MA 124 Calculus II
Spring 2018

As you learned in Calculus I, calculus is the mathematics of change. For a continuously varying quantity, we use calculus both to compute its instantaneous rates of change and to sum it over an interval of inputs. A typical first course in calculus introduces the definite integral and the concept of integration in general, but usually one needs a second semester to obtain a solid understanding of one-dimensional calculus.

In this course, you will learn how to use the definite integral to answer questions such as

- How do I compute the area of a complicated two-dimensional region?
- How do I compute the volume of a complicated solid in three dimensions?
- How do I compute the pressure that water exerts on a dam?
- How do I approximate the values of the various functions that arise in important applications?

This course is the second course in BU's traditional sequence of three calculus courses. MA 123 or an equivalent course in calculus is a prerequisite. We continue the discussion of the definite integral that began at the end of MA 123. We emphasize the formulation of integrals that compute desired quantities such as area, volume, and pressure as mentioned above.

Another topic that will occupy essentially the entire second half of the semester is the topic of approximation. How do we know that π is approximately 3.141592653? How do we add an infinite number of numbers? And how does this type of addition help us with the approximation problem mentioned above?

Instructional Format:

A Sections: These sections are the weekly lectures (3 hours/week). **All students must be registered for one of these sections.**

- A1: MWF 1:25–2:15 in CAS 522
- A2: MWF 2:30–3:20 in CAS 522
- A3: TR 12:30–1:45 in STO B50

When you register for an A section, **you are also reserving the Thursday evening 6:30–8:30 time slot.** Our first midterm exam will be held 6:30–8:30 on Thursday, March 1, and our second midterm exam will be held at the same time on Thursday, April 12. **You should not schedule anything that conflicts with these exams.** Note that spring break begins on Saturday, March 3, and we expect you to be on campus on March 1.

The final exam will be administered 6–8 pm during one of the evenings of final exam week. **Do not make any travel arrangements until we have finalized the scheduling of this exam.**

B Sections: These sections are the "studio-style" discussion sections. **All students must be registered for one of these sections.** Attendance in discussion section is mandatory.

- B1: T 2 pm–3:15 am in EPC 207
- B2: T 3:30 pm–4:45 pm in EPC 207
- B3: T 5 pm–6:15 pm in EPC 205
- B5: R 2 pm–3:15 pm in EPC 207
- B6: W 4:30 pm–5:45 pm in EPC 207
- B7: R 3:30 pm–4:45 pm in EPC 207

During the first 55 minutes of each discussion section, you will work in groups of four on worksheets that we have developed to augment the lectures and on-line homework.

Instructors:

- Professor Paul Blanchard: Course coordinator and A3 lecturer
  Email: paul (at) bu.edu
  Office hours: M 10–11, T 9–10, and Th 10–11
  Office: Room 255, 111 Cummington Mall

- Professor Ranjan Panth: A1 lecturer and discussion section coordinator
  Email: rpanth (at) bu.edu
  Office hours: (tentative) M and F 4–5:30
  Office: Room 231, 64 Cummington Mall

- Professor Ryan Goh: A2 lecturer
  Email: rgoh (at) bu.edu
  Office hours: W 3:30–5 and F 10–11:30
  Office: Room 237B, 111 Cummington Mall

Textbook and on-line homework system: Detailed information about the textbook options is available at http://math.bu.edu/people/paul/124/textbook.html. We cover most of the material in Chapters 6–9 of the text.

Course web page: Most course materials and the on-line homework assignments will be available at www.mymathlab.com. Your course ID on MyMathLab is determined by your A section and is available from your lecturer.

Exams and grading: In addition to the two midterm exams and the final, there will be quizzes in discussion section.

Your grade for the course will be determined using the following percentages:

Each midterm exam	20%
Final exam	30%
Quiz grade	15%
Homework grade	10%
Lecturer's discretion	5%

Getting help:

- You are welcome and encouraged to visit the office hours for **any** of the lecturers for MA 124.
- The Mathematics and Statistics Tutoring Room, MCS B24, is open approximately 30 hours each week from the second week of classes. This room is also a good place to study between classes.
- A summary of the office hours and tutoring room hours of all of the MA 124 staff is available here.
- Professor Wayne Snyder will supervise "Math Help Night" in the Cinema Room of Rich Hall on West Campus on Tuesdays, 7:30–10:30 pm. You do not need to live on West Campus to take advantage of this opportunity.
- The Education Resource Center offers free individual and group tutoring. The Center gets very busy as the end of the semester approaches, so it is good to make contact with them earlier rather than later.

Homework policies:

- Make sure that you run the **BROWSER CHECK** the first time that you use MyMathLab. You must also allow pop-up windows and session cookies, and Javascript must be enabled. See http://www.pearsonmylabandmastering.com/northamerica/mymathlab/system-requirements/ for more details.
- The on-line homework is due weekly. MyMathLab clearly displays the day and time at which each assignment is due.
- Extensions on homework sets will not be granted for any reason (including a system freeze on the night the homework is due—start your homework early!). However, **your lowest two homework grades will be dropped at the end of the semester.**
- If you feel a question was graded incorrectly on MyMathLab, click on the "Report MML Grading Issue" menu item in MyMathLab and follow the instructions listed there.
- All work submitted through MyMathLab must be your own. Doing otherwise will be considered a violation of the academic conduct code (see below).

Discussion section policies:

- Attendance at discussion sections is mandatory.
- Each discussion section will focus on a worksheet that reviews and goes more deeply into topics discussed during lecture.
- You are expected to have one section of your notebook devoted solely to your work on the discussion section worksheets. This part of your notebook may be inspected by your TFs on occasion. Even though you are expected to work in groups, you must write up your own solutions to the questions on the worksheets.
- There will be a quiz during every discussion section (starting the second week of the semester) based on the worksheet and on the week's homework set.
- No make-up quizzes will be given except as required by the University's policy on religious observance (see below). However, **your lowest two quiz grades will be dropped at the end of the semester.**
- If you are unable to make your discussion section for any reason, you are welcome to attend a different discussion section during that week. However, you will **NOT** be able to take a quiz in any discussion section except your own.

Exam and quiz policies:

- Calculators cannot be used during quizzes and exams.
- When you finish a quiz or an exam, raise your hand but stay seated. Someone will come to your seat, pick up your paper and check your BU ID.

Make-up exams: We do not give make-up exams except in truly extraordinary circumstances. For example, if you are suffering from an illness that requires hospitalization, we will either adjust the grading scheme given above or administer a make-up exam. If you miss an exam to participate in a sporting event hosted by a club sport, you will receive a grade of zero. Note the reference below to the University's policy on religious observance.

If you think that you might miss an exam, contact the course coordinator, Professor Blanchard, in advance as soon as possible.

University Policy on Religious Observance: This course adheres to the University's policy on religious observance. Note that this policy states that students are required to inform instructors, in writing, of conflicts with the course schedule and requirements due to their religious observance as early as possible in the semester, and in any case no later than one week in advance of conflict, so that accommodations can be made.

Course announcements: All general course announcements will be posted on the MyMathLab web sites. You are responsible for any information that is posted there.

Gradebooks: Your homework grades will be posted on the MyMathLab sites, and your exam and quiz grades will be posted on the Blackboard sites for this course. We double check the grades when we record them, but with so many students in this course, it is possible that some errors will be made when we record the grades. You should check your grades in a regular fashion, for example, once every two weeks, and if there is a mistake, show it to your TF or your lecturer at your next discussion section or lecture. You should keep all of your graded papers until the course grades have been determined. **No grades will be changed unless we can review your original papers.**

Academic conduct: Your work and conduct in this course are governed by the Boston University Academic Conduct Code. This code is designed to promote high standards of academic honesty and integrity as well as fairness. It is your responsibility to know and follow the provisions of the code. In particular, all work that you submit in this course must be your original work. If you have a question about any aspect of academic conduct, please ask.

Ensuring a positive learning environment: The lectures and the discussion sections are times that are devoted to learning calculus, and activities that interfere with this process are not permitted. Although you may use your smart phones, tablets, or laptops to answer questions at the Learning Catalytics website during lecture, your use of these devices at other times during lecture and discussion section will be subject to the approval of your lecturer or discussion section leaders. Tweeting, texting, shopping online, and visiting Facebook are certainly not allowed.

Important dates: In addition to the exam dates mentioned above, you should know that the last day to withdraw from the course without a grade of W is February 22. The last day to withdraw from the course while receiving a grade of W is March 30.

Week-by-week schedule of topics and readings: Since this course has lectures that meet either MWF or TR, the following schedule may not correspond exactly to the schedule that will be followed in your lecture. If you are unsure about what material you are responsible for at the end of any particular week, you should ask your lecturer at the end of class on either Thursday or Friday.

1. (one class) Introduction to MA124 including course logistics; some review of the definite integral.

2. A little more review of integration, especially the methed of substitution.

   We begin our discussion of the use of calculus to model various physical applications with a discussion of velocity as well as "net change" in general (Sections 6.1–6.2).

We also begin to study applications of the definite integral to various geometric problems including the computation of volume for certain types of three-dimensional solids (Section 6.3).

3. Additional geometric applications of the definite integral include another way to compute volume for certain solids, the computation of the length of a curve in the plane, and the computation of the area of a surface in space (Sections 6.4–6.6).

4. Other applications of the definite integral include the computation of mass from a density function, the computation of work from physics, and the computation of water pressure on a dam (Section 6.7). We also revisit our discusstion of exponential models of growth or decay from MA 123. This discussion includes a wider range of examples than those that were discussed last semester (Section 6.9). We also begin a more detailed discussion of the computation of definite integrals. We consider integrals that can be computed with the use of the Fundamental Theorem of Calculus and integration by parts (Sections 7.1 and 7.2).

5. We continue our discussion of the computation of definite integrals. This week we consider integrals that can be computed with the use of trigonometric identities, trigonometric substitution, and partial fractions (parts of Sections 7.2–7.5).

   We note that the integrals that arise in applications often cannot be computed exactly because we cannot find an antiderivative. We discuss the judicious use of computer "algebra" systems for computing exact as well as approximate values of definite integrals. We also discuss some of the standard methods of numerical approximation of definite integrals such as the Midpoint Rule, the Trapezoid Rule, and Simpson's Rule (Sections 7.6 and 7.7).

6. We continue our discussion of numerical methods.

   We also consider improper integrals. These integrals arise in physical applications such as the computation of escape velocities. They are also appear in the definitions of various "transforms" such as the Laplace transform and the Fourier transform.

   Improper integrals are conceptually and technically more complicated than the standard definite integral because either the interval of integration is unbounded or the integrand is unbounded over a finite interval of integration. Either case involves the subtle issue of convergence. They will also play a role in determining the interval of convergence of a power series—one of the last topics in this course (Section 7.8).

7. We return to the elementary study of differential equations that we began in MA 123, and we consider separable differential equations (Section 7.9). We also devote some time to review what has been discussed so far this semester in preparation for the first midterm.

8. This week we begin what at first seems to be a totally different approach to calculus. The second half of the semester is devoted to the topics of infinite sequences and series, power series, and Taylor series. Our approach includes a substantial discussion of the

issue of convergence (Section 8.1).

We begin with the notion of an infinite sequence, and we study the ways by which one determines if the sequence converges or diverges (Section 8.2).

We also begin our discussion of infinite series by considering a few of the standard examples (Section 8.3)

9. We are now ready to pursue our discussion of convergence of infinite series, and this discussion takes slightly more than two weeks. Most of that time is spent on "tests" for convergence. This week we study the Integral Test (Section 8.4).

10. Next we consider two Comparison tests, the Ratio Test, and the Root Test (Section 8.5).

11. We conclude our discussion of tests for convergence by considering alternating series and the notions of absolute and conditional convergence (Section 8.6).

    We begin to harvest the benefits of our hard work over the last three weeks with a discussion of approximation of arbitrary differentiable functions by polynomial functions. These functions are called Taylor polynomials (Section 9.1).

12. An approximation is only as good as its accuracy. One of the most challenging theorems discussed in the first year of calculus is Taylor's Theorem, which is also referred to as the Remainder Theorem. With this theorem, we can determine an upper bound on the error that results when we estimate a function by its Taylor polynomial of a given degree (Section 9.1).

    We also devote some time to review for the second midterm.

    We transition from the question estimating the accuracy of an approximation to the question of representing a complicated function such as a trigonometric function, an exponential function, or a logarithmic function using an "infinitely long" polynomial. Such "polynomials" are called power series (Section 9.2).

13. Associated to every power series is an important interval called the interval of convergence. An infinite series makes sense on its interval of convergence and is meaningless otherwise. We spend this week studying methods to determine this interval (Section 9.2).

    We also consider how the operations of differentiation and integration apply to power series, and by doing so we see how a given function is represented by a power series (Section 9.2).

14. Our year-long study of calculus in one variable ends with the topic of representing a complicated function by its power series. This series is also called its Taylor series (Section 9.3).

15. The remainder of MA 124 focuses on computing and working with Taylor series (Sections

9.3 and 9.4).