

AP Calculus BC: Syllabus

Scoring Components:	Page (s)
SC1 The course teaches all topics associated with Functions, Graphs, and Limits as delineated in the Calculus BC Topic Outline in the AP Calculus course description.	2, 3
SC2 The course teaches all topics associated with Derivatives as delineated in the Calculus BC Topic Outline in the AP Calculus course description.	2
SC3 The course teaches all topics associated with Integrals as delineated in the Calculus BC Topic Outline in the AP Calculus course description.	2, 3
SC4 The course teaches all topics associated with Polynomial Approximations as delineated in the Calculus BC Topic Outline in the AP Calculus course description.	3
SC5 The course provides students the opportunity to work with functions represented graphically.	2
SC6 The course provides students with the opportunity to work with functions represented numerically.	2
SC7 The course provides students with the opportunity to work with functions represented analytically.	2, 3
SC8 The course provides students with the opportunity to work with functions represented verbally.	2, 3
SC9 The course teaches students how to explain solutions to problems orally.	3
SC10 The course teaches students how to explain solutions to problems in written sentences.	4
SC11 The course teaches students how to use graphing calculators to help solve problems.	4
SC12 The course teaches students how to use graphing calculators to experiment.	4
SC13 The course teaches students how to use graphing calculators to interpret results and support conclusions.	4

AP Calculus BC Course Outline and Planner:

Unit 1: Limits and Continuity:

(12 days) [SC1]

- Limits:
 - Limit at a point, limit at infinity, infinite limits
 - Properties of limits
- Continuity
- Tangent line to a curve
- Slope of a curve at a point

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Unit 2: Derivatives:

(14 days) [SC2]

- Definition of f' [SC7]
- Derivative at a point
- Relating the graphs of f and f' [SC5]
- When does f' (a) fail to exist?
- Rules for differentiation:
 - Sum, product, quotient [SC7]
- Chain rule
- Implicit differentiation
- Derivatives of trigonometric, inverse trigonometric, exponential, and logarithmic functions

SC2 The course teaches all topics associated with Derivatives as delineated in the Calculus BC Topic Outline in the AP Calculus course description.

SC7 The course provides students with the opportunity to work with functions represented analytically.

Unit 3: Applications of Derivatives

(19 days) [SC2]

- Mean value theorem
- Using the derivative to find:
 - Critical point(s) and extreme values
 - When the function is increasing or decreasing
 - Point(s) of inflection
 - When the function is concave up or concave down
- Motion along a line:
 - Moving left and right, speeding up and slowing down [SC8]
- Optimization problems
- Using the tangent line to approximate function values
- Newton's method
- Differentials and change
- Related rates

SC5 The course provides students the opportunity to work with functions represented graphically.

SC8 The course provides students with the opportunity to work with functions represented verbally.

Unit 4: The Definite Integral

(16 days) [SC3]

- Riemann sums (left, right, midpoint)
 - This will include using numerical values of a function. Given these values, students will then calculate Riemann sums. [SC6]
- Finding a formula for an antiderivative [SC7]
- Using a definite integral to find area, volume, average value of a function
- Fundamental theorem of calculus
- Approximating the definite integral:
 - Trapezoidal rule, Simpson's rule
- Error analysis

SC3 The course teaches all topics associated with Integrals as delineated in the Calculus BC Topic Outline in the AP Calculus course description.

SC6 The course provides students with the opportunity to work with functions represented numerically.

Unit 5: Differential Equations and Mathematical Modeling (17 days)

- Slope fields [SC5]
- Antiderivatives and the indefinite integral

- Techniques of integration:
Substitution, integration by parts, trigonometric substitution, and partial fractions
[SC7]

- Separable differential equations
- Euler's method
- Exponential growth and decay
- Logistic growth

SC7 The course provides students with the opportunity to work with functions represented analytically.

Unit 6: Applications of Definite Integrals (14 days) [SC3]

- Using the definite integral to discuss:
Net change—motion on a line, consumption over time [SC9]
Area, volume, length of a curve, surface area of a solid of revolution
Work, fluid force [SC8]

SC3 The course teaches all topics associated with Integrals as delineated in the Calculus BC Topic Outline in the AP Calculus course description.

Unit 7: L'Hôpital's Rule, Improper Integrals, Partial Fractions (15 days) [SC3]

- Indeterminate forms and L'Hôpital's rule
- Relative rates of growth
- Improper integrals (partial fractions and trig substitutions—done with Unit 5)

SC9 The course teaches students how to explain solutions to problems orally.

Unit 8: Infinite Series (21 days) [SC4]

- Geometric series
- Power series:
Finding new functions from known power series using term-by-term differentiation and integration [SC7]
- Taylor's series / Maclaurin series
- Lagrange form of the remainder
- Tests for convergence/divergence:
nth term test
Direct comparison
Ratio test
Integral test
Limit comparison test
Alternating series test (Leibniz's theorem)
- Radius and interval of convergence

SC8 The course provides students with the opportunity to work with functions represented verbally.

SC4 The course teaches all topics associated with Polynomial Approximations as delineated in the Calculus BC Topic Outline in the AP Calculus course description.

Unit 9: Parametric, Vector, and Polar Functions (17 days) [SC1]

- Parametric functions:
First Derivative at a point
Second Derivative
Length of a curve, surface area of a solid of revolution
- Vectors:
Angle between vectors
Scalar product
Using vectors to describe motion in the plane
- Polar coordinates and pole graphs:
Slope, horizontal and vertical tangent lines
Area, length of a curve

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Review for AP Exam: (15 days)

Post Exam Project and Additional Topics (20 days)

Teaching Strategies:

AP Calculus Course Description:

The topic outline shown above is the basics of our course. We study every area mentioned in the *AP Calculus Course Description*. We also include some other topics—Newton’s method, Simpson’s rule, integration by trigonometric substitution, volume by cylindrical shells, just to name a few—to provide alternate methods of solution or to give additional insights into how calculus operates.

Graphing Calculator:

[SC11, SC12, SC13]

Graphing Calculators are required for this course. The recommended calculators are:

TI 84+, TI 89, or Casio 9850 +

Calculators will be used for the following major purposes:

Conduct explorations and experiments [SC12]

Graph functions in arbitrary windows [SC12]

Solve equations numerically [SC6, SC11]

Analyze and interpret results [SC12]

Justify and explain results of graphs and equations [SC13]

SC11 The course teaches students how to use graphing calculators to help solve problems.

SC12 The course teaches students how to use graphing calculators to experiment.

Calculators will also be required in preparation for the AP Exam. Students must be able to:

Plot the graph of a function within an arbitrary viewing window

Find the zeroes of functions (solve equations numerically)

Numerically calculate the derivative of a function

Numerically calculate the value of a definite integral

SC13 The course teaches students how to use graphing calculators to interpret results and support conclusions.

I feel that Graphing Calculators play a vital role in the development of Calculus.

Students use calculators throughout the course. They are used for students to solve problems using techniques I have taught them, and then students must solve the same problem on the graphing calculator. [SC13] This allows for the making of connections numerically, graphically, and algebraically. Students must also experiment with graphing calculators. This is illustrated when students are asked to find the Area of Polar Sectors. This is a great way for students to connect polar and rectangular coordinates. [SC12]

SC6 The course provides students with the opportunity to work with functions represented numerically.

Classroom Strategies and Learning Environment:

My classroom is the primary environment where learning takes place. While different teaching methods are employed, and instruction differentiated, students are expected to come to my classroom with an open mind expecting to learn, be challenged, and to have questions. While the delivery of the material may vary, students will have the opportunity to learn from the teacher, each other, and from sources outside of the classroom. As an educator, how and where understanding takes place is not as important as that it does, indeed, take place. Students will have the opportunity to work in groups. This encourages critical thinking, sharing ideas, questioning, and explaining both orally and in written form.

Student Assessment / Evaluation:

[SC10]

Whenever possible, assessments will take on the form of the AP Test. There will be multiple choice questions modeled after the AP Test with and without the use of a calculator. Free response questions will also be modeled after the AP Test, and graded similar to the test. Students will need to explain clearly their responses in complete sentences, and use the calculator to support their results.

SC10 The course teaches students how to explain solutions to problems in written sentences.

Review for AP Exam:**[SC13]**

In the final preparation for the AP Exam, Released Exams and Free Response Questions from College Board will be used. I will review correct solutions, the process by which these solutions were obtained, alternate methods for obtaining the correct answer. I will also share with my students the scoring guidelines of the free response from College Board.

SC13 The course teaches students how to use graphing calculators to interpret results and support conclusions.

Primary Textbook:

Finney, Ross L., Franklin Demana, Bert Waits, and Daniel Kennedy. *Calculus: Graphical, Numerical, Algebraic*. 4th Edition AP* Edition Boston Prentice Hall Pearson 2012