the project standards. See section F.4 for details.

S1. ⊛ I can analyze the qualitative behavior of a first-order ODE using a direction field, and **sketch** sample trajectories of solutions.

S2. I can determine and **classify** the equillibria of an autonomous first order ODE; **construct** a phase line and **predict** long-term (asymptotic) behavior of solutions.

S3. I can **solve** separable first-order IVPs via separation of variables and **justify** the maximal interval of definition.

S4. ⊛ I can **solve** first-order linear ODEs using an integrating factor and **verify** solutions by substitution.

S5. ⊛ Given the eigenvalues and corresponding eigenvectors for a constant-coefficient 2×2 real linear system, I can **construct** the general solution, and **classify** the type of equilibrium from spectral data, and **sketch** a sample phase portrait.

S6. Given a family of 2×2 constant-coefficient real linear systems with parameters, I can **classify** the phase portrait in parameter space using the Trace and the Determinant.

S7. I can **solve** IVPs for homogeneous second-order constant-coefficient linear ODEs.

S8. I can **find** a particular solution for a forced harmonic oscillator with exponential or polynomial (or a product of the two) forcing functions, **decompose** a general solution to transient and steady-state, and **distinguish** between undamped, underdamped, overdamped, and critically damped motions.

S9. ⊛ I can **find** and **interpret** the general solution for a sinusoidally forced undamped harmonic oscillator, and **identify** the resonant frequency.

S10. I can **find** the Laplace Transform of the dependent variables in a first or second-order IVP or a system of IVPs.

S11. I can **find** the Inverse Laplace Transform of a given rational function.

S12. I can **solve** IVPs with discontinuous or impulse forcing involving the Heaviside step function and the Dirac delta function **using** the Laplace transform.

S13. ⊛ I can **solve** a separable PDE by **formulating** the boundary-value problem, **separating** variables, and **assembling** the series solution.

S14. I can **calculate** Fourier series coefficients, and **construct** Fourier (sine/cosine) series for piecewise-smooth functions.

S15. I can **solve** a non-homogeneous Initial-Boundary Value Problem (IBVP) on a finite domain by **decomposing** the solution into a steady-state component and a transient component, **calculating** the steady-state ODE solution, and **formulating** and solving the resultant homogeneous IBVP using a Fourier series expansion.

S16. **Project 1.** Analyze a magnetic hysteresis model using qualitative and numerical tools.

S17. **Project 2.** Analyze the oscillatory behavior of a Brusselator chemical reaction model.