MATH 1101 - Calculus I MWF 10:30-11:35am, T 9:50-11:30am, Room: Sci 3510

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Office Hours: M 2:05-3:05pm, T 1-2pm, W 9-10am, T 1:30-2:30pm, F 9-10am, or by appointment

Textbook: The textbook for the course is "Single Variable Calculus: Early Transcendentals," Sixth Edition, by James Stewart.

Prerequisites: Students should have mastered the topics discussed in Math 1012 and Math 1013. You may also take this course if you have mastered Math 1012 and are currently enrolled in Math 1013.

Main themes: In precalculus, you learned about the notion of a mathematical function. Recall that a function is a rule that assigns to each input a unique output. You can think of a function as a deterministic machine. You hand this machine a real number and the machine outputs a real number. By deterministic, I mean that every time you hand the machine the same input, it gives back the same output. The goal of calculus is to develop tools to quantitatively understand the behavior of functions. This quantitative understanding also informs qualitative understanding of the behavior of functions. The name "calculus" seems to imply that the subject has something to do with calculation. We will see that the ideas that we develop can indeed be used to approximate and calculate various quantities.

We will also learn how to make sense of seemingly impossible arithmetic computations such as dividing by zero. Here is an example of how this will come up (we'll discuss this in detail in class). This example is also the main motivation for *limits* and *derivatives* which are two of the the main tools we'll study this semester. Suppose a car is moving along a road. Let's say that the position of the car at time t is given by $s(t)$. You should interpret this as saying that if you mark a location on the road and call that position 0, at time t, the car will be distance $s(t)$ from position 0. Question: what is the velocity of the car at time $t = a$? At first this sounds conceptually easy. Velocity is distance traveled divided by time elapsed. So if we want to compute velocity at $t = a$, we should just take some number b really close to a and compute the difference quotient:

$$\frac{s(b) - s(a)}{b - a}.$$

This is distance traveled divided by time elapsed, so should equal the velocity. This isn't exactly what we're looking for though.

The issue is that this difference quotient just gives us the average velocity of the car over the interval $[a, b]$. When we asked the question, we wanted to know how fast the car was moving at the instant $t = a$. To put it another way, we want to know what the speedometer in the car should read at time $t = a$. The problem then is that to get the velocity at time $t = a$, it seems that we need to compute the difference quotient

$$\frac{s(a) - s(a)}{a - a} = \frac{0}{0}.$$

This is problematic! To deal with this, we need to develop new (to us) mathematics.

To deal with the $\frac{0}{0}$ problem and other similar and related issues, we'll develop the concept of finding *limits* of functions. To compute the instance of $\frac{0}{0}$ that came up in the velocity problem, we'll see that for sufficiently nice functions, the quantity $\frac{s(b)-s(a)}{b-a}$ will get closer and closer to a value as we look at numbers b getting closer and closer to a. After learning about limits, we'll see that they can be used to make sense of computing the rate-of-change of any sufficiently nice function. This rate-of-change gives another function called the *derivative* of the original function.

A large portion of the semester will be devoted to studying derivatives. We'll learn how to quickly compute derivatives for many functions. We'll see applications of derivatives to many different situations including optimizing functions, physical applications, curve sketching, estimation of roots of functions, and more.

The semester will conclude by asking a seemingly unrelated question: given a region in the xy–plane, how can one compute its area? We'll see why this is a difficult problem, develop the basics of a tool (the *integral*) to compute these areas, and conclude by seeing that (amazingly!) the problems of area in the plane and rate-of-change of functions are intimately connected.

Time commitment: University policy says "one credit is defined as equivalent to an average of three hours of learning effort per week (over a full semester) necessary for an average student to achieve an average grade in the course". Our course is a five–credit course, meeting approximately five hours per week: 5 credits times 3 (hours/week)/credit - 5 hours/week in lecture = 10 hours/week outside class. Thus, you are expected to spend 10 hours per week working outside of class, reading the textbook and working problems. Since no one wants to be average, you should expect to spend at least ten hours per week thinking about class.

Details of the class:

- **Topics:** For a detailed list of topics covered, see the second handout that was distributed with this document. Alternatively, see `https://ckatkinson.github.io/1101/1101-topics.pdf`.

- **Class meetings:** We meet on Monday, Wednesday, and Friday for 65 minutes and on Tuesday for 100 minutes. We will begin most class periods with a period of group discussion on problems assigned during the previous class meeting. After this discussion period, I will lecture on the main ideas and techniques needed for understanding the textbook. On most Tuesdays, we will have a quiz. See below for more details on what I expect from you.

- **Mathematica** Although calculators are neither required for this course nor allowed on assessments, we will be making use of the computer program *Mathematica* in this course. *Mathematica* is a very powerful computing system for performing all sorts of mathematical computations. We will be using *Mathematica* for experimenting with and visualizing concepts related to the course. Proficiency in *Mathematica* will be graded via discussion problems that require its use and on quizzes and exams. *Mathematica* is available on many computers on campus.

- **Homework:**
  - **WeBWorK:** WeBWorK is an online homework system. You can find our section either through the course webpage or by going directly here: http://webwork.morris.umn.edu/webwork2/F18Calc1_Atkinson/. A few problems will be assigned for each section of the textbook that we cover. These problems are intended to give you practice working though core examples. These assignments will usually be due one minute before the Monday, Wednesday, and Friday class meetings.
  - **Practice problems:** I can tell you what to think, but I can't think for you. To learn how to think about calculus, you need to think about the ideas yourself. To do so, you should work though many example problems.

    The document at https://ckatkinson.github.io/1101/1101-topics.pdf details the list of practice problems. In each row, I've listed a selection of practice problems. After we cover a section in class, you should work through as many of these problems as you need to to master the topic. In addition, when I write the exams, I consider any problem similar to assigned practice problems to be fair game.

    These problems will not be formally collected or graded, but see the following section to see what you will be turning in. You should come talk to me, talk to your classmates, or email me.
  - **Discussion problems:** After most class meetings, I will post a short subset (usually just two or three) of the practice problems on the course webpage. These are the discussion problems. I expect you to work together in small groups to solve these problems. Working collaboratively allows for you to help each other out when you get stuck and to learn from explaining your thoughts. You should produce a neat write-up to the solution of each of these problems. You should also be prepared to present your solutions to the class.

    During the first $15-20$ minutes of class, we will discuss the discussion problems. You will have some time to compare your solutions. I will walk around the class to answer questions, choose presenters, and check that students have completed the work. We will typically have one or two quick presentations of solutions. I will keep track of who has presented. Everyone should expect to present occasionally.

    Each Friday, I will collect your work from discussion problems from the week. You should turn in the neatly written and complete solutions to the problems. These will be graded for completion, correctness, and exposition. I'll also give feedback on your work.

    Your overall grade for the discussion problems will be based both on the problems you hand in and on participation. Participation will be assessed as follows: each student starts with a bank of three *participation points*. There are three different possible *participation infractions*:

    1. Absence: an unexcused absence during the discussion portion of class.
    2. Unpreparedness: arriving to the discussion session without having given an honest effort on the discussion problems.
    3. Non-presentation: refusing to give a presentation.

    A student will lose one participation point if a participation infraction is committed. Lost participation points can be earned back by turning in a complete, neatly written solution set to an **entire section** of practice problems (see list of practice problems). If the list of practice problems includes non–specific directions such as "skip around", your submitted set must include at least 15 problems. I will accept such a set at any point on or before the last day of instruction. You may only submit a solution set for a given section once (but feel free to submit any number of sections).

At the end of the semester, the balance of your participation point bank will be used to determine a *participation multiplier* for your discussion problem grade. I will multiply your grade for the collected discussion problems by the participation multiplier. The following table describes how the multiplier will be determined:

Point Balance	Multiplier
3	1.025
$0, 1, 2$	1
-1	0.9
-2	0.75
-3	0.5

- **Lecture:** The remaining time after the discussion will be spent with me talking about the new ideas. I'll help you integrate the ideas you read about into your previous mathematical knowledge and help you understand how to think about the ideas.

- **Quizzes:** On Tuesdays (except for during exam weeks), we'll have a short quiz. The material on the quiz will cover through what we have done in class through the previous Friday. These quizzes give you a chance to practice exam–type problems with time pressure. Quizzes will occasionally require you to write Mathematica commands by hand, so know your syntax.

- **Exams:** There will be three in–class exams and a cumulative final. You will not be allowed any outside material on your desks during exams. Calculators will not be allowed during exams. Exams will require you to write Mathematica code by hand, so study your syntax.

  The exams are tentatively scheduled as in the table below. The dates of Exams 1-3 are subject to change depending on the dynamics of the class. You will be given sufficient advanced notice if any of the dates change.

	Date
Exam 1:	October 2 (Week 6)
Exam 2:	October 30 (Week 10)
Exam 3:	December 4 (Week 15)
Final:	Friday, December 21, 8:30-10:30AM

- **Grading:** The university's policy for grades can be found at: http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html

  I grade homework assignments, quizzes and exams with the above guidelines in mind using the following numerical scheme. I reserve the right to change the grading scale at any point, but will not increase the requirements for any letter grades. When computing your letter grade, percentages are rounded to the nearest integer.

Letter	Percentage
A	95-100
A-	90-95
B+	86-89
B	83-86
B-	80-83
C+	76-69
C	73-76
C-	70-73
D+	65-69
D	60-64
F	< 60

If you are taking the course S-N, then you need 70% to earn an S.

The components of the course will be combined to calculate your grade as follows:

WeBWorK	15%
Discussion problems	15%
Quizzes	20%
Unit exams	30%
Final Exam	20%

Although I will not be posting grades online, feel free to ask at any point about where you stand in the course. I'll send you grade reports after each exam is graded.

- **Extra Credit:** There will be no extra credit. The time for earning your grade is during the semester. I will not assign extra assignments at the end of the semester to make up points, so please do not bother asking.

Univeristy policies: See http://policy.umn.edu/education for the official university policies on education. I will adhere to these policies.

Late work and missed exams: I will only accept late work under exceptional circumstances. Please talk to me as soon as possible if you miss a deadline.

Makeup exams will only be given in the case of legitimate absences as defined by the official university policy: http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html. Legitimate absenses must be supported by appropriate documents unless otherwise specified by university policy.

If you have a scheduling conflict and will miss an exam for a documented reason, let me know as far in advance as possible so that we can make arrangements for you to take the exam at another time.

Disability Accommodations:

The University of Minnesota views disability as an important aspect of diversity, and is committed to providing equitable access to learning opportunities for all students. The Disability Resource Center (DRC) is the campus office that collaborates with students who have disabilities to provide and/or arrange reasonable accommodations.

- If you have, or think you have, a disability in any area such as, mental health, attention, learning, chronic health, sensory, or physical, please contact the DRC office on your campus (UM Morris 320.589.6178) to arrange a confidential discussion regarding equitable access and reasonable accommodations.

- Students with short-term disabilities, such as a broken arm, should be able to work with instructors to remove classroom barriers. In situations where additional assistance is needed, students should contact the DRC as noted above.

- If you are registered with the DRC and have a disability accommodation letter dated for this semester or this year, please contact your instructor early in the semester to review how the accommodations will be applied in the course.

- If you are registered with the DRC and have questions or concerns about your accommodations please contact the Coordinator of the Disability Resource Center.

  Additional information is available on the DRC website: http://www.morris.umn.edu/academicsuccess/disability/, or e-mail hoekstra@morris.umn.edu

Here is a link to more policy statements about syllabi: http://www.policy.umn.edu/Policies/Education/Education/SYLLABUSREQUIREMENTS_APPA.html
Student Learning Outcomes This course is designed to partially satisfy the following *UMM Student Learning Outcomes* http://www.morris.umn.edu/committees/Curriculum/Learning_Outcomes_Approved.pdf: 1a, 1c, 2b, 2e, 2g, 4b, 4c