

## COURSE INFORMATION

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Section: 01 *WEB*

Course Dates: May 18 - August 13, 2019

Credit Hours: 4

## COURSE DESCRIPTION

This is the initial course in a sequence of courses on the fundamental ideas of the calculus of one variable. It is here that truly significant applications of mathematics begin. Topics included are functions, continuity, limits, derivatives, maxima and minima and antiderivatives.

## COURSE OBJECTIVES

On successful completion of the course, students will be able to:

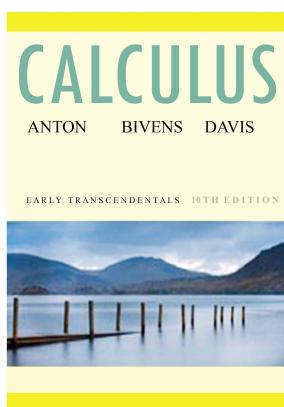
- recognize, define, and apply properties of functions, such as their domain, range, intercepts, and inverses;
- be able to evaluate a variety of limits;
- identify discontinuities of a function presented either graphically or algebraically;
- find the derivative of functions using the limit definition;
- find the derivative of sums, products, and quotients of composite polynomial, trigonometric, exponential, and logarithmic functions;
- understand conceptual relationships between derivatives, rates of change, and tangent lines;
- use properties of functions and derivatives to graph functions;
- apply differentiation procedures to solve related rates and extreme value problems;
- identify and evaluate limits involving indeterminate forms;
- compute definite and indefinite integrals using formulas and substitution;
- understand the relationship between the integral and the derivative; and
- read and interpret mathematical theorems, including checking that hypotheses are satisfied and reaching correct conclusions.

## PREREQUISITES

To remain enrolled in this course, you must satisfy at least one of the following criteria:

- Score of 70 or better on the ALEKS Mathematics Placement Assessment
- Passed Math 118 (Math for the Natural Sciences), or transfer credit for equivalent
- Passed both Math 111 (College Algebra) and Math 112 (Trigonometry and Functions), or transfer credit for equivalent

# REQUIRED MATERIALS



## Textbook

Calculus, Early Transcendentals by Anton, Bivens, and Davis, 10th Edition. We will be covering chapters 0-5 in the textbook. If you prefer to purchase or rent an electronic version of the text, you're welcome to do so.

## Internet Access

This course will be conducted entirely online using the Blackboard Learning Management System. You are responsible for ensuring that you have access to reliable internet access throughout the semester, and that you are able to access the course site on Blackboard.

## Camera and Scanner

In order to receive partial credit on exam problems and to receive useful feedback on your work, you will be required to submit your written work for all exams. After completing the exams, you will have 24 hours to submit scans or photos of your work for each problem. Please make sure you'll have access to a camera or scanner for each exam.

## Email

All course reminders and information will be sent to your Mercyhurst email address. Please check your Mercyhurst email regularly during the semester.

# COURSE STRUCTURE SUMMARY

The course will be divided into four units. Each unit will end with an exam covering topics from that unit. You will have two days to complete each exam. There will also be 2-3 quizzes for each unit, each of which will be available as soon as the unit opens and will be due the day before the unit exam ends, so you'll have a few weeks to complete them. The quizzes and exams will be based on the assigned homework problems from the textbook, which will not be collected. There will not be a cumulative final at the end of the semester, so your grade will be based entirely on the unit quizzes and exams.

# OFFICE HOURS

No matter where you'll be this summer, you can join my virtual office hours using the Office Hours channel on Teams. You may also make an appointment if you would like to chat outside office hours. If you're in Erie this summer, we can also arrange to meet in person in my office on the main campus.

# MOODLE

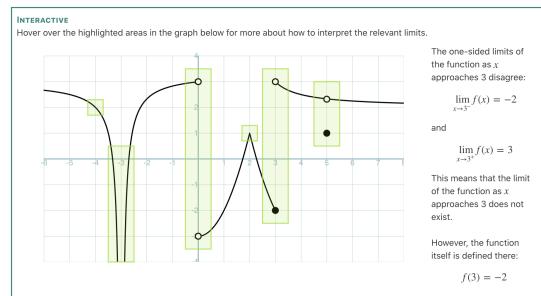
At the beginning of the semester, you will receive a code to register for our course on Moodle. This is a free site created for this course by the Mercyhurst Mathematics Department. While most materials will also be posted on Blackboard, you will need to access Moodle for the course quizzes. You can use any email or password you like when creating your Moodle account. More information about how to register and find material on Moodle will be emailed to you and posted on Blackboard.

# COURSE RESOURCES

Even though this is an online course, you don't have to learn the material on your own! There is a variety of materials created specifically for this class to help you succeed:

## Interactive Notes

For every section of the textbook, you'll find additional examples, illustrations, and interactive applets to help clarify the material and see how the mathematics works. These notes, available only on the Moodle course site, are best viewed using a web browser on a computer or tablet, though a smartphone will work too. Unfortunately, these notes are not supported on Blackboard.



Interactive explanation of limits, Section 1.1

## PDF Notes

If you'd prefer to read notes in print or download them to read later, there are also notes for every section available as a PDF. While there is some overlap with the examples and comments in the interactive notes, there are usually additional examples to read though in these PDFs as well. These notes will be available on Moodle and Blackboard.

### Videos

#### Inverses of Functions

- Definition of inverse
- Inverse notation explained
- The Horizontal Line Test
- Method of finding inverses
- Example: Find the inverse of  $f(x) = 8x^3 - 3$

#### Relationship Between a Function and its Inverse

- Finding properties of an inverse from the function
- Graphs of inverses

#### Inverse Trig Functions

- Restricting domains
- Simplifying inverse trig expressions with right triangles
- Example: Find an expression equivalent to  $\sin(\cos^{-1} x)$

#### More Examples

- Find  $f^{-1}(x)$  if  $f(x) = \sqrt[3]{x + 8}$
- Find  $f^{-1}(x)$  if  $f(x) = \frac{x}{x - 5}$
- Find the exact value of  $\sin(\sin^{-1}(0.83))$
- Find the exact value of  $\tan^{-1}(\tan(1.891))$
- Let  $f(x) = 5x^3 + 3x + 2$ . Find  $x$  if  $f^{-1}(x) = -1$

Video menu for Section 0.4

### Videos

Every section will also include several videos, each approximately 10-15 minutes in length. An index of videos for each section, including the topics and examples covered in each, is also available to help you find the resource. The video topics cover important theorems and definitions, along with explanations on how to approach most of the homework problems you'll encounter in the class. These videos will be available on Moodle and Blackboard.

## Other Resources

Many sections will also have suggested links, readings, or additional notes that might be helpful.

# HOMEWORK

A list of all recommended homework problems from the textbook is included in this syllabus. While your work for these problems will not be collected, practicing the material as much as possible is the best (and only) way to learn it. You are strongly encouraged to work through additional problems as well.

If you're stuck on a homework problem, please let me know! I can help via email or office hours, and I'd be happy to create additional notes or videos to explain a tricky problem or topic.

## QUIZZES

Keeping up with the homework will ensure that you are prepared for the quizzes, which will feature problems very similar to those in the homework as well as more conceptual questions about the topics you'll see each week. While you will have several weeks to complete each quiz, try to complete each quiz by the end of the suggested week in the schedule.

There will be a total of 11 quizzes available for the semester. Your lowest quiz grade will be dropped when calculating your final grade, including a missed quiz (so only your best 10 quiz grades will be counted towards your final grade).

The quizzes for each unit will be available on Moodle as shown in the course schedule. The quizzes for each unit will be due *before* the unit exam opens. You'll know your quiz grade as soon as you're finished with it, but the correct answers will not be visible until the quiz end date - just before the unit exam opens.

Though the quizzes will be taken online, most questions will not be multiple choice and will require you to enter a number or a function as your answer. Before you can get started with a graded quiz, you'll need to complete a Quiz Tutorial on Moodle. This ungraded quiz (that will not test your mathematical knowledge) will help you get acquainted with the quiz layout and how to enter your responses.

You will have 90 minutes to complete each quiz from the time you begin, so please be sure that you allow time to finish a quiz before starting. You can sign off and return to Moodle after starting a quiz, but your time will end after 90 minutes from when you first accessed the quiz. You will only have one chance to take each quiz, and will not be able to change your response after submitting. You will not be required to submit any written work for your quizzes. You are not permitted to work with other students on quizzes, but you can consult course materials (textbook, notes, videos, etc).

## EXAMS

We will have four exams, one at the end of each unit. Unlike quizzes, exams will be taken offline. The exam questions will be available for a period of two days, as shown on the course schedule. Your work will be due before midnight on the second day the exam is available.

### Submitting Work

In order to award partial credit and provide comments on your work, **you will be required to submit a scan or photo of your written work in PDF format**. More information about how to create a PDF and submit your work will be available before each exam.

Unless otherwise stated, you are expected to show your work in detail for each question on an exam. A correct answer with no supporting work will receive at most 20% of the point value for that question.

### Missed Exams

If you will be unable to take a unit exam during the planned period on the course schedule, please let me know. In most cases, I can adjust the exam dates for you so you do not have to miss it. If you do miss an exam and do not contact me until after the exam window has closed, you will receive a 0 for that exam and will not be permitted to take it unless there are exceptional circumstances.

## ACADEMIC HONESTY EXPECTATIONS

Even though you'll be taking your exams at home, your exam grades should still reflect what you have learned and how well you understand it. You are expected to read and follow the Mercyhurst University policy on Academic Honesty:

*Students are expected to contribute actively to the development of an atmosphere of academic integrity. Mercyhurst University assumes, therefore, that students will not resort to plagiarism or any other form of academic dishonesty. Students found guilty of willful academic dishonesty may be subject to a broad range of sanctions. At the discretion of their instructor, they may be required to redo the plagiarized assignment, or they may receive an automatic F for the exam/assignment and/or course. Students found to be in collaboration with other students involved in willful academic dishonesty are subject to disciplinary action.*

In addition, please be sure to follow the specific requirements for this course:

### You may...

- refer to your textbook and course materials while taking quizzes and exams.
- use a calculator while taking exams.
- contact me during an exam for clarification on an exam question, grading policy, etc.

### You may NOT...

- refer to any materials besides the textbook or course materials. This includes solution manuals, web pages, etc. If it is not on Moodle, Blackboard, or in the textbook, do not use it while taking an exam!
- use mathematical software or apps such as Wolfram Alpha, CoCalc, or any other utilities.
- ask for help or clarification on an exam from a classmate, friend, family member, online service, or anyone besides the instructor of the course.

## GRADING

Your final grade will be calculated as follows:

Component	Value	Total Points
Quizzes (10 best)	18 points each	<b>180 points</b>
Exams (4)	80 points each	<b>320 points</b>
		<b>500 points</b>

Your letter grade will be based on the total number of points you earn throughout the semester:

Grade	Percentage	Points Needed
A	90	<b>448</b>
B+	87	<b>433</b>
B	80	<b>398</b>
C+	77	<b>383</b>
C	70	<b>348</b>
D+	67	<b>333</b>
D	60	<b>298</b>

## OTHER COURSE INFORMATION

- Not all material for the course will be available on the Blackboard Mobile app, so it is highly recommended that you work on the course materials using a computer. However, the app will alert you to course announcements and reminders, so it is a good idea to have it installed if you have a compatible mobile device.
- Please ask questions - via Blackboard, office hours, email, or phone - as soon as you feel stuck. Mathematics is a naturally cumulative subject. If you do not understand a particular topic, you will not understand topics that come after.
- I will attempt to answer email as quickly as possible, but please allow up to 24 hours for a response (particularly on weekends).
- You are neither expected nor required to purchase any materials for the course, aside from the textbook and a device that allows you to access the course and upload documents. Graphing calculators and mathematical software could be used to check your work, but should not be relied on to do the work for you.
- Math Department Tutoring is not available during the summer semester.

## FREE ONLINE RESOURCES

- Kahn Academy Calculus I: <https://www.khanacademy.org/math/calculus-1>  
Featuring videos and exercises for the topics we'll see in this course.
- Kahn Academy Algebra II: <https://www.khanacademy.org/math/algebra2>  
A review of the algebraic tools you'll need for calculus, many of which appear in Chapter 0 of this course.
- Kahn Academy Trigonometry: <https://www.khanacademy.org/math/trigonometry>  
A review of the trigonometric tools you'll need for calculus.
- Community Calculus: <https://www.whitman.edu/mathematics/multivariable/>  
An extra calculus textbook, available as a free PDF with inexpensive print copies available.
- Marsden and Weinstein Calculus: <http://www.cds.caltech.edu/marsden/volume/Calculus/>  
Another extra calculus textbook, available as a free PDF with print copies available.
- Wolfram Alpha: <https://www.wolframalpha.com/>  
Ask it just about anything (not just math!). May be useful for plotting functions and checking your homework.

## LEARNING DIFFERENCES

In keeping with college policy, any student with a disability who needs academic accommodations must call Learning Differences Program secretary at (814) 824-3017, to arrange a confidential appointment with the director of the Learning Differences Program during the first week of classes.

## COURSE EVALUATIONS

Near the end of the semester, you will be asked to complete an online course evaluation. The evaluation may be completed using any laptop, tablet, or mobile device. The response tool allows you to note aspects of the course that helped you learn, as well as aspects that might be modified to help future students learn more effectively. You will receive an email letting you know when the evaluation window for our class is open. Please note that these course evaluations are anonymous and instructors do not see the results until after the grades for the course are submitted.

# UNIT OVERVIEW

This course will be divided into four units, each involving related material. The dates, objectives, and relevant textbook sections for each unit are described below.

Please keep in mind that mathematics is a naturally cumulative subject. Your success on each topic will depend on your skills prior topics, so be sure to work through each unit in order.

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## UNIT 1: PREREQUISITES, LIMITS, AND CONTINUITY

MAY 18 - JUNE 6

We'll start with a review of necessary algebra skills and the properties of functions. Then we'll begin our study of limits, which are the true basis of calculus. For this first unit of the semester, we'll focus on computing limits and how to interpret them. We'll finish with an introduction to continuity and why it's important, and learn to identify discontinuities of a function.

### Unit Objectives:

- Manipulate and simplify algebraic expressions using order of operations and properties of real numbers
- Identify properties of functions, including domain, range, and inverses
- Classify families of functions and their associated properties
- Gain intuition about the concept of limits and their geometric interpretation
- Compute limits at finite values or infinity and understand their relationship with functions
- Decide if a function is continuous, or locate and name its discontinuities

**Textbook Sections:** 0.1, 0.2, 0.3, 0.4, 0.5, 1.1, 1.2, 1.3, 1.5, 1.6

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## UNIT 2: THE DERIVATIVE

JUNE 8 - JUNE 27

Derivatives allow us to measure change over time, and are vitally important to all lab sciences, economics, finance, social sciences, and of course, mathematics. We'll see how to understand the derivative geometrically, then use limits to compute the derivative of a function. We'll also see how to apply theorems to simplify the computation of derivatives, and how to evaluate the derivative of some useful families of functions.

### Unit Objectives:

- Use the limit definition of the derivative to find the derivative of a function
- Apply the power rule, product rule, quotient rule, and chain rule to simplify the computation of a derivative
- Find the first and second derivatives of an implicitly defined function
- Compute the derivatives of trigonometric, exponential, and logarithmic functions

**Textbook Sections:** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 3.1, 3.2, 3.3

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## UNIT 3: APPLICATIONS OF THE DERIVATIVE

JULY 6 - JULY 25

If you've ever wondered why calculus is important, the answer will likely be found in this unit. We'll see how to solve several types of problems using the derivative, including finding optimal solutions, predicting trends, and understanding systems with multiple factors. We'll also learn how to use calculus to sketch graphs of functions and find useful information about them.

### Unit Objectives:

- Correctly interpret and solve related rates problems: real life situations with two changing variables, each under the influence of the other
- Evaluate limits of indeterminate forms using l'Hôpital's Rule
- Find critical values, inflection points, asymptotes, and relative extrema of functions, and use them to sketch their graph
- Find the optimal solutions to real life situations under financial or spatial constraints

**Textbook Sections:** 3.4, 3.5, 3.6, 4.1, 4.2, 4.3, 4.4, 4.5, 4.6

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## UNIT 4: INTEGRATION

JULY 27 - AUGUST 13

After a few remaining topics involving the derivative, we'll move to the last major topic of Calculus I: an introduction to integration. An understanding of the meaning and purpose of the integral will lead to evaluating indefinite and definite integrals. Direct integration and integration by substitution methods will be used to evaluate integrals, with other techniques of integration reserved for Calculus II.

### Unit Objectives:

- Apply Rolle's Theorem and the Mean Value Theorem
- Gain an intuitive understanding of the indefinite and definite integral
- Compute integrals using direct integration and substitution techniques
- Evaluate definite integrals using the Fundamental Theorem of Calculus

**Textbook Sections:** 4.8, 5.1, 5.2, 5.3, 5.5, 5.6, 5.9

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## SEMESTER SCHEDULE

Week	Dates	Topics
1	May 18 to May 24	Functions: Definitions, Families, and Properties Composition of Functions and Inverses Exponential and Logarithmic Functions
2	May 26 to May 31	Limits: Intuition and examples Computing limits Limits at infinity: End behavior of functions
3	June 1 to June 4	Continuity: Definitions and essential theorems Continuity of trigonometric, exponential, and inverse functions Unit I recap
	June 4	<b>Quiz 1, 2, 3 Due</b>
<b>June 5 - 6</b>		<b>Unit I Exam Open</b>
4	June 8 to June 14	Tangent lines and rates of change Limit definition of the derivative The derivative function
5	June 15 to June 21	Techniques of differentiation Product and quotient rules The chain rule
6	June 22 to June 25	Implicit differentiation Derivatives of logarithms and inverse trigonometric functions Unit II recap
	June 25	<b>Quiz 4, 5, 6 Due</b>
<b>June 26 - 27</b>		<b>Unit II Exam Open</b>
<i>June 29 to July 5: Summer Break</i>		
7	July 6 to July 12	Related rate problems Local linear approximations L'hopital's rule
8	July 13 to July 19	Properties of functions: increase, decrease, concavity Relative extrema and derivative tests Graphing polynomials and rational functions
9	July 20 to July 23	Absolute extrema Applied minimum/maximum problems Unit III recap
	July 23	<b>Quiz 7, 8, 9 Due</b>
<b>July 24 - 25</b>		<b>Unit III Exam Open</b>
10	July 27 to August 2	Rolle's Theorem and The Mean Value Theorem The area problem The indefinite integral
11	August 3 to August 9	Substitution method The Fundamental Theorem of Calculus Definite integrals: substitution method
12	August 10 to August 13	Unit IV Recap
	August 10	<b>Quiz 10, 11 Due</b>
<b>August 11 - 13</b>		<b>Unit IV Exam Open</b>

## HOMEWORK LIST

Your homework will not be collected, but these problems (and similar questions) are likely to appear on quizzes and exams. Answers to most of the questions are available in the back of the textbook. Working on additional problems is highly recommended.

Sec.	Page	Problems
0.1	12	1, 3, 5, 7, 9, 15, 19, 23, 27, 29, 31a-c
0.2	24	1, 3, 5, 11, 13, 17, 25, 27, 29, 31, 33, 35, 39, 41, 49, 53, 61, 63
0.3	35	1, 3, 11, 15, 17, 19, 25, 29, 31
0.4	49	1, 3, 5, 9, 13, 17, 19, 25, 27, 31, 39, 41
0.5	61	1, 5, 9, 11, 13, 15, 17, 21, 23, 25, 27, 47, 57
1.1	77	1, 3, 5, 7, 9, 17-20, 21, 23, 25, 31
1.2	87	1, 3, 7, 11, 13, 15, 19, 21, 25, 31
1.3	96	1, 3, 5, 9, 13, 15, 21, 31, 33, 37, 43
1.4	106	You are not responsible for this section (but try #17 and #21 anyway!)
1.5	118	1, 3, 5, 7, 11, 13, 17, 21, 29, 31, 35, 45, 47
1.6	125	1, 7, 9, 13, 17, 19, 21, 23, 27, 31, 37, 49, 67
2.1	141	3, 11, 13, 15, 17, 23
2.2	152	1, 3, 7, 9, 11, 21, 23, 25, 29
2.3	161	1, 3, 5, 7, 9, 13, 15, 17, 21, 23, 29, 37, 39, 41, 43, 45, 49
2.4	168	1, 3, 5, 7, 11, 13, 19, 21, 23, 27, 29, 31, 33, 39
2.5	172	1, 5, 11, 15, 17, 21, 23, 27, 29, 31
2.6	178	3, 7, 9, 11, 15, 17, 19, 23, 27, 35, 37, 39, 45, 49, 51, 53, 77
3.1	190	3, 5, 7, 9, 11, 13, 15, 17, 27
3.2	195	1, 3, 7, 9, 13, 19, 23, 25, 27, 35, 37, 41
3.3	201	15, 17, 19, 21, 23, 25, 37, 43, 51, 65
3.4	208	1, 5, 13, 15, 17, 19, 25, 27
3.5	217	3, 5, 7, 23, 25, 29, 31, 43
3.6	226	1, 7, 9, 11, 13, 17, 21, 23, 27, 29, 33, 57
4.1	241	1, 5, 7, 9, 15, 17, 19, 21, 25, 29, 39
4.2	252	3, 5, 7, 9, 11, 19, 25, 27, 29, 33, 37, 41, 43, 45, 53
4.3	264	1, 3, 5, 9, 13, 19, 23, 25, 31
4.4	272	3, 7, 9, 11, 13, 21, 23, 25, 27, 31, 33
4.5	283	3, 5, 13, 19, 21, 23, 27, 29, 31, 37, 55
4.6	294	1, 3, 13, 17, 19, 33
4.8	308	1, 3, 5, 7, 15, 25, 41
5.1	321	7, 9, 13, 15, 17
5.2	330	5, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 43, 45
5.3	338	1, 3, 7, 9, 11, 15, 17, 21, 23, 27, 31, 33, 39, 41, 47, 53, 55, 61, 69, 71
5.5	360	13, 15, 19, 21, 23, 25, 33
5.6	373	7, 9, 13, 15, 17, 19, 23, 29, 31, 59, 61
5.9	393	1, 5, 9, 15, 17, 19, 21, 31, 33, 35, 37, 43, 45, 49, 53