# Math 106

## Calculus with Elementary Functions

### Course Description

Calculus is the study of changing quantities, and that course typically hinges on three central calculus topics: limits, derivatives, and integrals. Math 106 will begin with reviews of early Calculus I, and relevant topics from algebra, trigonometry, and precalculus along the way. In our time together, we will explore more Differential calculus, using Trigonometric functions, and then Integration, and a few more topics to transition to Calculus II. Students will improve their decomposition skills for complex problems, as well as advance their presentation of rock-solid, persuasive justifications.

**Meetings:** MWF 10:00–10:50 AM and Tues 10–11:20 am

**Professor:** **Danielle Benedetto**

**Office:** Seeley Mudd 512

**Phone:** x5465

**Email:** `dbenedetto@amherst.edu`

**Office Hours:** See Posted Homework Assignments

**Webpage:** `https://dbenedetto.people.amherst.edu/math106/`
Find all class information, handouts and assignments here.

**Text:** James Stewart, *Single Variable Calculus*, 8th edition, Brooks/Cole, 2016.

**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 23**
**Midterm 2:** **Friday, March 29**
**Midterm 3:** **Friday, April 26**
**Final Exam:** TBD. (It will be three hours.)

**Homework:** Problem sets will be due (usually) twice a week, in online program called *Gradescope.*

**Weekly Quiz:** Weekly Take-Home Problem(s) due Sunday in *Gradescope.*

**Grading:** Computed roughly as follows:

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| **Effort:** | 5%. |
| **Homework/Worksheets:** | 15%. |
| **Quizzes:** | 10%. |
| **Midterm Exams:** | 15% each (Total 45%.) |
| **Final Exam:** | 25%. |

"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

Math 106 definitely requires a larger commitment than most of you made to Math 105. The work load increases some, but mainly the intensity increases. Overall a better focus and stronger work ethic is necessary to succeed. The pace will probably be faster than you are used to, and theory and concepts will get a heavier emphasis. 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. Although most of the exercises and exam problems will still be computational, our focus will be more on the connective arguments involving limits, derivatives and integrals and other objects, rather than on how to blindly manipulate them. Similarly, even on exam and homework problems, we will be more interested in how you arrived at your answer, than in the answer itself. Communication is key here!

## Course Content

In this second semester, we will introduce trigonometry and go back through the differential calculus from Math 105, this time with Trigonometric functions in the mix. Then, we'll go on to the beginnings of integral calculus and then talk about exponential function and logarithms. Here's a more detailed summary:

- To start, we'll review trigonometric functions and their uses. We'll spend some time locking down the details before we do any calculus with them.
- Next we'll skip back through some Math 105 topics, seeing limits, derivatives, and applications of the derivative, all involving not just elementary functions of Math 105, but also the trig functions. We'll learn about antiderivatives, which will lead into the rest of the course.
- In Chapter 4, we'll use limits to introduce definite integrals (which measure the area under the curve). We'll also see that integrals are closely related to the antiderivatives at the end of Chapter 3. We'll learn some techniques for computing some integrals (which are usually more difficult to compute than derivatives) and see a few applications in Chapter 5.
- In Chapter 6, we'll learn about exponentials and logarithms, and do some calculus with these interesting functions and some applications, including Exponential Growth/Decay.

## Necessary Background

You need to have strong skills in algebra (simplifying, solving equations, the quadratic formula, and so on), analytic geometry (Cartesian coordinates and graphing functions like lines and parabolas, mostly). We will review!! You will also need some skills in standard limits and derivatives, as well as applications to the derivative, that you learned in Math 105.

## Structure of the course

**Worksheet Labs:** Beyond lectures, our course meets for an extended time on Tuesdays in order to do worksheets that help students learn the material in a more active mode. The work is done in small groups, with a goal of not just *doing* the problem, but rather of *understanding* what is really going on. The problems are interesting and varied, though definitely not easy. The philosophy is based on *active learning* (class should be more than just taking notes) and *getting smarter at math* (working hard in the right way can make you smarter). You should prepare for worksheet days by reading over your notes completely.

## 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.
- Gain (or extend) knowledge of and proficiency with integration, with a focus on problem-solving techniques and ability to use multiple approaches. Learn applications for Integration.
- 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. Generally, strive to improve independence and resourcefulness.
- Find success and support when visiting friendly Office Hours.

## Homework and Weekly Quizzes

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. Weekly quizzes will provide direct feedback from Professor Benedetto. Do not rely on using a calculator for homework, since they will not be allowed in exams. Do **not** use any online websites (like Slader, Chegg or Google, etc) 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 calculators, iPods, 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:

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| **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 Assistant, Ellerman. |

## 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 abscences. 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!! Based on the difficulty of the course, the pace could pick up at any time.
- **Read your notes Daily;** search the sections looking for relevant definitions, theorems, examples, for full understanding.
- **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!** Find study time every day.
- **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!