

# APPM 1340 - Calculus 1 with Algebra, Part A

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**COURSE OBJECTIVES:** This is the first in a two-semester sequence that covers the Calculus I curriculum.

Specifically, students will:

- Understand the concepts, techniques and applications of differential calculus including limits, rate of change of functions, and derivatives of algebraic and transcendental functions.
- Improve problem solving and critical thinking.
- Strengthen algebra and trigonometry skills.

This course and APPM 1345 together are equivalent to APPM 1350 (Calculus 1 for Engineers). The sequence of this course and APPM 1345 is specifically designed for students whose manipulative skills in the techniques of high school algebra and precalculus may be inadequate for APPM 1350.

**TEXTBOOK:** *Essential Calculus*, 2<sup>nd</sup> Edition by James Stewart. We will cover Sections 1.1 through 3.2. You will also need an access code for WebAssign's online homework system. The access code can also be purchased separately.

## SCHEDULE AND TOPICS COVERED

Day	Section	Topics
1	Algebra Review	Simplifying Rational Expressions; Exponents; Common Algebra Mistakes
2	Algebra Review	Solving equations; Equations of Lines
3	Algebra Review	Solving Inequalities; Graphing Quadratics; Solving Systems of Equations; Completing the Square
4	Algebra Review	Word Problems; Solving Systems of Equations
5	Appendix A	Trig Review
6	Appendix A	Trig Review cont'd;
7	1.1	Functions and Their Representation
8	1.2	Essential Functions
9	Exam 1 Review	Exam 1 Topics
10	Exam 1 Review	Exam 1 Topics
11	1.2	Essential Functions cont'd.
12	1.3	The Limit of a Function
13	1.1-1.3	Review of 1.1-1.3
14	1.4	Calculating Limits
15	1.4	Calculating Limits cont'd.
16	1.5	Continuity
17	1.4-1.5	Review of 1.4-1.5
18	1.6	Continuity/Limits Involving Infinity
19	1.6	Continuity/Limits Involving Infinity cont'd.
20	2.1	Derivatives and Rates of Change
21	Exam 2 Review	Exam 2 Topics
22	Exam 2 Review	Exam 2 Topics
23	2.2	The Derivative as a Function
24	2.2	The Derivative as a Function
25	1.6-2.2	Review of 1.6-2.2
26	2.3	Basic Differentiation Formulas
27	2.3	Basic Differentiation Formulas
28	2.4	Product and Quotient Rules
29	2.3/2.4	Review of 2.3-2.4
30	2.5	Chain Rule
31	2.6	Implicit Differentiation
32	2.5/2.6	Review of 2.5-2.6

33	Exam 3 Review	Exam 3 Topics
34	Exam 3 Review	Exam 3 Topics
35	2.7	Related Rates
36	2.7	Related Rates
37	2.5-2.7	Review of 2.5-2.7
38	2.8	Linear Approximation and Differentials
39	2.8	Linear Approximation and Differentials
40	3.1	Max and Min Values
41	3.2	The Mean Value Theorem
42	3.1/3.2	Review of 3.1-3.2
43	Final Review	Sections 1.1-3.3
44	Final Review	Sections 1.1-3.3

**PREREQUISITES:**

- Placement into calculus based on your admissions data and/or CU Boulder coursework
- OR any ONE of the following courses (minimum grade C-): APPM 1235, MATH 1021, MATH 1150, MATH 1160, or MATH 1300

**EQUIVALENT COURSES:** Duplicate Degree Credit Not Granted:

- APPM 1345, ECON 1088, MATH 1081, MATH 1300, MATH 1310, MATH 1330

**LEARNING OBJECTIVES BY SECTION**

Section	Topics	Learning Objectives – After completing this section, students should be able to do the following:
App. A	Trigonometry	<ul style="list-style-type: none"> <li>• Define trigonometric functions; understand right triangle trigonometry and the unit circle</li> <li>• Know and apply identities involving trigonometric functions</li> <li>• Plot graphs of trigonometric functions</li> <li>• Find the domain and range of trigonometric functions</li> <li>• Solve equations involving trigonometric functions</li> </ul>
1.1	Functions and Their Representation	<ul style="list-style-type: none"> <li>• State the definition of a function</li> <li>• Find the domain and range of a function</li> <li>• Perform basic operations and compositions of functions</li> <li>• Determine whether a function is even or odd</li> <li>• Work with piecewise defined functions</li> </ul>

1.2	Essential Functions	<p>Plot, find the domain and range, and state key properties of:</p> <ul style="list-style-type: none"> <li>• Linear Functions</li> <li>• Polynomials</li> <li>• Power Functions</li> <li>• Rational Functions</li> <li>• Trigonometric Functions</li> <li>• Piecewise defined functions</li> </ul>
1.3	The Limit of a Function	<ul style="list-style-type: none"> <li>• Consider values of a function at inputs approaching a given point.</li> <li>• Understand the concept of a limit.</li> <li>• Understand the precise mathematical definition of a limit using <math>\delta</math> and <math>\epsilon</math>.</li> <li>• Calculate limits from a graph (or state that the limit does not exist).</li> <li>• Define a one-sided limit.</li> <li>• Explain the relationship between one-sided and two-sided limits</li> <li>• Distinguish between limit values and function values.</li> </ul>
1.4	Calculating Limits	<ul style="list-style-type: none"> <li>• Calculate limits using limit laws.</li> <li>• Calculate limits by replacing a function with a continuous function that has the same limit.</li> <li>• Understand the Squeeze Theorem and how it can be used to find limit values.</li> <li>• Calculate limits using the Squeeze Theorem.</li> </ul>
1.5	Continuity	<ul style="list-style-type: none"> <li>• Identify where a function is, and is not, continuous.</li> <li>• Understand the connection between continuity of a function and the value of a limit.</li> <li>• Make a piecewise function continuous.</li> <li>• State the Intermediate Value Theorem including hypotheses.</li> <li>• Determine if the Intermediate Value Theorem applies.</li> <li>• Sketch pictures indicating why the Intermediate Value Theorem is true, and why all hypotheses are necessary.</li> <li>• Explain why certain points exist using the Intermediate Value Theorem.</li> </ul>

1.6	Limits at Infinity	<ul style="list-style-type: none"> <li>• Understand what is meant by the form of a limit.</li> <li>• Calculate limits of the form zero over zero.</li> <li>• Identify determinate and indeterminate forms.</li> <li>• Discuss why infinity is not a number.</li> <li>• Recognize when a limit is indicating there is a vertical asymptote.</li> <li>• Evaluate the limit as <math>x</math> approaches a point where there is a vertical asymptote.</li> <li>• Understand the relationship between limits and vertical asymptotes.</li> <li>• Discuss what is means for a limit to equal <math>\infty</math>.</li> <li>• Define a horizontal asymptote.</li> <li>• Find horizontal asymptotes using limits.</li> <li>• Recognize that a curve can cross a horizontal asymptote.</li> <li>• Produce a function with given asymptotic behavior.</li> </ul>
2.1	Derivatives and Rates of Change	<ul style="list-style-type: none"> <li>• Recognize and distinguish between secant and tangent lines.</li> <li>• Compute a difference quotient and take a limit of a difference quotient.</li> <li>• Use limits to find the slope of the tangent line at a point.</li> <li>• Understand the definition of the derivative at a point.</li> <li>• Estimate the slope of the tangent line graphically.</li> <li>• Compare average and instantaneous velocity.</li> </ul>
2.2	Derivative as a Function	<ul style="list-style-type: none"> <li>• Understand the derivative as a function related to the original definition of a function.</li> <li>• Find the derivative function using the limit definition.</li> <li>• Relate the derivative function to the derivative at a point.</li> <li>• Explain the relationship between differentiability and continuity.</li> <li>• Relate the graph of the function to the graph of its derivative.</li> <li>• Determine whether a piecewise function is differentiable.</li> </ul>

2.3	Basic Differentiation Formulas	<ul style="list-style-type: none"> <li>• Use the definition of the derivative to develop shortcut rules to find derivatives of: <ul style="list-style-type: none"> <li>– constants and constant multiples</li> <li>– powers of <math>x</math></li> <li>– sums and differences of functions</li> </ul> </li> <li>• Compute the derivative of polynomials.</li> <li>• Recognize different notation for the derivative.</li> <li>• State the derivative of the sine and cosine functions.</li> </ul>
2.4	The Product and Quotient Rules	<ul style="list-style-type: none"> <li>• Identify products of functions.</li> <li>• Use the product rule to calculate derivatives.</li> <li>• Identify quotients of functions.</li> <li>• Use the quotient rule to calculate derivatives.</li> <li>• Combine derivative rules to take derivatives of more complicated functions.</li> </ul>
2.5	The Chain Rule	<ul style="list-style-type: none"> <li>• Recognize a composition of functions.</li> <li>• Take derivatives of compositions of functions using the chain rule.</li> <li>• Understand rate of change when quantities are dependent upon each other.</li> <li>• Apply chain rule to relate quantities expressed with different units.</li> <li>• Take derivatives that require the use of multiple rules of differentiation.</li> <li>• Use order of operations in situations requiring multiple rules of differentiation.</li> <li>• Use the product, quotient and/or chain rules to calculate derivatives of trigonometric functions.</li> </ul>
2.6	Implicit Differentiation	<ul style="list-style-type: none"> <li>• Identify explicit vs implicit functions</li> <li>• Understand the derivatives of functions that are not defined explicitly in terms of an independent variable.</li> <li>• Calculate derivatives of expressions with multiple variables implicitly.</li> <li>• Find the equation of the tangent line for curves that are not plots of functions.</li> </ul>

2.7	Related Rates	<ul style="list-style-type: none"> <li>• Identify word problems as related rates problems.</li> <li>• Translate word problems into mathematical equations</li> <li>• Solve related rates word problems.</li> </ul>
2.7	Linear Approximations and Differentials	<ul style="list-style-type: none"> <li>• Find the linear approximation to a function at a point and use it to approximate the function value.</li> <li>• Identify when linear approximation can be used.</li> <li>• Label a graph with the appropriate quantities in linear approximation.</li> <li>• Compute differentials.</li> <li>• Contrast the notation and meaning of <math>dy</math> and <math>\Delta y</math></li> <li>• Determine the error in using the linear approximation to a function</li> </ul>
3.1	Max and Min Values	<ul style="list-style-type: none"> <li>• Define and find critical points.</li> <li>• Define and find local maximum and local minimum.</li> <li>• Classify critical points.</li> <li>• State and apply the First Derivative Test.</li> <li>• Define and find absolute maximum and minimum.</li> <li>• Understand the statement of the Extreme Value Theorem.</li> </ul>
3.2	The Mean Value Theorem	<ul style="list-style-type: none"> <li>• Understand the statement of the Mean Value Theorem.</li> <li>• Sketch pictures to illustrate why the Mean Value Theorem is true.</li> <li>• Understand how Rolle's Theorem relates to the Mean Value Theorem.</li> <li>• Determine whether Rolle's Theorem or the Mean Value Theorem can be applied.</li> <li>• Find the values guaranteed by Rolle's Theorem or the Mean Value Theorem.</li> <li>• Compare and contrast the Intermediate Value Theorem, Mean Value Theorem and Rolle's Theorem.</li> <li>• Use the Mean Value Theorem to solve word problems.</li> </ul>