

MATH 2552: Differential Equations – Fall 2024

Canvas: <http://gatech.instructure.com/courses/395852>

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Schedule: Tue/Thu 2-3:15pm, Weber III-1

Office hours: Tue 4-6pm & Wed 4-5pm, Skiles 263

Contact. The best way to contact me is by email (please, include **Math 2552** in the subject) or in person in the office hours. Meetings outside of the office hours can be arranged by email.

Studios (M/W):

K01: 2-2:50pm Skiles 156. **K02:** 2-2:50pm Skiles 254. **K03:** 12:30-13:20pm Skiles 156.

- **TA** for K01 & K03: Thibaud Alemany, office hours Wed 3-4pm at Clough 280 (Mathlab).
- **TA** for K02: Evan Zhou, office hours Mon 1-2pm at Skiles 230.

Disclaimer. This is an introductory course in differential equations, intended primarily for second-year undergraduate students. Think of it as a mandatory course that any STEM person should take. Meanwhile, some more advanced topics—e.g. PDEs, numerical methods, dynamical systems—are not covered in 2552; for these, please take more advanced 4xxx and 6xxx classes.

Prerequisites. Calculus II, Linear Algebra; see <http://math.gatech.edu/courses/math/2552> for the respective GaTech courses. A more detailed breakdown (the courtesy of Xu-Yan Chen):

- Elementary algebra & precalculus: roots of quadratic polynomials and simple higher degree polynomials; the fundamental theorem of algebra; inequalities; functions and graphs.
- Elementary functions: polynomials, rational functions; trigonometric functions; exp, ln.
- Derivatives and integrals: tangent lines, rate of change, and the geometric view of derivatives; increasing functions; the product and chain rule; integration by parts, by substitution, and using partial fractions; derivatives and integrals of elementary functions.
- Vector calculus: vector functions, parametrizations of curves, tangent lines.
- Multivariate calculus: partial derivatives, Jacobian matrix.
- Complex numbers & functions: real and imaginary parts; modulus and argument; rectangular and polar forms of a complex number; Euler's formula.
- Linear algebra: matrix multiplication, row reduction, solving linear systems; determinant; characteristic polynomial; eigenvalues; eigenvectors & eigenspaces; diagonalization.

COURSE MATERIALS

- **Textbook** (we cover Chap. 1-8): **J. R. Brannan, W. E. Boyce.** *Differential Equations – An Introduction to Modern Methods and Applications, 3rd ed.* John Wiley & Sons, 2015.
- **Canvas** – used for announcements & gradebook. Assignments tab has links to WeBWorK.
- **Gradescope** – used to grade quizzes, midterms & the final exam. Your graded exams will be stored on Gradescope. Regrading requests should also be submitted on Gradescope.
- **Piazza** – use it to ask questions to your peers. Response times on Piazza might be way shorter than if you reach out to TAs or the instructor, and TAs might also respond there. Good practice is asking your question in the following order: Piazza → TA → Instructor.

OUTLINE OF THE TOPICS

- 1st-order **linear** equation: $u' + a(t)u = b(t)$.
 - solution method: integrating factor.
- 1st-order **separable** equation: $u' = g(t)f(u)$.
 - solution method: separating variables.
- 1st-order **autonomous** equation: $u' = f(u)$.
 - qualitative analysis: equilibria and their classification, phase portrait, direction field.
- 1st-order **linear system with constant coefficients**:
 - *homogeneous*: $\vec{x}' = A\vec{x}$.
 - reduction of n -order linear equation to 1st-order linear system.
 - solution methods: eigendecomposition, Laplace transform.
 - stability analysis.
 - *nonhomogeneous*: $\vec{x}' = A\vec{x} + \vec{b}(t)$.
 - solution method: variation of parameters.
 - specialization to 2nd-order equations.
- 1st-order **nonlinear systems**: $\vec{x}' = \vec{f}(\vec{x}, t)$.
 - stability analysis, linearization near equilibria.
- **Applications** in physics, chemistry, mechanical & electrical engineering, ecology, etc.

COURSE ASSESSMENT AND GRADING

Testing. There will be 5 quizzes, 2 midterms (75 minutes), and the cumulative final exam (170 minutes). These assessments are closed notes, closed text and administered in-person.

No use of electronic equipment is permitted during any of these tests!

- **Grading policy:**

| | |
|--|-----|
| Online homework (on WeBWorK) Two lowest HW sets among HW01-HW15 will be dropped | 5% |
| Quizzes Each quiz is 6% (4 better quizzes, the lowest one dropped) | 24% |
| Midterms Each midterm is 17% | 34% |
| Final | 37% |

- **Grading scale:**

| | | | | | |
|-----------------|----------|---------|---------|---------|--------|
| Average | [90,100] | [80,90) | [70,80) | [60,70) | [0,60) |
| Letter grade | A | B | C | D | F |
| Pass/Fail grade | S | | | F | |

Online homework. Homework sets (HW00, HW 01, \dots HW15) are assigned on WeBWorK, which will be accessed via “CANVAS class site \rightarrow Assignments \rightarrow WeBWork Online Homework”.

- WeBWorK assignments are due regularly (almost weekly) on **Mon at 11:59am (noon)**.
- No late homework will be accepted.
- The warmup assignment, HW00, is just for practice and will not be graded.
- Your two lowest HW sets of HW01-HW15 will be dropped.
- Each of your best 13 HW sets counts the same amount of credit toward your grade.
- Before the deadline, you get unlimited attempts for each problem without penalty.

Extra credit opportunities. These are as follows:

- **Studio grade:** Students who attend more than 80% of studio sessions will receive extra credit of 1%. It will be added to the course average, affecting all borderline grades.
- **CIOS incentive score:** If the lecture class completes the course instructor and the studio opinion survey (CIOS) with a response rate of 85% or higher before 11:59 pm on July 23 (the last day of class, prior to the final examination) then an extra credit of 1% will be added onto the course average, affecting all borderline grades.

COURSE EXPECTATIONS & GUIDELINES

- **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. For information on GT's Academic Honor Code, visit <http://www.catalog.gatech.edu/policies/honor-code/> or <http://www.catalog.gatech.edu/rules/18/>. Any student suspected of cheating or plagiarizing 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. Cheating includes, but is not limited to:
 - Collaborating during an online quiz or test.
 - Using any third-party websites such as Chegg and CourseHero to obtain answers or hints to graded problems.
 - Copying directly from any source, including friends, classmates, tutors, internet sources, or a solutions manual.
 - Allowing another person to copy your work.
 - Taking a test or quiz in someone else's name, or having someone else take a test or quiz in your name.
 - Asking for a regrade of a paper that has been altered from its original form.
 - Using someone else's account to gain attendance or homework points for them, or asking someone else to use your account for any graded homework or attendance submission.
- **Accommodations for students with disabilities.** If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or <https://disabilityservices.gatech.edu/>, 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.
- **Netiquette.** Our course has a significant online component. Netiquette is the etiquette of online behavior. In all online interactions, you will need to follow the same rules of behavior as you would in an in-person meeting with the other students, teaching assistants, and instructor. This means that you will have to respect others: negative personal comments are strictly prohibited. Please also respect your fellow classmates by turning off your microphone and web cam when appropriate. If it is appropriate to turn on your web cam, be sure that you are wearing appropriate clothing. During the sessions you may unmute yourself to ask questions; however, spamming the chat or posting inappropriate content will result in your displacement from the virtual session.
- **Health-related considerations.** If you test positive for Covid-19, begin to have symptoms of Covid-19, or are not up to date with your Covid19 vaccinations and are exposed to someone with Covid-19, you must take immediate action for your own health and for

the safety of others. See <https://health.gatech.edu/coronavirus/isolation-quarantine> for more info about “Isolation and Quarantine”.

- **Rescheduled/missed exams.** In general, no make-up exams (including quizzes, midterms, and the final exam) will be given, and any missed exam results in a “0” score.
 - If you have a valid reason to request a make-up exam, please email me as early as possible, before the exam, with a reasonable written documentary evidence supporting your case.
 - In the case of serious illness or family emergency, please contact the Dean of Students. They will verify the case and communicate with us if necessary.
 - Students who are absent because of participation in a particular religious observance will be permitted to make up the work missed during their absence with no late penalty, provided the student informs me via email of the upcoming absence, in writing, within the first two weeks of class, and provided the student makes up the missed material within the timeframe established by the course instructor.
 - No makeups will be scheduled after the corresponding exam has been graded and returned to other students.
 - If you miss (excused absence) both the midterm and make-up, then the average of another midterm and final will replace the missed one. This is only good for one midterm. If more than one midterm and make-up midterm are missed, then you will receive a zero for the subsequent missed midterm.
- **Regrading requests.** Any regrading request should be submitted on Gradescope, with an explanation of the reason, within two weeks of the date the graded exam has been returned to you. Please make sure to check the solutions before submitting a request.
- **Exercises.** Exercises will be assigned on the Course Schedule Webpage. These exercises are different from the WeBWork Online Homework on CANVAS and are not collected. I do strongly suggest you to attempt all of the assigned exercises. In order to get a good understanding of the course material, the minimum work you need to do consists of four parts: read the text, review the examples discussed in lectures and studios, do online homework, and solve exercise problems.

ADDITIONAL HELP

- **Math Lab:** Asking questions is a key to success! Free “drop-in” help is available in the Math Lab, located in Clough 280. The Math Lab is staffed by math Graduate Teaching Assistants. A live schedule can always be found on the Tutoring & Academic Support website: <https://tutoring.gatech.edu/drop-in/>.
- **PLUS Sessions** for MATH-2552: TBD.
- **Student-faculty expectations agreement.** 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. See the Catalog for an articulation of some basic expectation that you can have of me and that I have of you. 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.

- **Statement of intent for inclusivity.** As a member of the Georgia Tech community, I am committed to creating a learning environment in which all of my students feel safe and included. Because we are individuals with varying needs, I am reliant on your feedback to achieve this goal. To that end, I invite you to enter into dialogue with me about the things I can stop, start, and continue doing to make my classroom an environment in which every student feels valued and can engage actively in our learning community.

CAMPUS RESOURCES FOR STUDENTS

In your time at Georgia Tech, you may find yourself in need of support. Below you will find some resources to support you as a student and a person.

- **Academic Support**

- Drop-In Tutoring/MathLab <https://tutoring.gatech.edu/drop-in/>
- Center for Academic Success <http://success.gatech.edu>
 - * 1-to-1 tutoring <https://tutoring.gatech.edu/tutoring/>
 - * Peer-Led Undergraduate Study (PLUS) <https://tutoring.gatech.edu/plus-sessions/>
 - * Academic coaching <https://advising.gatech.edu/academic-coaching>
- Residence Life's Learning Assistance Program <https://housing.gatech.edu>
 - * Drop-in tutoring for many 1000 level courses
- OMED: Educational Services <https://omed.gatech.edu/academic-support>
 - * Group study sessions and tutoring programs
- Communication Center <http://www.communicationcenter.gatech.edu>
 - * Individualized help with writing and multimedia projects
- Academic advisors for your major <http://advising.gatech.edu/>

- **Personal Support:**

- The Office of the Dean of Students: <https://studentlife.gatech.edu/>; 404-894-2565; Smithgall Student Services Building 2nd floor
- Counseling Center: <https://mentalhealth.gatech.edu/>; 404-894-2575; Smithgall Student Services Building 1st floor
 - * Services include testing and assessment, referral to support services, short-term individual counseling, group counseling, couples counseling, crisis intervention, as well as mental health workshops, and consultation for faculty and staff, family and friends of Tech students.
 - * Students in crisis may walk in during business hours (8am-5pm, Monday through Friday) or contact the counselor on call after hours at 404-894-2575.
- Students' Temporary Assistance and Resources (STAR): <https://studentlife.gatech.edu/content/star-services>
 - * Can assist with interview clothing, food, and housing needs.
- Stamps Health Services: <https://health.gatech.edu>; 404-894-1420
 - * Primary care, pharmacy, women's health, psychiatry, immunization and allergy, health promotion, and nutrition
- OMED: Educational Services: <http://www.omed.gatech.edu>; 404-894-3959
- Women's Resource Center: <https://womenscenter.gatech.edu/>; 404-385-0230
- LGBTQIA Resource Center: <http://lgbtqia.gatech.edu/>; 404-385-4780
- Veteran's Resource Center: <http://veterans.gatech.edu/>; 404-385-2067
- Georgia Tech Police: <https://police.gatech.edu/>; 404-894-2500

IMPORTANT DATES & LOGISTICS

Important dates of homework, quizzes, midterms, and the final exam

| | | | |
|-------------------|--------|---------|---------------------------------|
| | Week 1 | | |
| August 26 | M | Studio | Webwork HW 00 |
| September 2 | M | Studio | Webwork HW 01 |
| September 4 | W | Studio | Quiz 1 |
| September 9 | M | Studio | Webwork HW 02 |
| September 16 | M | Studio | Webwork HW 03 |
| September 18 | W | Studio | Quiz 2 |
| September 23 | M | Studio | Webwork HW 04 |
| September 30 | M | Studio | Webwork HW 05 |
| October 1 | T | Lecture | Midterm 1 |
| October 7 | M | Studio | Webwork HW 06, HW 07 |
| October 9 | W | Studio | Quiz 3 |
| October 14 | M | Studio | Fall break, Webwork HW 08 |
| October 15 | T | Lecture | Fall break |
| October 28 | M | Studio | Quiz 4, Webwork HW 09 and HW 10 |
| November 4 | M | Studio | Webwork HW 11, HW 12 |
| November 7 | Th | Lecture | Midterm 2 |
| November 18 | M | Studio | Webwork HW 13 |
| November 25 | M | Studio | Quiz 5, Webwork HW 14 |
| December 2 | M | Studio | Webwork HW 15 |
| Final exam matrix | | | |

Make-up schedule for the assessments

| Assessment | Make up on | Make up time | Location |
|-------------------|-----------------------|--------------------|--------------------|
| Make up Quiz 1 | September 6 (Friday) | 1:00 PM -1:25 PM | Room 311 in Skiles |
| Make up Quiz 2 | September 20 (Friday) | 1:00 PM - 1:25 PM | Room 311 in Skiles |
| Make up Midterm 1 | October 4 (Friday) | 1:00 PM - 2:30 PM | Room 311 in Skiles |
| Make up Quiz 3 | October 11 (Friday) | 1:00 PM - 1:25 PM | Room 311 in Skiles |
| Make up Quiz 4 | November 1 (Friday) | 1:00 PM - 1:25 PM | Room 311 in Skiles |
| Make up Midterm 2 | November 15 (Friday) | 1:00 PM - 2:30 PM | Room 311 in Skiles |
| Make up Quiz 5 | November 26 (Tuesday) | 11:30 AM -11:55 AM | Room 311 in Skiles |

Full schedule of the course can be found on Canvas: <http://gatech.instructure.com/files/53609429/>.

Digital learning days. In cases where the campus may be physically closed due to events such as inclement weather, a DLD may replace in-person classes. If such a DLD occurs:

- on a lecture day, then a recording will be posted for students to watch asynchronously (before/on/after the DLD).
- on a studio day, then a recording will be posted for students to watch asynchronously (before/on/after the DLD).
- on quiz day, then that quiz will be rescheduled to another studio day.
- on midterm exam day, then a recording will be posted for students to watch asynchronously, and that exam will be rescheduled to another lecture day.