Math 1231-20: Single-Variable Calculus I

GWU Summer 2024 Session II

Meetings:	MTWR, 12:30 - 2:00 1957 E Street Room 315 07/01/2024 - 08/08/2024	**Textbook:**	OpenStax Calculus Vol. 1 by Strang and Herman Freely available online
Instructor:	Ben Clingenpeel	**Office:**	Phillips 720G
Email:	ben.clingenpeel@gwu.edu	**Office hours:**	MW 2:00 - 4:00 or by appointment
Course page:	https://bncling.github.io/courses/math-1231		

Course content and learning outcomes

Though condensed into just six weeks, this course covers the material of a first semester of a standard year-long sequence in single-variable calculus. The main topics are limits and continuity; differentiation and integration of algebraic and trigonometric functions; and applications of these ideas.

By the end of the course, students will acquire the following skills and knowledge. Students will be able to:

- state and apply the intuitive and formal definitions of the limit, derivative, antiderivative, and definite integral of a function;
- distinguish continuous from discontinuous functions by graphical and analytic methods;
- calculate derivatives of functions both by definition and using various rules;
- formulate and solve related rates and optimization problems;
- accurately sketch graphs of functions;
- calculate antiderivatives and definite integrals of a variety of functions;
- compute areas of regions in the plane and volumes of solids of revolution; and
- explain the significance of important theoretical results such as the Extreme Value Theorem, Mean Value Theorem, and Fundamental Theorems of Calculus.

Textbook and additional Resources

Course textbook: The textbook for the course is OpenStax Calculus Volume 1 by Gilbert Strang and Edwin Herman, and can be read online for free at the OpenStax website. As a student in math classes, I have always found it helpful to read at least a little about a topic and try a problem or two before it is covered in lecture—it gives an idea of what to expect in the lecture and helps me think of some questions to ask in advance (and please do ask them). During each lecture I'll try to keep you oriented as to what part of the textbook we're covering, and at the end I'll suggest some

sections to read before the next class.

Lecture notes: I have written a set of lecture notes that follows what I'll be presenting in class meetings much more closely than the OpenStax textbook. These notes will be available on the course website, and I recommend reading them after each class meeting to review.

Algebra and Precalculus review through Khan Academy: Some of the most common things that trip people up in this course are more to do with algebra and trig than calculus itself. If you feel at all fuzzy with topics like factoring polynomials, the unit circle, or exponent rules, I would highly recommend doing a little review on Khan Academy either before the course starts or at the beginning of the course. Here are some specific sections from the Algebra II course there that will come up a lot in Math 1231:

- Unit 3: Polynomial factorization
  - Factoring higher degree polynomials
  - Factoring using structure
- Unit 6: Rational exponents and radicals
  - Rational exponents
  - Properties of exponents (rational exponents)
  - Evaluating exponents & radicals
- Unit 11: Trigonometry
  - Unit circle introduction
  - The Pythagorean identity
  - Trigonometric values of special angles
  - Graphs of sin(x), cos(x), and tan(x)

Peer tutoring: GW offers a peer tutoring service through the Academic Commons. You can book a completely free 50 minute tutoring session here: https://academiccommons.gwu.edu/tutoring.

Mental health services: The University's Mental Health Services offers 24/7 assistance and referral to address students' personal, social, career, and study skills problems. Services for students include: crisis and emergency mental health consultations confidential assessment, counseling services (individual and small group), and referrals. For additional information see: https://counselingcenter.gwu.edu/ or call 202-994-5300.

Course structure

The course meeting times will be used for lectures, and although I won't be taking attendance, going to these lectures will be essential—we'll discuss the theory of calculus as well as numerous example problems similar to what you will see on homework and exams. Outside of the lectures, you will have regular homework, and in addition to the time you spend on this, you should also review your notes regularly (the guideline here is that you should try to spend 2 hours outside of class for every hour spent in class). Your grade in the course will be based on the following:

- Online homework through WeBWorK – 10%
- Mastery points – 32% (1pt = 1%)
- Participation – 3%
- Two midterms – 15% each
- Comprehensive final exam – 25%

Minimum scores for each letter grade are as follows: A, 94%; A-, 90%; B+, 87%; B, 84%; B-, 80%; C+, 77%; C, 74%; C-, 70%; D+, 67%; D, 64%; D-, 60%.

WeBWorK: Accessed through Blackboard under the **Assignments** tab, WeBWorK is an online homework system. The point of WeBWorK is to give you a good amount of problems to practice with. You never know how well you understand something until you try applying it, and as such you will get as many attempts as you need to answer all WeBWorK problems. There is, however, a due date for each problem set, usually a few days after the set becomes available. If you need more time, there is always a reduced scoring period available where you can still earn 90% credit.

Mastery quizzes, mastery points: In addition to the WeBWorK, these will be the main homework. These quizzes cover 12 topics that are core to a first semester of calculus, and will be graded based on *mastery*. Each quiz will feature one to four different topics, and your performance on each topic will be graded on a two-point scale, where a 0/2 means you've shown little-to-no understanding of the topic, and a 2/2 means you've demonstrated mastery of the topic. The topics are the following:

Major topics	**Secondary topics**
1. Computing limits	1. Definition of derivative
	2. Linear approximation
2. Computing derivatives	3. Implicit differentiation
	4. Related rates
3. Extrema and optimization	5. Curve sketching
	6. Applied optimization
4. Computing integrals	7. Riemann sums
	8. Applications of integration

You will have a chance to show mastery on each secondary topic twice, i.e. for any secondary topic, there will be two mastery quizzes with problems on that topic (among other topics). For a major topic, you will have three chances.

Every secondary topic is worth 2 mastery points, and every major topic worth 4. Your mastery score for any secondary topic is your best score on the mastery quizzes for that topic, and your mastery score for any major topic is the sum of your best two scores on the mastery quizzes. For example, if on the mastery quizzes for S3 (implicit differentiation) you get a 1/2 and then a 2/2, your mastery score for S3 is a 2/2. If for M2 (computing derivatives) you get a 1/2, a 0/2, and then a 2/2, your mastery score for M2 is a 3/4.

Your final mastery score is the sum of all of your mastery points. There are 8 secondary topics, worth 2 points a piece, and 4 major topics, each worth four points. Your final mastery score is therefore some number between 0 and 32, and this part of your grade is weighted so that every mastery point is worth 1% of your final grade in the course.

In addition to the mastery quizzes, **there are two other ways you can raise your mastery score**. One is by doing well on exams. Doing well on a particular topic on an exam will mean (in addition to getting a good score on the exam) that you get the equivalent of a 2/2 on a mastery quiz for that topic. For major topics, you can also raise your mastery score by retaking a mastery quiz with me in person. If you receive a 0/2 or a 1/2 for any major topic on a mastery quiz, you can retake that part of the quiz (but only once per topic). These retakes will be meetings with me in my office—I will give you a new problem on the topic you're retaking and ask you to work through it at the whiteboard to show mastery, explaining your thinking as you go. You can choose if you'd like to do this on your own or with a partner, but you'll be graded individually either way. As with exams, doing well on a retake will be the equivalent of a 2/2 on a mastery quiz and will count as one of your two best attempts toward your overall grade.

If this all seems like a rather convoluted way to do assessments, I just ask you to bear with me for the time being. **Once we do a few mastery quizzes I think the system will become completely transparent**, and if you still feel unsure how the system works or unclear on what your grade is at any point, please let me know! I'm always happy to go over it with you. Convoluted though it may be, this approach does have a purpose! One thing that makes calculus different from a lot of previous math classes you may have taken is that the vast majority of the material is *completely new*. Derivatives and integrals are nowhere else to be found in prior courses, unlike the way some of the central topics in a course like Precalculus (solving equations, trig, etc.) have already been introduced. Mastery grading allows you to be a little bit more flexible in how you absorb all this new information coming at you. For example, if in the middle of the course you reach a point where curve sketching (S5) is absolutely no problem for you, but related rates problems (S4) still seem really opaque, you can spend your time focusing on related rates problems. As long as you eventually master related rates, it shouldn't impact your grade that it took a bit longer to master than some of the other topics.

Participation: As mentioned above, I won't be taking attendance at each class meeting. Your participation grade will reflect your engagement with the course, particularly in the lecture portion—I'll be posing questions frequently, and you'll help things along by answering them, even if you answer them incorrectly! In fact, incorrect answers can be especially helpful, and I'll sometimes ask for them explicitly when there's something we might really *like* to be able to do or something that really *seems* like it should work but for one reason or another doesn't. Thinking through why some things don't work is really just as important as seeing why other things do work.

Exams: There will be midterms on July 16th and 25th, and a final exam on August 8th (the last day of the course). I'll post mock exams before each so you have an idea of what to expect, and at least before the final I'll hold some extra office hours—I'll try to do this before the midterms as well (TBA). If for some acceptable reason you need to miss a midterm, I will adjust the weight of the final exam to cover the midterm as well. (The following section gives an exception.)

Religious holidays and other excused absences

In accordance with University policy, students should notify faculty during the first week of the semester of their intention to be absent from class on their day(s) of religious observance. For details and policy, see "Religious Holidays" at the Office of the Provost.

Accommodations

Any student who may need an accommodation based on the impact of a disability should contact the Office of Disability Support Services (DSS) to inquire about the documentation necessary to establish eligibility and to coordinate a plan of reasonable and appropriate accommodations. DSS is located in Rome Hall, Suite 102. For additional information, please call DSS at 202-994-8250, or consult https://disabilitysupport.gwu.edu.

Academic integrity

The complete GWU academic integrity code can be viewed at https://studentconduct.gwu.edu. Per the code, "academic dishonesty is defined as cheating of any kind, including misrepresenting one's own work, taking credit for the work of others without crediting them and without appropriate authorization, and the fabrication of information." One thing to highlight here is that the definition given of cheating includes "engaging in unauthorized collaboration in any academic exercise." In this course there will be some assignments on which collaboration will not be allowed (e.g. Mastery Quizzes), and some on which it will be okay (e.g. the WeBWorK, although this is for your own practice, so if you do collaborate, make sure you understand everything your collaborators do). If you're ever unsure about whether collaboration is permitted on a particular assignment, please let me know.

Safety and security

In the case of an emergency, if at all possible, the class should shelter in place. If the building that the class is in is affected, follow the evacuation procedures for the building. After evacuation, seek shelter at a predetermined rendezvous location. Review the Emergency Response Handbook.

Schedule

This is an overview of the topics we'll be covering in more detail, along with when I think we'll cover things (but this is subject to change). Red cells below are exams and blue cells are when I anticipate having mastery quizzes due (again usually these will be Mondays and Wednesdays with some exceptions at the end of the course).

July 1	Syllabus, review of functions, intro to limits	July 22	Concavity and curve sketching
July 2	Limit laws, continuity, and limits of trigonometric functions	July 23	More on curve sketching, applied optimization
July 3	Infinite limits, intro to derivatives (if time permits)	July 24	More on applied optimization, midterm review
July 4	No meeting	July 25	Midterm 2
July 8	Tangent lines, computing derivatives	July 29	The area problem and Riemann sums
July 9	Derivatives of trigonometric functions and the chain rule	July 30	Properties of definite integrals, the first Fundamental Theorem
July 10	Rates of change, linear approximations	July 31	Antiderivatives and the second Fundamental Theorem
July 11	Implicit differentiation, intro to related rates	Aug 1	Integration by substitution, finding areas
July 15	More on related rates, midterm review	Aug 5	Applications of integration
July 16	Midterm 1	Aug 6	Volumes by slicing, solids of revolution
July 17	Extreme Value Theorem, finding maxima and minima	Aug 7	More on solids of revolution, final review
July 18	Mean Value Theorem, classifying critical points	Aug 8	Final exam