Math 115 Calculus of Functions of One Variable II

Summer 2024, Session B, July 1st – August 2nd

Description

In Math 115, we take complex problems and break them up into simpler ones. For instance, we can approximate the area of an irregular region by slicing it into pieces that look roughly like rectangles. By splitting a problem into smaller and smaller parts, we get better and better approximations for the solution. When we compute the LIMIT of these approximations, we get the exact answer. Otherwise, we bound the ERROR in our approximation.

Over the semester, we will develop concepts and skills that lie at the foundation of tools in each of the STEM disciplines, including engineering, economics, the physical and biological sciences, statistics, and data science. In particular, we will learn about Riemann sums, integration strategies, convergence tests, Taylor series, parametric equations, and polar functions. We will also develop strategies for problem solving and good habits of communication and mathematical reasoning.

Goals

In Calculus of Functions of One Variable II, you will learn how to…

- compute integrals by finding antiderivatives,
- approximate definite integrals and analyze the error in those approximations,
- determine whether infinite series converge or diverge,
- represent and approximate functions with Taylor series,
- compute lengths, areas, and volumes of geometric objects,
- model curves using parametric and polar equations.

Instructors

Instructor:	Ning Jia	<ning.jia@yale.edu>
TA:	Phuc Tran	<phuc.tran@yale.edu>

Explorations and Videos

Before each class, you will watch videos and complete online explorations on our Canvas umbrella site. The explorations introduce you to new concepts, definitions, and

skills through a sequence of questions. You will have up to six attempts to submit your exploration answers, and your highest score will be recorded. The explorations also include the findings (key concepts / definitions / results), a short narrative video, and an open ended question allowing you to reflect on what you've learned. **The explorations are due at 7am before each class.**

Class

Your class will meet on Zoom three times per week to discuss the material and work through example problems. **Attendance is mandatory.** The class sessions are interactive, and you should participate with your video on. If circumstances make it difficult to keep your video on, you should discuss alternative options with your instructor.

Problem Sets

We will have weekly problems sets to allow you to practice and get feedback on your understanding of the material. Wherever possible, you should explain your thinking and clearly document your work -- we will assess both the clarity and correctness of your solutions. The problems will be assessed according to the following rubric.

- **3 points:** Work is completely accurate and ideas are fully developed.
- **2 points:** Work is on the right track, but ideas are not fully developed, work is hard to read or disorganized.
- **1 point:** Work is sketchy or mostly on the wrong track. Or the work is messy/illegible.
- **0 points:** Work is completely incorrect or a numerical solution is presented with no explanation.

The problem sets are posted on the Canvas umbrella site and due on Fridays at 11pm (with exceptions on test weeks). You will submit your problem sets on Gradescope.
Written work should be captured using a scanning app on your phone. For iOS devices, we recommend Scannable by Evernote, and for Android devices, we recommend Genius Scan. If you have questions about how to scan/submit your problem sets, email your instructor.

Exams

There will be three exams during the semester. The exams are opportunities to reflect on the concepts and skills we have learned, and to communicate your understanding of this material. The test questions will emphasize conceptual understanding over computation. **You will not be allowed to use a calculator or any electronic devices to help you solve problems during the exams.** Exams will be proctored over Zoom.

- **Exam 1:** Friday, 7/12
- **Exam 2:** Friday, 7/26
- **Exam 3:** Friday, 8/2

Grading

Our grading policy rewards improvement over the course of the semester. Your grade will be determined as follows.

- Explorations 10%
- Problem Sets 15%
- Exam 1 25%
- Exam 2 25%
- Exam 3 25%

At the end of the semester, numerical scores will be converted into letter grades according to the following scale.

Percentage	100-90	90-80	80-65	65-50	50-0
Grade	A/A-	B+/B/B-	C+/C/C-	D+/D/D-	F

Resources

Textbook

***Calculus, Early Transcendentals*, 8th edition by James Stewart.**
We will assign exercises from the textbook on problem sets. WARNING: These exercises differ in older editions of the book. The Yale Bookstore prints a version of the text that contains only the chapters we use in Math 115.

Problem Workshop

Our TA will host a weekly problem workshop to go over examples and field questions about the material. Times and Zoom links are posted on the Canvas site.

Homework Sessions

Our TA will host a Zoom room where you can ask questions and collaborate with other students on the weekly homework. Times and Zoom links are posted on the Canvas site.

Instructor Office Hours

Your instructor has weekly office hours on Zoom. Office hours are a great opportunity to ask questions and gain a deeper understanding of the material. More information about office hours are posted on the Canvas section site.

Summer Session STEM tutoring

Drop-in tutoring hours are available through the Poorvu Center:
https://summer.yale.edu/academics/summer-session-tutoring

Student Accessibility Services

If you need and are not currently receiving exam accommodations (additional time, breaks, scribing, large-text, etc.), reach out to Student Accessibility Services as soon as possible at sas@yale.edu and/or susan.olson@yale.edu. If you need help navigating the accommodations process, consider requesting a Disability Peer Mentor, and check out the Disability@Yale Survival Guide.

Inclusive Learning

The University adheres to the philosophy that all community members should enjoy an environment free of any form of harassment, sexual misconduct, discrimination, or intimate partner violence. If you have been the victim of sexual misconduct, we encourage you to report this. If you report this to a faculty/staff member, they must notify our college's Title IX coordinator about the basic facts of the incident (you may choose to request confidentiality from the University). If you encounter sexual harassment, sexual misconduct, sexual assault, or discrimination based on race, color, religion, age, national origin, ancestry, sex, sexual orientation, gender identity, or disability please contact the Title IX Coordinator, Stephanie Spangler, at stephanie.spangler@yale.edu

203.432.4446 or any of the University Title IX Coordinators,who can be found at http://provost.yale.edu/title-ix/coordinators

Academic Honesty

At Yale, academic honesty is taken very seriously. Please take a moment to read the homework and exam policies in Math 115, so that you can be sure to follow them. In particular, the use of calculators, cell phones, or any other aid on our exams is forbidden. If you have any questions about our policies, please feel free to ask your instructor; they will be happy to answer them for you.

Course Schedule

Class	Section	Topic	Date
1	5.1.1	Areas	7/1
1	5.1.2	Distances	7/1
1	5.2	The Definite Integral	7/1
2	5.3	The Fundamental Theorem of Calculus	7/3
2	5.4	Indefinite Integrals	7/3
2	5.5	The Substitution Rule	7/3
3	7.1	Integration by Parts	7/5
3	7.2	Trig Integrals	7/5
4	7.3	Trig Substitutions	7/8
4	7.5	Integration Strategies	7/8
5	7.7.1	Integral Approximations	7/10

Exam 1: Integration and Approximating Integrals, Friday 7/12

6	7.8.1	Improper Integrals (Type 1)	7/15
6	7.8.2	Improper Integrals (Type 2)	7/15
6	11.1	Sequences	7/15

7	11.2	Series	7/17
7	11.3	The Integral Test	7/17
7	11.4.1	The Comparison Test	7/17
8	11.4.2	The Limit Comparison Test	7/19
8	11.5	Alternating Series	7/19
8	11.6.1	Absolute Convergence	7/19
9	11.6.2	The Ratio Test	7/22
9	11.7	Strategies for Testing Convergence	7/22
9	11.8	Power Series	7/22
10	11.9	Representing Functions with Power Series	7/24
10	11.10.1	Taylor Series	7/24
10	11.10.2	Taylor Polynomials and Error	7/24

Exam 2 - Convergence and Taylor Series, Friday 7/26

11	6.2	Volumes	7/29
11	6.3	Volumes of Revolution - the Shell Method	7/29
11	10.1	Parametric Equations	7/29
12	10.2.1	Tangent Lines with Parametric Equations	7/31
12	10.2.2	Arc Length with Parametric Equations	7/31
12	10.3	Polar Coordinates	7/31

Exam 3 - Geometric Applications, Friday 8/2