Calculus I

Course Information

- **Institution**: Dordt University
- **Course**: Math 152-01 (4 cr.)
- **Term**: Spring 2021
- **Instructor**: Dr. Mike Janssen, Associate Professor of Mathematics
- **Classroom**: CL 1302
- **Class time**: 8:10-9:25am MWF
- **Office**: SB 1612
- **Student Hours**: Make an appointment or drop by
- **Course notes**: https://prof.mkjanssen.org/c1/notes/ | PreTeXt source
- **Course website**: https://prof.mkjanssen.org/c1/
- **Catalog Course Description**: A study of the basic concepts and techniques of calculus for students in all disciplines. Topics include limits, differentiation, integration, and applications. This course is intended for students without any previous calculus credit. Prerequisite: Mathematics 116 or equivalent or ALEKS PPL score of 70 or higher by third class meeting.

Required Resources

- Access to the free textbook, *Active Calculus*
- *Active Calculus* Dordt bundle, containing the activities workbook and an Edfinity access code
- Regular access to our Canvas page

A graphing calculator feature equivalent to a TI-84+ will likely come in handy, but is not required. We will make regular use of Desmos for in-class work.

Learning Objectives

In this course, students will:

- be *learners* by demonstrating mastery of the mathematical concepts that have driven the development of our understanding of the inner working of creation and technology over the past 400 years. (RO, CD)
- be *explorers* by actively inquiring into/working with and applying the techniques of limits, differentiation, and integration using standard methods of calculus. (CS)
- be *connectors* by applying these tools and concepts to mathematical and real-world problems in a variety of settings. (CS, CR)
- be *ambassadors* by reflecting on the beauty and truth that can be found through a careful study of God's mathematical creation. (RO, CD)

Course Liturgies

In this section, we briefly describe the basic rhythms of the course.

Before Class

In order to maximize your learning, it is important that you regularly attend class, and come prepared. For days on which we start a new section, this means that you should:

- read over the relevant section of the book (especially the Motivating Questions and introduction), and
- complete the Preview Activity (done on Desmos) and submit it by 8:00am.

Each timely submission of a Desmos Preview Activity on which you have made a good-faith effort to be correct will earn one Engagement Point (EP).

During Class

Unlike many "traditional" courses in mathematics, you will drive the in-class work, not me. A typical class period will begin with a brief reminder of a big idea or two from the pre-class work. We'll spend the majority of the time working in small groups on activities from our course materials, with occasional interruptions to discuss new insights and confirm that we're all on the same page. For one EP/week, you'll upload a scan of your solutions to the week's activities by 5pm on Friday.

After Class

In order to build toward mastery of the fundamental concepts and skills of the course, you will be assigned regular post-section homework, to be accessed on our Canvas site and completed on the Edfinity platform. See the due dates in the tentative schedule.

Assessed Work

Your mastery of the main concepts of calculus (and thus your final grade) will be assessed via the following items of work.

Engagement Your progress on this aspect of the course will be based on the number of Engagement Points (EPs) earned. You will earn one (1) PEP by: submitting a Desmos Preview Activity by 8:00am Central on the assigned due date (see schedule below); attending one class period (physically, or virtually with appropriate accommodation); submitting a completed set of the week's in-class activities, scanned and uploaded to Canvas by 5:00pm Central each Friday. Daily Prep assignments and class attendance may not be made up/revised after the fact. You may submit your set of weekly activities up to 24 hours late for free. No later submissions will earn credit.

Homework The online homework (done on Edfinity and accessed via Canvas) consists of regular problems due by 5:00pm Central on the listed due dates, typically the class day after we finish covering the relevant section. Your average on all of the homework sets will affect your final grade. You have an unlimited number of attempts on each problem, so your overall homework average should reflect not only your knowledge of the material but also your perseverance and commitment to finishing the work.

Learning Target Exams There are 30 learning targets in this course (listed below). Each learning target will be assessed on at least two exams. Each problem will earn a grade of **M** (meets expectations) or **R** (revision/reassessment needed). The number of learning targets assessed at **M** will affect your final grade.

Derivative Calculation Exam One of the topics that we are going to spend a majority of the semester exploring is the derivative of a function. In order to properly explore and answer questions about applications, it is important that you differentiate a function quickly and correctly. To this end, you will take an exam on which you must correctly differentiate at least 8 of 10 functions given to pass. In order to pass this class and move on to Calculus II, you must pass the Calculation Exam.

Reflections Dordt University places itself squarely in the Reformed tradition of the Protestant Christian faith. We affirm, as Abraham Kuyper said, that there is not a square inch in all of Creation over which Christ does not claim lordship—not even the abstract aspects of Creation commonly associated with mathematics. You will write two reflection papers this semester: the first will explore the aesthetic qualities of mathematics. In the second, we'll explore the human story of the development of the Fundamental Theorem of Calculus. These reflection assignments will be due as described below and assessed on a Pass/Not Yet scale. More details are available on each assignment's Canvas page.

Final Exam The final exam will be comprehensive and will be used to determine how your base grade is modified (add a plus, leave unchanged, add a minus, drop a letter grade).

Grading

Base Grade

Your Base Grade will be determined by your work on the assignments described above. In general, the highest fully completed row the following table will determine your Base Grade.

Base Grade	Learning Targets	Homework Average	Engagement Points	Reflections	Derivative Calculation Exam
A	28	92%	90	2	Passed
B	25	80%	80	2	Passed
C	22	67%	67	2	Passed
D	16	55%	55	1	Passed

Final Exam Modifier

The final exam will consist of 10 problems (each graded out of 10 points) corresponding to the bolded learning targets. The final exam will modify your base grade in the following way:

- If you earn 85 points or more, your base grade will have a plus attached to it (unless it is an A; Dordt does not award A+ grades).
- If you earn 65 – 84 points, your base grade will be unmodified.
- If you earn 50 – 64 points, your base grade will have a minus attached to it.

- If you earn 49 points or less, your base grade will drop by a full letter grade.

Note that if your base grade is an F, your course grade will be an F regardless of your performance on the final exam.

Reassessments and Revisions

There are two goals of the assessments in this course. **The first goal** is to hold you accountable for being an active and engaged member of our classroom learning community. This is where the Preview Activities come into play. Since these are intended to keep you on pace with the course material, late submissions will not be accepted.

The second goal of the assessments is to measure how well you are meeting the learning outcomes of the course. However, I am primarily concerned with your ability to demonstrate mastery of the learning outcomes eventually, so the opportunity to reattempt or to revise and resubmit is available for the other assessment categories.

Reattempts

If you do not pass the Calculation Exam or a learning target during the scheduled exam times in class, you will be able to reattempt them outside of class. During non-exam weeks, you will be allowed to sign up by Tuesday at 11:59pm to reassess the Calculation Exam or up to 2 learning targets on Fridays immediately following class from 9:25am-9:50am. Learning Targets may only be reassessed after they first appear on an exam, and up to the Friday prior to the exam that is two exams after the first exam they appeared on. For example, learning targets 1-9 will be assessed on Exams 1 and 2, and can be reassessed during Friday quizzes on Feb. 19, Feb. 26, Mar. 5, Mar. 12, Mar. 19, and Mar. 26 (and then only if you fill out the form!). Learning Targets 14 – 30 may be reassessed during the final exam block.

Other Polices and Advice

- I am generally fairly accepting of late work, with a built-in 24-hour grace period for any non-classroom activities. Additional time beyond the 24-hour grace period must be approved ahead of time.
- Student hours are your time to ask questions about all aspects of the class and college life. If you can't find an appointment, send me an email! I will do my very best to accommodate your schedule.
- **Email Policy**: I check my email twice per school day: once in the morning, where I'll deal with any emergencies, and once in the afternoon, when I'll respond to other emails (including any that have come in since the morning). If you require a more immediate response, you're welcome to come find me in my office.

Additional Information

Dordt University Student's Right to Accommodations Policy Any student who needs access to accommodations based on the impact of a documented disability should contact the Coordinator of Services for Students with Disabilities (CSSD): Marliss Van Der Zwaag, Academic Enrichment Center, (712) 722-6490, marliss.vanderzwaag@dordt.edu.

Dordt University Academic Dishonesty Policy Dordt University is committed to developing a community of Christian scholars where all members accept the responsibility of practicing personal and academic integrity in obedience to biblical teaching. For students, this means not lying, cheating, or stealing others' work to gain academic advantage; it also means opposing academic dishonesty. Students found to be academically dishonest will receive academic sanctions from their professor (from a failing grade on the particular academic task to a failing grade in the course) and will be reported to the Student Life Committee for possible institutional sanctions (from a warning to dismissal from the university). Appeals in such matters will be handled by the student disciplinary process. For more information, see the Student Handbook.

COVID-19 Classroom Protocols As we begin the semester, Dordt is a mask-required environment. While on Dordt's campus, you will need to wear a mask in all public places or common indoor spaces, which include: classrooms, hallways, laboratories, restrooms, the Hulst Library and all building lobbies. Should you forget your mask, there may be a disposable paper mask available in the classroom/lab for your use. If not, your instructor will ask you to return to your room to retrieve your mask. Physical distancing practices will also be in effect. Your instructor may also ask for student volunteers to who are willing to take a few minutes to spray cleaning solution on classroom surfaces when class concludes.

If you are approved by Student Services for accommodations for virtual learning due to COVID-19, your instructor will be notified by Student Services and you will receive information from your instructor about virtual learning during your isolation period.

Learning Targets

Bolded Learning Targets will be covered on the Final Exam. Representative problems appear in parentheses, though note that you should not expect exam problems to look exactly like one of these.

1. Given information about a function (either a table of data or a graph), answer questions about its average and/or instantaneous rates of change. (Exercises, 1.1.1.1.1.2, 1.1.4, 1.1.5, 1.6.3)
2. **Sketch a graph that has specific behaviors at indicated points and intervals.** (Exercise 1.2.7, 1.6.9)
3. Given the graph of a function, answer questions about the function, its derivative, and its second derivative. (Exercises 1.3.1, 1.3.2, 1.3.3, 1.4.3, 1.4.4, 1.6.1, 1.6.2)
4. Use the limit definition to find the derivative function. (Exercises 1.4.2, 1.4.5)
5. Use the central difference and other estimation techniques to answer questions about applications of the derivative. (Exercises 1.5.1, 1.5.2, 1.5.3, 1.5.4, 1.6.8)
6. Given the graph of the derivative, answer questions about the function, the first derivative, and the second derivative. (Exercise 1.6.5, 1.6.7)
7. Given the graph of a function, determine the values of indicated limits. (Exercises 1.2.1, 1.2.2, 1.2.3, 1.7.1, 1.7.2)
8. **Given the graph of a function, determine the x-values where the function is not continuous and the points where it is not differentiable.** (Exercises 1.7.3, 1.7.5)
9. **Find a local linearization, use it to estimate the function at a nearby point, and answer questions about the accuracy of that estimate.** (Exercises 1.8.1, 1.8.2, 1.8.3, 1.8.4)

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10. Find the equation of a tangent line. (Exercises 2.1.8, 2.2.2, 2.3.12b, 2.4.5)

11. **Given information about two or more functions (either graphs or values, but not the equations), answer questions about new functions involving those functions and their derivatives.** (Exercises 2.1.10, 2.1.11. 2.3.8, 2.3.9, 2.3.12a,d, 2.5.5, 2.5.6, 2.6.5, 2.8.1)
12. Find dy/dx for a function given implicitly. (Exercises 2.1.1, 2.1.2, 2.1.3, 2.1.4, 2.1.5)
13. **Use L'Hopital's Rule to evaluate limits involving indeterminate forms.** (Exercises 2.8.3, 2.8.4, 2.8.5)
14. Find the intervals where a function is increasing/decreasing and identify the relative maximums and minimums of the function. (Exercises 3.1.1, 3.1.4)

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15. Find the intervals where a function is concave up/down and identify the inflection points of the function. (Exercises 3.1.1, 3.1.2)
16. Use the second derivative test to identify the local maximums and minimums of a function.
17. **Given information about a function (but not its equation), answer questions about the function, its first derivative, and its second derivative.** (Exercise 1.6.6, 3.1.5)
18. Given a family of functions, answer questions about the function and its derivative.(Exercises 3.2.3, 3.2.4)
19. Given a function and a closed interval, identify the absolute maximum and minimum on that interval. (Exercises 3.4.2, 3.4.4)
20. Solve an applied optimization problem. (Exercises 3.4.1, 3.4.2, 3.4.3, 3.4.4, 3.4.5)
21. Solve a related rates problem. (Exercises 3.5.1, 3.5.2, 3.5.3, 3.5.4, 3.5.5)

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22. **Use antiderivatives to answer questions involving total distance traveled, change in position, velocity, and acceleration.** (Exercises 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.1.5)
23. Use Riemann sums to estimate the area between a positive function and the horizontal axis. (Exercises 4.2.1, 4.2.2, 4.2.3, 4.2.4)
24. Given a Riemann sum, identify the function and interval it is approximating to the area under the curve for. (Exercise 4.2.5)
25. **Use graphs of functions and properties of definite integrals to evaluate definite integrals.** (Exercises4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.6, 4.3.7)
26. **Use the fundamental theorem of calculus to evaluate definite integrals.** (Exercises 4.4.2, 4.4.3, 4.4.4, 4.4.5)
27. Given the graph of a function, answer questions about its antiderivatives. (Exercises 5.1.1, 5.1.4, 5.1.5

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28. Given the graph of a function, sketch a specified accumulation function of that function. (Exercises5.1.3, 5.2.4)
29. Use the second fundamental theorem of calculus to determine the derivative of an accumulation function. (Exercise 5.2.2)
30. **Use substitution to evaluate definite and indefinite integrals.** (Exercises 5.3.1, 5.3.2, 5.3.3, 5.3.4, 5.3.5, 5.3.6)

Tentative Schedule

I aim to build a dynamic classroom; as such, the schedule below may be changed as the semester progresses. Any changes will be reflected here and in the course notes.

Week	Day	Prep Due	Topic	Other Work Due
1	15-Jan		Course Intro/1.1: How do we measure velocity?	
2	18-Jan	1.2	1.1: How do we measure velocity/1.2: The notion of a limit	Edfinity Demo
2	20-Jan		1.2: The notion of a limit	Edfinity 1.1
2	22-Jan	1.3	1.3: The derivative of a function at a point	Edfinity 1.2; Weekly Uploads 1
3	25-Jan	1.4	1.4: The derivative function	Edfinity 1.3
3	27-Jan	1.5	1.5: Interpreting, estimating, and using the derivative	Edfinity 1.4
3	29-Jan	1.6	1.6: The second derivative	Edfinity 1.5; Weekly Uploads 2
4	1-Feb	1.7	1.7: Limits, Continuity, and Differentiability	Edfinity 1.6
4	3-Feb	1.8	1.8: The tangent line approximation	Edfinity 1.7
4	5-Feb		Review/catch up	Edfinity 1.8; Weekly Uploads 3
5	8-Feb		**Exam 1: Learning Targets 1-9**	
5	10-Feb	2.1	2.1: Elementary Derivative Rules	
5	12-Feb	2.2	2.2: The sine and cosine functions	Edfinity 2.1; Weekly Uploads 4
6	15-Feb		**No class**	
6	17-Feb	2.3	2.3: The product and quotient rules	Edfinity 2.2
6	19-Feb	2.4	2.4: Derivatives of other trig functions	Edfinity 2.3; Weekly Uploads 5
7	22-Feb	2.5	2.5: The chain rule	Edfinity 2.4
7	24-Feb		2.5: The chain rule	
7	26-Feb	2.6	2.6: Derivatives of inverse functions	Edfinity 2.5; Weekly Uploads 6
8	1-Mar	2.7	2.7: Derivative of functions given implicitly	Edfinity 2.6
8	3-Mar	2.8	2.8: Using derivatives to evaluate limits	Edfinity 2.7
8	5-Mar		Derivative practice/review	Edfinity 2.8; Weekly Uploads 7
9	8-Mar		**Exam 2: Learning Targets 1-14, Derivative Calculation Exam**	
9	10-Mar	3.1	3.1: Using derivatives to identify extreme values	
9	12-Mar		3.1: Using derivatives to identify extreme values/3.2: Using derivatives to describe families of functions	Weekly Uploads 8
10	15-Mar	3.2	3.2: Using derivatives to describe families of functions	Edfinity 3.1
10	17-Mar	3.3	3.3: Global Optimization	Edfinity 3.2
10	19-Mar	3.4	3.4: Applied Optimization	Edfinity 3.3; Weekly Uploads 9
11	22-Mar		3.4: Applied Optimization	Reflection on beauty

Week	Day	Prep Due	Topic	Other Work Due
11	24-Mar	3.5	3.5: Related Rates	Edfinity 3.4
11	26-Mar		3.5: Related Rates	Weekly Uploads 10
12	29-Mar		**Exam 3: Learning Targets 10-21**	
12	31-Mar	4.1	4.1: Determining distance traveled from velocity	Edfinity 3.5
12	2-Apr	4.2	4.2: Riemann Sums	Edfinity 4.1; Weekly Uploads 11
13	5-Apr	4.3	4.3: The definite integral	Edfinity 4.2
13	7-Apr		**No class**	
13	9-Apr	4.4	4.4: The Fundamental Theorem of Calculus	Edfinity 4.3; Weekly Uploads 12
14	12-Apr		**Exam 4: Learning Targets 15-27**	
14	14-Apr	5.1	5.1: Constructing accurate graphs of antiderivatives	Edfinity 4.4
14	16-Apr	5.2	5.2: The Second Fundamental Theorem of Calculus	Edfinity 5.1; Weekly Uploads 13
15	19-Apr		5.2: The Second Fundamental Theorem of Calculus	
15	21-Apr	5.3	5.3: Integration by Substitution	Edfinity 5.2
15	23-Apr		5.3: Integration by Substitution	Weekly Uploads 14
16	26-Apr		Review	Edfinity 5.3
16	28-Apr		**Exam 5: Learning Targets 22-30**	
16	30-Apr		Review for Final	Reflection on historical development of calculus; Weekly Uploads 15
Finals			TBD	