Leonia School District

AP Calculus AB

10-12

Course Description

AP Calculus BC is roughly equivalent to both first and second semester college calculus courses. It extends the content learned in AB to different types of equations (polar, parametric, vector-valued) and new topics (such as Euler's method, integration by parts, partial fraction decomposition, and improper integrals), and introduces the topic of sequences and series. The AP course covers topics in differential and integral calculus, including concepts and skills of limits, derivatives, definite integrals, the Fundamental Theorem of Calculus, and series. The course teaches students to approach calculus concepts and problems when they are represented graphically, numerically, analytically, and verbally, and to make connections amongst these representations. Students learn how to use technology to help solve problems, experiment, interpret results, and support conclusions.

Students will have opportunity to work collaboratively, think critically, and problem solve, in addition to other 21st century skills.

Pacing Guide

Time Frame	Unit Title
2 weeks	Limits
6 Weeks	Derivatives
5 Weeks	Application of Derivatives
6 Weeks	Integration
3 Weeks	Logarithmic, Exponential, Transcendental Functions
3 Weeks	Applications of Integration
3 Weeks	Differential Equations
2 Weeks	Integration by Parts
2 Weeks	Partial Fractions
2 Weeks	Arc Length and Surfaces of Revolution
2 Weeks	Improper Integrals

Born on:
Board Approved:
Readopted:

Unit 1 - Limits

Goals/Objectives of Unit:

- **1. Find limits graphically and numerically.**
- **2. Estimate a limit using a numerical or graphical approach.**
- **3. Find different ways that a limit can fail to exist.**
- **4. Evaluate a limit using properties of limits.**
- **5. Develop and use a strategy for finding limits.**
- **6. Evaluate a limit using dividing out and rationalizing techniques.**
- **7. Determine continuity at a point and continuity on an open interval.**
- **8. Determine one-sided limits and continuity on a closed.**
- **9. Use properties of continuity.**
- **10. Understand and use the Intermediate Value Theorem.**
- **11. Determine infinite limits from the left and from the right.**
- **12. Find and sketch the vertical asymptotes of the graph of a function.**

Core Instructional Resources/Materials:
Calculus of a Single Variable by Larson, AP edition

NJ-Student Learning Standards:

Unit 2 - Derivatives

Goals/Objectives of Unit:

- Find the slope of the tangent line to a curve at a point.
- 2. Find the derivative of a function using the constant rule.
- 3. Find the derivative of a function using the power rule.
- 4. Find the derivative of a function using the constant multiple rule.
- 5. Find the derivative of a function using the sum and difference rules.
- 6. Find the derivatives of the sine and cosine functions.
- 7. Use derivatives to find rates of change.
- 8. Find the derivative of a function using the product rule.
- 9. Find the derivative of a function using the quotient rule.
- 10. Find the derivative of a trigonometric function.

Core Instructional Resources/Materials:
Calculus of a Single Variable by Larson, AP edition

- 11. Find a higher order derivative of a function.
- 12. Find the derivative of a composite function using the chain rule.
- 13. Find the derivative of function using the general power rule.
- 14. Simplify the derivative of function using algebra
- find the chain rule.
- 15. Distinguish between functions written in implicit form and explicit form.
- 16. Use implicit differentiation to find the derivative of a function.
- find a related rate.
- 17. Use related rates to solve real life problems.

NJ-Student Learning Standards:

HSF-IF.B.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
HSF-IF.B.6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★

HSF-IF.C.7a. Graph linear and quadratic functions and show intercepts, maxima, and minima.
HSF-IF.C.7b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
HSF-IF.C.7c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
HSF-IF.C.7d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

Unit 3 - Application of Derivatives

Goals/Objectives of Unit:

- 1. Understand the definition of extrema of a function on an interval.
- 2. Understand the definiton of relative extrema of a function on an open interval.
- 3. Find extrema on a closed interval.
- 4. Understand and use the Mean Value Theorem.
- 5. Determine intervals on which a function is increasing or decreasing.
- 6. Apply the first derivative test to find relative extrema of a function.
- 7. Determine intervals on which a function is concave upward or concave downward.
- 8. Find any points of inflection of the graph of a function.
- 9. Apply the second derivative test to find relative extrema of a function.
- 10. Determine limits at infinity.
- 11. Determine the horizontal asymptotes, if any, of the graph of a function.
- 12. Determine infinite limits at infinity.
- 13. Analzye and sketch the graph of a function.
- 14. Solve applied minimum and maximum problems.

Core Instructional Resources/Materials:

Calculus of a Single Variable by Larson, AP edition

- 15. Approximate a zero of a function using Newton's Method.
- 16. Understand the concept of a tangent line approximation.
- 17. Compare the value of the differential, dy, with the actual change in y, Δy.
- 18. Estimate a propegated error using a differential.
- 19. Find the differential of a function using differerntiation formulas.

NJ-Student Learning Standards:

HSF-IF.B.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.
HSF-IF.B.6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★

HSF-IF.C.7a. Graph linear and quadratic functions and show intercepts, maxima, and minima.
HSF-IF.C.7b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.
HSF-IF.C.7c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior.
HSF-IF.C.7d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.

Unit 4 - Intergration

Goals/Objectives of Unit:

- 1. Approximate the area under the graph of a nonnegative continuous function by using rectangle approximation methods.
- 2. Students will be able to interpret the area under a graph as a net accumulation of a rate of change.
- 3. Express the area under a curve as a definite integral and as a limit of Riemann sums.
- 4. Compute the area under a curve using a numerical integration procedure.
- 5. Apply rules for definite integrals and find the average value of a function over a closed interval.
- 6. Apply the relationship between the derivative and definite integral as expressed in both parts of the Fundamental Theorem of Calculus.
- 7. Approximate the definite integral by using the Trapezoidal Rule .

Core Instructional Resources/Materials:

Calculus of a Single Variable by Larson, AP edition

NJ-Student Learning Standards:

HSF-BF.A.1. Write a function that describes a relationship between two quantities.★
HSF-BF.A.1a. Determine an explicit expression, a recursive process, or steps for calculation from a context.

HSF-LE.A.1. Distinguish between situations that can be modeled with linear functions and with exponential functions.

Unit 5 - Logarithmic, Exponential, Transcendental Functions

Goals/Objectives of Unit:

- 1. Develop and use properties of the natural logarithmic function.
- 2. Understand the definition of the number e.
- 3. Find derivatives of functions involving the natural logarithmic function.
- 4. Use the Log Rule for Integration to integrate a rational function.
- 5. Integrate trigonometric functions.
- 6. Verify that one function is the inverse of another function.
- 7. Determine whether a function has an inverse function.
- 8. Find the derivative of an inverse function.
- 9. Develop properties of the natural exponential function.
- 10. Differentiate natural exponential functions.
- 11. Integrate natural exponential functions.
- 12. Define exponential functions that have bases other than e.
- 13. Differentiate and integrate exponential functions that have bases other than e.
- 14. Use exponential functions to model compound interest and exponential growth.
- 15. Develop properties of the six inverse trigonometric functions.
- 16. Differentiate an inverse trigonometric function.
- 17. Review the basic differentiation rules for elementary functions.
- 18. Integrate functions whose antiderivatives involve inverse trigonometric functions.
- 19. Review the basic integration rules involving elementary functions.

Core Instructional Resources/Materials:

Calculus of a Single Variable by Larson, AP edition

NJ-Student Learning Standards:

HSA-SSE.B.3c. Use the properties of exponents to transform expressions for exponential functions.

HSA-REI.D.10. Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

HSF-IF.B.4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship.★
HSF-IF.B.6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.★

HSF-IF.C.7e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
HSF-IF.C.8b. Use the properties of exponents to interpret expressions for exponential functions.

HSF-IF.C.9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions).

HSF-BF.B.4. Find inverse functions.
HSF-BF.B.4a. Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse.
HSF-BF.B.4b. (+) Verify by composition that one function is the inverse of another.
HSF-BF.B.5. (+) Use the inverse relationship between exponents and logarithms to solve problems involving exponents and logarithms.

HSF-LE.A.1a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals.
HSF-LE.A.1b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another.
HSF-LE.A.1c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
HSF-LE.A.3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
HSF-LE.A.4. Understand the inverse relationship between exponents and logarithms. For exponential models, express as a logarithm the solution to abct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

HSF-TF.B.7. (+) Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.★

Unit 6 - Application of Integration

Goals/Objectives of Unit:

- 1. Find the area of a region between two curves using integration.
- 2. Find the area of a region between intersecting curves using integration.
- 3. Describe integration as an accumulation process.
- 4. Find the volume of a solid of revolution using the disk method.
- 5. Find the volume of a solid of revolution using the washer method.
- 6. Find the volume of a solid with known cross section.

Core Instructional Resources/Materials:
Calculus of a Single Variable by Larson, AP edition

NJ-Student Learning Standards:

Unit 7 - Differential Equations

Goals/Objectives of Unit:

- 1. Find the integral using integration by parts and the tabular method.
- 2. Tell when the tabular method will not work.

Core Instructional Resources/Materials:
Calculus of a Single Variable by Larson, AP edition

NJ-Student Learning Standards:

Unit 8 - Integration By Parts

Goals/Objectives of Unit: • Integrate a function using partial fractions	Core Instructional Resources/Materials: Calculus of a Single Variable by Larson, AP edition
NJ-Student Learning Standards:	

Unit 9 - Partial Fractions

Goals/Objectives of Unit: • Integrate a function using partial fractions	Core Instructional Resources/Materials: Calculus of a Single Variable by Larson, AP edition
NJ-Student Learning Standards:	

Unit 10-Arc Length and Surfaces of Revolution

Goals/Objectives of Unit: • Evaluate an improper integral that has an infinite limit of integration • Evaluate an improper integral that has an infinite discontinuity	Core Instructional Resources/Materials: Calculus of a Single Variable by Larson, AP edition
NJ-Student Learning Standards:	

Unit 11 - Improper Integrals

Goals/Objectives of Unit: • Evaluate an improper integral that has an infinite limit of integration • Evaluate an improper integral that has an infinite discontinuity	Core Instructional Resources/Materials: Calculus of a Single Variable by Larson, AP edition

NJ-Student Learning Standards:

General Assessments (may include but not limited to):	
Possible Summative Assessment: ● Benchmark Assessments ● Pre/Post Assessments ● Chapter tests ● AP Exam	**Optional Daily Assessment:** ● Exit ticket/survey (game/web-based: Kahoot!, Pear Deck, EdPuzzle, Plickers, Quizizz, FlipGrid, Google Suite) ● Reflection/self-assessment tool ● Graphic organizers ● Anecdotal notes/teacher observations