Math 121: Intermediate Calculus

Course Description

Intermediate Calculus will work through topics from a second-semester college calculus course, interspersed with reviews of Calculus I, and relevant topics from algebra, trigonometry, and pre-calculus along the way. Calculus is the study of changing quantities, and that course typically hinges on three central calculus topics: limits, derivatives, and integrals. In our time together, we will explore more Techniques of Integration, Infinite Series, and a few more topics to transition to Multivariable Calculus. Students will improve their decomposition skills for complex problems, as well as advance their presentation of rock-solid, persuasive justifications.

Meetings:	**Section 01** MWF 9:00–9:50 AM;
Professor:	**Danielle Benedetto**
Office:	Seeley Mudd 512
Phone:	x5465
Email:	dbenedetto@amherst.edu
Office Hours:	See Posted Homework Assignments. TBA
Webpage:	https://dbenedetto.people.amherst.edu/math121/
	Find all class information, handouts and assignments here.
Text:	James Stewart, *Single Variable Calculus*, 9th edition
Exams:	There are three midterm exams (given on dates below) and a final exam. There are NO EXCUSES, other than incapacitating illness, religious conflict, or the like, for missing an exam. Please email me immediately about conflicts.
Exam Dates:	**Midterm 1:** **Friday, February 20**
	Midterm 2: **Friday, March 27**
	Midterm 3: **Friday, April 24**
	Final Exam: TBD. (It will be three hours.)
Homework:	Problem sets will be due (usually) twice a week, in online program called *Gradescope*.
Grading:	Computed roughly as follows:

Effort:	5%.
Homework:	10%.
Midterm Exams:	Best one: 20%. Second best: 20%. Lowest: 15%. (Total 55%.)
Final Exam:	30%.

"Effort" is a combination of class attendance, class participation, and handing in problem sets. Despite the fact that homework is not given a large value, you are *expected* to complete all of it. Quite often, borderline cases for final grades are decided by knowing that certain students made a largely active effort (or lack thereof!) on homework. You are encouraged to make fully engaged visits to office hours every week.

What to Expect

Calculus II definitely requires a larger commitment than most of you made to Calculus I. The work load increases some, but mainly the intensity increases. Overall a better focus and stronger work ethic is necessary to succeed. Many of the problems in this course require the combination of several techniques from many different sections. In general, the homework problems are much longer. You must keep on top of all the various strategies we learn. The first time that you find yourself hesitating on how to solve a problem, please get help. The pacing of this course will require you to independently stay on top of the weekly calendar.

Amherst College's version of Calculus II is more intensive than most high school versions of the same course. Although most of the exercises and exam problems will still be computational, our focus will be more on the connective arguments involving integrals, series, and other objects.

Course Content

Intermediate Calculus covers three main topics: Intergration Techniques, Sequences and Series, and Parametric Equations/Polar Coordinates. Here's a more detailed summary:

- In Chapter 6, we'll discuss **inverse** functions and their derivatives. We'll review exponentials and logarithmic functions, maybe define the hyberbolic functions ($\sinh x$ and $\cosh x$), and study the inverses of trigonometric (and maybe hyperbolic) functions. We will also learn about **L'Hôpital's rule**, used for computing certain difficult limits.

- In Chapter 7, we'll have a brief review of **integration**, including a refresher for integration by substitution and learn several new **methods of integration.** Finally, we will talk about **improper integrals**, which are integrals where either the domain or range runs off to infinity.

- In Chapter 11, we'll introduce **sequences** (infinite lists of numbers) and **series** (infinite sums). The key questions are whether a given series converges, and in what case can we find an actual sum. We will learn several tests/techniques to help us answer these questions. Finally, we'll talk about **power series**, which are a special way of writing certain functions as infinite sums. The focus will be on writing persuasive and precise justifications.

- In Chapter 5, we may return to **integration** and discuss methods for finding volumes of certain solid (three-dimensional) solids, providing a natural review of integration techniques.

- In Chapter 10 we'll discuss **parametric equations**, which are a nice way to describe curves in the plane. Closely related are **polar coordinates**. We'll apply Calculus to find area or lengths of curves for parametric and polar work to prepare for multivariable calculus.

Necessary Background

You need to know Calculus I. We'll assume precalculus stuff like functions and graphing, as well as trigonometry. Within Calculus itself, we'll rely on former knowledge of limits, derivatives, and early integration. Besides being able to compute such things, you should have an intuitive knowledge of what each means. We will review most of the final topics from Math 111, but at high speed. Please come *see* me if you have any questions.

Learning Goals

During this semester, students will strive to...

- Learn to approach mathematical concepts in multiple ways: as intuitive ideas, via formal definitions, and in the context of computation and problem-solving.

- Learn/review/solidify some of the content of a standard first-year college calculus course. Although some students may have seen some of the topics before in a high school calculus course, a college course naturally approaches these concepts at a deeper level.

- Practice choosing a suitable approach (or combination of approaches) to an unfamiliar and complex problem from multiple options, decomposing the problem into smaller pieces.

- Extend knowledge of and proficiency with integration, with a focus on problem-solving techniques and ability to use multiple approaches. Learn applications for Infinite Series.

- Learn to prioritize carefully reasoned arguments and clear explanations with precise mathematical reasoning, rather than simply arriving at a final answer. This goal is especially relevant to those students who have already learned some Calculus. Aim to focus more on your presentation of solutions, rather than simply putting down the answer.

- Pay attention to accurate mathematical writing, including the correct use of notation, terminology and grammar, and unfamiliar definitions.

- Challenge yourself to work differently and find a few ways to adjust your approach to studying. Generally, study more than ever before, stay organized, and stay completely on top of your schedule. Work with classmates and seek help from instructors. If you feel like you need help, as you likely will at some point, ask anything you want to the professors or assistants. Overall, strive to improve independence and resourcefulness.

- Find success and support when visiting friendly Office Hours.

Homework

Start working on each homework as soon as possible, because some of the problems may turn out to be challenging. Your work should be double-checked and written neatly. Unexcused late assignments will not be accepted or graded. Do not rely on using a calculator for homework, since they will not be allowed in exams. Do **not** use any AI sources or online websites (like Google, Slader or Chegg) that provide solutions. All copied work will receive zero credit and risk serious academic penalty.

About the Statement of Intellectual Responsibilty

For exams: your work must be entirely your own, so no looking at other people's papers, no talking to each other or passing signals, and no outside help. Unless I specifically allow it, aids like AI sources, calculators, iPads, cell phones, books, notes, webpages are **not** permitted in exams. No credit is given for copying from **any** source, and you will be reported to the Dean(s) and will risk FAILURE in the course.

For problem sets: you may interact with other students discussing problems. Still, the work must be your own, even if you received substantial input from others. *Everyone works on every problem.* Each student must write up each problem **in their own words**. Obviously, copying someone else's solution (even when the source doesn't mind) is plagiarism and a violation of intellectual responsibility. Secret Code Word: NINJA

Getting Help

If you get stuck on a problem, or you're feeling lost in the material, which happens to everyone at some point, there is a lot of help available out there:

Office Hours: Please stop by (unannounced) to see me during my scheduled office hours. Make an appointment to see me another time.

The QCenter: The Moss Quantitative Center is running office hours with Tim St. Onge. They provide drop-in help during the daytime and some one-on-one tutoring.

Peer Tutoring: If you feel you need several hours of help a week, you might want to get a peer tutor. Please talk to me about it first.

Math Fellows: Weekly evening hours with Math Fellow Teaching Assistants.

Expectations and Advice

- **"Attend" class faithfully;** in general, a Calculus class moves very quickly, and the material repeatedly builds on itself daily. I will not reteach material for unexcused absences. Simply put, I strongly discourage you from skipping class.

- **Be on time;** if you miss the first five minutes, you'll be behind and confused for the next forty-five. Besides that, honestly, it's disrespectful to the professor.

- **Be active and inclusive in class;** engage with the material and respectfully with all classmates.

- **Come to Office Hours regularly;** please never be embarrassed to come ask for help!! One of my favorite parts of teaching is helping students in office hours. I "expect" to see all of you there at some point. Take advantage of my help; I become really invested in my students.

- **Be patient;** if you feel like you are struggling, come see me. I'm so happy to help!!

- **Read the lecture notes or book;** search the sections for relevant definitions, theorems, examples.

- **Do all of the problem sets;** my experience teaching convinces me that it's absolutely vital for success with learning the material. Ultimately, we are all here to truly learn, so please make this a commitment. Assignments are designed carefully and are important. Start early.

- **Active participation is encouraged and expected;** ask and answer lots of questions. Always get concerns clarified during office hours. Usually other students share the same question. Meanwhile, please show respect for other people's questions.

- **Make an impression!** If are skipping class regularly and not handing in problem sets, you are essentially telling me you aren't taking things seriously. **Being attentive in class, visiting office hours, and completing problems sets make strong impressions.**

- **Invest time and take responsibility!** Put in time studying every day that is not solely for Homework. Make study guides and review your notes.

- **Be respectful;** please **NO** cell phones or texting in class or office hours! Put them away...

Welcome! Let's have a fantastic semester! We will learn a lot, work hard, and have fun!