MATH1110: Calculus I for the Arts and Sciences

Fall 2017

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1 Course Description

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Office: Rhodes 657 (The building is on Hoy Road across from the baseball field.)
Office Hours: Wednesday 5:30pm - 7:30pm, Rhodes 657
Section Info: TR 11:40-12:55pm in **Rockefeller 102**.
Course Webpage: www.blackboard.cornell.edu
Course Notes and Worksheets: https://people.cam.cornell.edu/mfh72/math1110fa17.html.
Textbook: Thomas, Weir, and Hass, *Thomas' Calculus: Early Transcendentals, Single Variable*, Pearson Education, 2017 (Edition: 14; ISBN: 0134439023).

Calculus is the study of how quantities change. Since things tend to change over time, the tools and ideas from this course can be used to analyze and solve problems from Physics, Engineering, Biology, Economics, Sociology, Pharmacology, and so on. The specific topics we will see include: functions and graphs, limits and continuity, differentiation and integration of functions, applications of differentiation, antiderivatives, definite and indefinite integrals, and The Fundamental Theorem of Calculus.

Topics include functions and graphs, limits and continuity, differentiation and integration of algebraic, trigonometric, inverse trig, logarithmic, and exponential functions; applications of differentiation, including graphing, max-min problems, tangent line approximation, implicit differentiation, and applications to the sciences; the mean value theorem; and antiderivatives, definite and indefinite integrals, the fundamental theorem of calculus, substitution in integration, the area under a curve.

This course serves as a general collegiate math competency for students in the College of Arts & Sciences and is the first class of a 2 course sequence that serves as a comprehensive study of single-variable calculus. Students may also choose to replace this class with one of its sister classes: MATH1910: Calculus for Engineers or MATH1105: Calculus for Life Sciences. This course is a prerequisite for most higher-level mathematics and engineering classes such as differential equations, analysis, and optimization.

2 Course Philosophy

I've found that collegiate calculus courses often face several difficult challenges that make the class an unnecessarily difficult course for students. Successful students in difficult mathematical courses often have three important skills: (1) the ability to effectively communicate mathematical concepts, (2) the ability to identify and impose a mathematical framework to resolve problems and obstacles, and (3) the ability to appropriately apply mathematical tools and techniques within said frameworks. I have found that secondary education have often overdeveloped the third skill for students and thus render most students focused on obtaining solutions to problems without much reflection or understanding of the process of *why* or *how*. To help provide balance, the two other skills will act as overarching themes as we progress through this calculus course. The student will have opportunities to develop their mathematical writing every week in drafting their solutions to homework assignments which will challenge students to effectively frame problems mathematically. It is my hope that by the end of the semester, the student will be able to demonstrate

their abilities by synthesizing a well-written mathematical document that compellingly solves an open-ended problem.

Given that the course is a 3-credit course, I expect students to spend a minimum of 12 hours a week studying for this course. Struggling students may find that they need to invest more hours. In addition, since students often lead busy lives, I understand this initial time allotment to change as the student's priorities during the semester changes. It is important to note that 4 of these hours are easily achieved by attending sessions and office hours. I especially encourage any student to attend office hours as they offer a more intimate setting to review material and work through assignments. In my opinion, the most effective way to approach this course is to preempt each lecture by reading the relevant sections in the textbook, attend the lecture sessions to ask any questions from the reading, use the classroom activities and homework assignments as opportunities to develop mathematical writing and understanding of calculus, and attend office hours to ask any remaining questions from lecture and from the assignments.

While many students have seen calculus in some or another, it is important to understand that this class will not be an easy one. There will be times in this course where the theory and formulations escape students at first pass. It is entirely acceptable to struggle – mathematics is not known to be an easy topic. However like most things, with enough persistence and support, students can overcome these challenges. In my time teaching this course, I've often found that some students struggle with the analytical aspects of calculus, I recommend when this occurs to work through the frustrations with your peers and with me. I've also found students often find that the hardest part about calculus is the algebra, for those students I would recommend spending an extra hour a week solving algebraic equations. At the end of this course, I hope students will have a bigger appreciation for how a mathematician perceives the world and approaches problems as well as the ability to communicate with mathematicians. Here are a few tips for success:

- Go to office hours! It is highly encouraged to go to office hours to help understand the material and problems.
- When reading the textbook:
  - Focus on key words and phrases (they are often bolded)
  - Identify assumptions and conclusions of a theorem or statement
  - Work through each example problem before reading through its solution
  - Try a few problems from the exercises section
- Come to discussion with questions about material from the textbook!
- Find a good group to work with. Study groups are super-effective!
- Start your homework early! Give yourself sometime to work through and think about the problems on the assignments.
- Approach the instructor if you have any concerns or require any assistance!
- Be honest. Don't cheat. Don't plagiarize.
- Make use of the Learning Strategies Center: http://lsc.cornell.edu/
- Make use of the Math Support Center: https://twiki.math.cornell.edu/do/view/MSC#Mathematics_Support_Center

3 Course Objectives

By the end of the course, students will be able to

- draft a coherent and concise mathematical essay.
- identify and resolve obstacles using a calculus framework within the context of larger, applied problems.

- find the limit of a function using the formal definition of limit laws and limit identities.
- determine infinite limits, limits of a function at infinity, and vertical and horizontal asymptotes of a function.
- determine if a function is continuous.
- determine the derivative of algebraic and trigonometric functions using the definition of a derivative and derivative identities.
- determine the derivative of a function using implicit differentiation.
- determine the derivative of a function using the chain rule.
- identify and solve related rates problems and linearization problems using derivative identities and techniques.
- analyze functions using the extreme value theorem, intermediate value theorem, and mean value theorem.
- sketch the graph of a function using information from its two derivatives and antiderivatives.
- identify limits involving indeterminate forms and appropriately use L'Hospital's Rule to resolve them.
- construct optimization problems using geometric or algebraic constraints and solve them using derivative identities and techniques.
- determine definite integrals using Riemann sums and the fundamental theorem of calculus.

4 Format and Procedures

The course meets twice a week for 15 weeks with each session spanning 75 minutes. Each session will consist of lectures and activities intended for students to review and practice material from selected topics for the week. During every session, the instructor expects that students...

- have consistent attendance,
- have completed the assigned reading prior to the session,
- behave in a responsible and respectful fashion to peers and the instructor,
- are willing to contribute in group and class activities, and
- ask questions about the material, no matter how silly or intensive.

During every session, students expects that the instructor...

- has prepared lecture and practice material,
- behaves in a responsible and respectful fashion to students,
- answers student questions to the best of the instructor's abilities, and
- is responsive to student feedback.

Note that the classroom experience is actively impacted by a feedback loop between student and instructor. Students are highly encouraged to provide feedback as soon as possible on the quality of lectures, assignments, activities, and accommodations. Students can provide this feedback after class, during office hours, or over email. In addition, students will have an opportunity midway and at the end of the semester to anonymously provide feedback for the instructor using surveys managed by the University.

5 Course Schedule

See Table 1 for a tentative course schedule for the semester. Here are other important dates:

- September 5: Last Day to Add a Course
- October 17: Last Day to Drop a Course or Change Grading Option
- October 18 - November 17: Withdrawal by Petition Only

Week	Dates	Readings & Topics	Assignment Due Thursday
1	8/21-8/25 Classes begin 8/22	Chapter 1 Functions	
2	8/289/1	2.1 Rates of Change and Tangents to Curves 2.2 Limit of a Function and Limit Laws	HW1 (Ch. 1) Due **Students will be able to:** *- draft a coherent and concise mathematical essay*
3	9/49/8	2.4 One-Sided Limits 2.5 Continuity	HW2 (2.1, 2.2) Due **Students will be able to:** *- find the limit of a function using the formal definition of limit laws and limit identities*
4	9/119/15	2.6 Limits Involving Infinity; Asymptotes of Graphs 3.1 Tangents and the Derivative at a Point 3.2 The Derivative as a Function	HW3 (2.4, 2.5) Due **Students will be able to:** *- determine if a function is continuous*
5	9/189/22	3.3 Differentiation Rules 3.4 The Derivative as a Rate of Change	HW4 (2.6, 3.1, 3.2) Due **Students will be able to:** *- determine infinite limits, limits of a function at infinity, and vertical and horizontal asymptotes of a function* *- determine the derivative of algebraic functions using the definition of a derivative*
6	9/259/29, 9/26, Prelim 1, Location TBA 7:30-9:00P on sections 1.13.2 (not 2.3)	3.5 Derivatives of Trigonometric Functions 3.6 The Chain Rule	
7	10/210/6	3.7 Implicit Differentiation 3.8 Derivatives of Inverse Functions and Logarithms 3.9 Inverse Trigonometric Functions	HW5 (3.3, 3.4, 3.5) Due **Students will be able to:** *- determine the derivative of algebraic and trigonometric functions using the definition of a derivative and derivative identities*
8	10/910/13 FALL BREAK No class M or T	3.10 Related Rates	HW6 (3.6, 3.7, 3.8) Due **Students will be able to:** *- determine the derivative of a function using implicit differentiation* *- determine the derivative of a function using the chain rule*
9	10/1610/20	3.11 Linearization (Differentials not on the exams or homework) 4.1 Extreme Values of Functions	HW7 (3.9, 3.10) Due Prelim I Revision Due **Students will be able to:** *- identify and solve related rates problems using derivative identities and techniques*
10	10/2310/27	4.2 The Mean Value Theorem 4.3 Monotonic Functions and the First Derivative Test	HW8 (3.11, 4.1) Due **Students will be able to:** *- identify and solve linearization problems using derivative identities and techniques* *- analyze functions using the extreme value theorem*
11	10/3011/3, 10/31, Prelim 2, Location TBA 7:30-9:00P on sections 1.14.1 (not 2.3)	4.4 Concavity and Curve Sketching 4.5 Indeterminate Forms and L'Hpital's Rule	
12	11/611/10	4.6 Applied Optimization 4.8 Antiderivatives	HW9 (4.2, 4.3, 4.4) Due **Students will be able to:** *- analyze functions using the intermediate value theorem and mean value theorem* *- sketch the graph of a function using information from its two derivatives and antiderivatives*
13	11/1311/17	5.1 Area and Estimating with Finite Sums 5.2 Sigma Notation and Limits of Finite Sums 5.3 The Definite Integral	HW10 (4.5, 4.6, 4.8) Due Prelim II Revision Due **Students will be able to:** *- identify limits involving indeterminate forms and appropriately use L'Hospital's Rule to resolve them* *- construct optimization problems using geometric or algebraic constraints and solve them using derivative identities and techniques*
14	11/2011/24 THANKSGIVING BREAK No class W, R or F	5.4 The Fundamental Theorem of Calculus	HW11 (5.1, 5.2, 5.3) Due Capstone Project Due **Students will be able to:** *- determine definite integrals using Riemann sums*
15	11/27-12/1 Last day of class: 12/1	More on 5.4 FTCs and Review for Final	HW12 (5.4) Due **Students will be able to:** *- determine definite integrals using the fundamental theorem of calculus*
Final Exam 12 December 2017 from 7:00pm to 9:30pm, location T.B.A., comprehensive			

Table 1: Tentative Course Schedule: During a typical week, students are assigned readings from the textbook before Tuesday and Thursday class. Weekly homework assignments and prelim revisions are due at 11pm EST on Thursdays.The schedule also marks the various times and dates for each of the prelims, final exam, and capstone project. A full scale version of this table is available on the course website.

6 Grading Policies

In general, late homework, prelim revisions, and projects will not be accepted late. If you feel like you need extra time with an assignment, please feel free to contact me to arrange for an extension. In general, each assignment will be graded on the quality of mathematical writing and correctness of solution. Solutions with good mathematical writing are often clear, concise, and coherent responses to a problem. Solutions are properly formatted (with staples and headers) and contain clear and well-thought out explanations in both English and mathematics. What is submitted for grading should be considered as a final draft of a personal solution manual instead of a collection of scrap work. A rule of thumb is that if the work is necessary to make the logical progression clear, then it should be included in a clear and coherent fashion. A proper response should not only feature mathematical expressions and equations, but also supplementary sentences that discuss the reasoning behind each statement. There are applications available to typeset your solutions on the computer such as LaTeX. Your grade for the class consists of weekly homework assignments, two preliminary exams, a capstone project, and a final exam. Here's the grade breakdown:

- Homework: 100 points.
  - Each homework assignment consists of short and long problems covering material from the previous weeks.
  - Short problems are intended to develop a student's proficiency by extending the material covered in readings and class.
  - Long problems are intended to develop a student's ability to apply calculus frameworks to new models and problems.
  - Of the 12 homework assignments during the semester, only the top 10 are used to compute the Homework grade.
  - Note that while each assignment consists of a different number of score points, each homework assignment is weighted equally.
- Capstone Project: 100 points.
  - The capstone project is an opportunity for students to collaborate in small groups to compose a significant mathematical document that addresses an open-ended problem. Students should demonstrate their ability to analyze a problem using a mathematical framework to synthesize a coherent and compelling solution.
- Prelim I: 100 points.
  - Prelim I serves as a benchmark of a student's proficiency to solve problems that require mathematical frameworks involving limit definitions, identities, and function continuity.
  - Prelim I can be revised to increase a student's Prelim I grade by up to 50% of its missing points. Thus a score of 80 can be revised up to a maximal score of 90.
  - Solutions will be provided after prelim revisions are due.
- Prelim II: 100 points.
  - Prelim II serves as a benchmark of a student's proficiency to solve problems that require mathematical frameworks involving definitions and identities of limits and derivatives.
  - Prelim II can be revised to increase a student's Prelim I grade by up to 50% of its missing points. Thus a score of 80 can be revised up to a maximal score of 90.
  - Solutions will be provided after prelim revisions are due.
- Final Exam: 200 points.
  - The Final challenges a student to demonstrate their ability to solve problems that require mathematical frameworks involving any calculus definition, identity, or theorem covered in the semester.

7 University Policies and Accommodations

7.1 Academic Integrity

Each student is expected to fully abide by the Cornell University Code of Academic Integrity. Familiarize yourself and precisely follow the Universitys Code of Academic Integrity (http://cuinfo.cornell.edu/aic.cfm). This code includes but is not limited to, A Cornell student's submission of work for academic credit indicates that the work is the student's own. All outside assistance should be acknowledged, and the student's academic position truthfully reported at all times. In addition, Cornell students have a right to expect academic integrity from each of their peers. Collaboration between students in this course is highly encouraged. Collaborations and outside sources should be cited in APA format whenever applicable. For the homework assignments, it is expected that each student writes their own solution. Collaboration is not allowed during the examination and students are expected to follow the examination rules as outlined on its cover sheet. Any student found breaking the Code of Academic Integrity, or helping another student break the code, or having any knowledge of other students breaking the code will automatically receive a zero for the assignment. Egregious violations may incur severe consequences such as failure of the course and University disciplinary action.

7.2 Student Accommodations

As an instructor I am invested in facilitating an inclusive and accessible classroom to students who require accommodations on the basis of cultural and faith observances and disabilities. Please try to submit requests for academic accommodations during the first three weeks of the semester so arrangements can be made. I am also available to discuss additional academic accommodations for students who feel they require it. If you are experiencing personal or academic stress at any time during the semester, or if you need to talk with someone about a personal problem, please seek support as soon as possible. I am available to talk with you about stresses related to your work and can also help you connect with campus resources.

7.2.1 Inclusivity Statement

We understand that our members represent a rich variety of backgrounds and perspectives. Cornell University is committed to providing an atmosphere for learning that respects diversity. While working together to build this community we ask all members to:

- Share the unique experiences, values and beliefs
- Be open to the views of others
- Honor the uniqueness of their colleagues
- Appreciate the opportunity that we have to learn from each other in this community
- Keep confidential discussions that the community has of a personal (or professional) nature
- Value each others opinions and communicate in a respectful manner
- Use this opportunity together to discuss ways in which we can create an inclusive environment in this course and across the Cornell community.

7.2.2 Faith Observances

Cornell University policy states that no student should be refused admission or be expelled because he or she is unable to participate in any examination, study, or work requirements because of his or her religious holy day requirements. An opportunity will be provided to make-up any examination, study, or work requirements that many have been missed as a result of a religious observance providing I have been notified in writing one week prior to absence.

7.2.3 Student Disabilities Services

Cornell University is invested in making online course materials accessible to students with disabilities. To this end, we have reviewed this course for baseline accessibility, which includes the captioning of videos, and use with assistive technology. This may not include some complex content (graphs, images, and/or equations). Please contact your Student Disability Services Counselor if students have difficulty with accessing online course material at 607-254-4545 or email sds_cu@cornell.edu for additional assistance. If students have already established accommodations with Student Disability Services (SDS), please communicate the approved accommodations to the instructor as soon as possible. If SDS has not been contact, but the student requires an accommodation due to a disability, please contact SDS at 607-254-4545 or email sds_cu@cornell.edu for additional assistance.

7.3 Campus Resources

- Student Services Office:
  https://sha.cornell.edu/current-students/contact.html
- Cornell Learning Strategies Center:
  http://lsc.cornell.edu/
- Gannett Health Services:
  https://health.cornell.edu/
- Lets Talk Walk-In Consultations at Gannett:
  https://health.cornell.edu/services/counseling-psychiatry
- Empathy Assistance and Referral Service:
  http://orgsync.rso.cornell.edu/org/ears
- Cornell Library:
  https://www.library.cornell.edu/