# AP Calculus



| Month | Content | Skills | Assessment |
|---|---|---|---|
| **September** | **<u>Preparation for Calculus</u>**<br><br>P.1 Graphs and Models<br>(1/2 day) | ▪ Sketch the graph of an equation.<br>▪ Find the intercepts of a graph.<br>▪ Test a graph for symmetry with respect to an axis and the origin.<br>▪ Find the points of intersection of two graphs.<br>▪ Interpret mathematical models for real life data. | ✓ Teacher-made tests/quizzes consisting of questions from book test bank<br>✓ Teacher-made worksheets<br>✓ Questions during class<br>✓ In-class discussions<br>✓ Appropriate homework assignment with follow-up discussions |
| | P.2 Linear Models and Rates of Change<br>(1/2 day) | ▪ Find the slope of a line passing through two points.<br>▪ Write the equation of a line with a given point and slope.<br>▪ Interpret slope as a ratio or as a rate in a real-life application.<br>▪ Sketch the graph of a linear equation in slope-intercept form.<br>▪ Write equations of lines that are parallel or perpendicular to a given line. | |
| | P.3 Functions and Their Graphs<br>(1 day) | ▪ Use function notation to represent and evaluate a function.<br>▪ Find the domain and range of a function.<br>▪ Sketch the graph of a function.<br>▪ Identify different types of transformations of functions.<br>▪ Classify functions and recognize combinations of functions. | |
| | P. 4 Fitting Models to Data<br>(1 day) | ▪ Fit a linear, quadratic, or trigonometric model to a real-life data set. | |
| | P.5 Inverse Functions<br>(1 day) | ▪ Verify that one function is the inverse function of another function.<br>▪ Determine whether a function has an inverse function.<br>▪ Develop properties of the six inverse trigonometric functions. | |

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| | P.6 Exponential and Logarithmic Functions<br>(1 day) | ▪ Develop and use properties of exponential functions.<br>▪ Understand the definition of the number *e*.<br>▪ Understand the definition of the natural logarithmic function.<br>▪ Develop and use properties of the natural logarithmic function. | |
| | **<u>Limits and Their Properties</u>**<br><br>1.2 Finding Limits Graphically and Numerically<br>(3 days) | ▪ Understand that the tangent line problem is basic to calculus.<br>▪ Understand that the area problem is basic to calculus.<br>▪ Estimate a limit using a numerical or graphical approach.<br>▪ Learn about the different ways that a limit can fail to exist. | ✓ Teacher-made tests/quizzes consisting of questions from book test bank<br>✓ Teacher-made worksheets<br>✓ Questions during class<br>✓ In-class discussions<br>✓ Appropriate homework assignment with follow-up discussions |
| | 1.3 Evaluating Limits Analytically<br>(1 day) | ▪ Evaluate a limit using the properties of limits.<br>▪ Evaluate a limit using dividing out and rationalizing techniques.<br>▪ Evaluate a limit using the Squeeze Theorem. | |
| | 1.4 Continuity and One-Sided Limits<br>(2 days) | ▪ Determine continuity at a point and continuity on an open interval.<br>▪ Determine one-sided limits and continuity on a closed interval.<br>▪ Use properties of continuity.<br>▪ Understand and use the Intermediate Value Theorem. | |
| | 1.5 Infinite Limits<br>(2 days) | ▪ Determine infinite limits from the left and right.<br>▪ Find and sketch the vertical asymptotes of the graph of a function. | |

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| **October** | **<u>Differentiation</u>**<br><br>2.1 The Derivative and the Tangent Line Problems<br>(2 days) | ▪ Find the slope of the tangent line to a curve at a point.<br>▪ Use the limit definition to find the derivative of a function.<br>▪ Understand the relationship between differentiability and continuity. | ✓ Teacher-made tests/quizzes consisting of questions from book test bank<br>✓ Teacher-made worksheets<br>✓ Questions during class<br>✓ In-class discussions<br>✓ Appropriate homework assignment with follow-up discussions |
| | 2.2 Basic Differentiation Rules and Rates of Change<br>(2 days) | ▪ Find the derivative of a function using the Constant Rule, Power Rule, Constant Multiple Rule, Sum and Difference Rule.<br>▪ Find the derivative of the sine, cosine, and exponential functions.<br>▪ Use derivatives to find rates of change. | |
| | 2.3 The Product and Quotient Rules, and Higher-Order Derivatives<br>(2 days) | ▪ Find the derivative of a function using the Product Rule and Quotient Rule.<br>▪ Find the derivative of a trigonometric function.<br>▪ Find the higher-order derivatives (second, third, etc.) of a function. | |
| | 2.4 The Chain Rule<br>(2 days) | ▪ Find the derivative of a composite function using the Chain Rule.<br>▪ Find the derivative of a function using the General Power Rule.<br>▪ Simplify the derivative of a function using algebra.<br>▪ Find the derivative of a transcendental function using the Chain Rule.<br>▪ Find the derivative of a function involving the natural logarithmic function.<br>▪ Define and differentiate exponential functions that have bases other than *e*. | |

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| | 2.5 Implicit Differentiation<br>(2 days) | ▪ Distinguish between functions written in implicit form and explicit form.<br>▪ Find the derivative of a function written in implicit form using the Chain Rule and implicit differentiation.<br>▪ Find derivatives of functions using logarithmic differentiation. | |
| | 2.6 Derivatives of Inverse Functions<br>(2 days) | ▪ Find the derivative of an inverse function.<br>▪ Differentiate an inverse trigonometric function. | |
| | 2.7 Related Rates<br>(4 days) | ▪ Find a related rate.<br>▪ Use related rates to solve real-life problems. | |
| **November** | **<u>Applications of Differentiation</u>**<br><br>3.1 Extrema on an Interval<br>(1 day) | ▪ Understand the definition of extrema of a function on an interval.<br>▪ Understand the definition of relative extrema on an open interval.<br>▪ Find extrema on a closed interval. | ✓ Teacher-made tests/quizzes consisting of questions from book test bank<br>✓ Teacher-made worksheets<br>✓ Questions during class<br>✓ In-class discussions<br>✓ Appropriate homework assignment with follow-up discussions |
| | 3.2 Rolle's Theorem and the Mean Value Theorem<br>(1 day) | ▪ Understand and use Rolle's Theorem and the Mean Value Theorem. | |
| | 3.3 Increasing and Decreasing Functions and the First Derivative Test<br>(1 day) | ▪ Determine intervals on which a function is increasing or decreasing.<br>▪ Apply the First Derivative Test to find relative extrema of a function. | |
| | 3.4 Concavity and the Second Derivative Test<br>(1 day) | ▪ Determine the intervals on which a function is concave up or concave down.<br>▪ Find any points of inflection of the graph of a function.<br>▪ Apply the Second Derivative Test to find relative extrema of a function. | |

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| | 3.5 Limits at Infinity<br>(1 day) | ▪ Determine finite and infinite limits at infinity.<br>▪ Determine the horizontal asymptotes, if any, of the graph of a function. | |
| | 3.6 A Summary of Curve Sketching<br>(2 days) | ▪ Analyze and sketch the graph of a function. | |
| | 3.7 Optimization<br>(5 days) | ▪ Solve applied minimum and maximum problems. | |
| | 3.8 Differentials<br>(1 day) | ▪ Understand the concept of a tangent line approximation.<br>▪ Compare the value of the differential, $dy$, with the actual change in $y$, $\Delta y$.<br>▪ Find the differential of a function using differentiation formulas. | |

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| December | **Slope Fields**<br><br>(2 days) | ▪ Draw a slope field from a differential equation.<br>▪ Use a slope field to draw the graphs of several solutions to a differential equation.<br>▪ Given the graph of a function, sketch its derivative, and vice-versa. | ✓ Teacher-made tests/quizzes consisting of questions from book test bank<br>✓ Teacher-made worksheets<br>✓ Questions during class<br>✓ In-class discussions<br>✓ Appropriate homework assignment with follow-up discussions<br>✓ Worksheet packet |
| | **Integration**<br><br>4.1 Antiderivatives and Indefinite Integration<br>(3 days) | ▪ Write the general solution of a differential equation.<br>▪ Use indefinite integral notation for antiderivatives.<br>▪ Use basic integration rules to find antiderivatives.<br>▪ Find a particular solution of a differential equation. | ✓ Teacher-made tests/quizzes consisting of questions from book test bank<br>✓ Teacher-made worksheets<br>✓ Questions during class<br>✓ In-class discussions<br>✓ Appropriate homework assignment with follow-up discussions |
| | 4.2 Area<br>(2 days) | ▪ Use sigma notation to write and evaluate a sum.<br>▪ Understand the concept of area.<br>▪ Approximate the area of a plane region.<br>▪ Find the area of a plane region using limits. | |
| | 4.3 Riemann Sums and Definite Integrals<br>(2 days) | ▪ Understand the definition of a Riemann Sum<br>▪ Evaluate a definite integral using limits.<br>▪ Evaluate a definite integral using properties of definite integrals. | |
| | 4.4 The Fundamental Theorem of Calculus<br>(5 days) | ▪ Evaluate a definite integral using the Fundamental Theorem of Calculus.<br>▪ Understand and use the Mean Value Theorem for integrals.<br>▪ Find the average value of a function over a closed interval.<br>▪ Understand and use the Second Fundamental Theorem of Calculus. | |

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| **January** | 4.5 Integration by Substitution<br>(6 days) | ▪ Use pattern recognition to evaluate an indefinite integral.<br>▪ Use a change of variables to find an indefinite or definite integral.<br>▪ Use the General Power Rule for Integration to evaluate an indefinite integral.<br>▪ Use a change of variables to evaluate a definite integral.<br>▪ Evaluate a definite integral involving an even or odd function. | |
| | **MIDTERM EXAM** | ▪ Review of previous skills | ✓ Midterm Exam |
| | 4.6 Numerical Integration<br>(1 day) | ▪ Approximate a definite integral using the Trapezoidal Rule.<br>▪ Approximate a definite integral using the Simpson's Rule. | |
| | 4.7 The Natural Logarithmic Function<br>(2 days) | ▪ Use the Log Rule for Integration to integrate a rational function.<br>▪ Integrate trigonometric functions. | |
| **February** | 4.8 Inverse Trigonometric Functions: Integration<br>(2 days) | ▪ Integrate functions whose antiderivatives involve inverse trigonometric functions.<br>▪ Use the method of completing the square to integrate a function.<br>▪ Review the basic integration formulas involving elementary functions. | |
| | **Differential Equations**<br><br>5.1 Differential Equations: Growth and Decay<br>(1 day) | ▪ Use separation of variables to solve a simple differential equation.<br>▪ Use exponential functions to model growth and decay in applied problems. | |

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| | 5.2 Differential Equations: Separation of Variables<br>(3 days) | ▪ Use initial conditions to find particular solutions of differential equations.<br>▪ Use a slope field to sketch solutions of a differential equation.<br>▪ Solve differential equations by separation of variables.<br>▪ Use a differential equation to model and solve an applied problem. | |
| **March** | **<u>Applications of Integration</u>**<br><br>6.1 Area of a Region Between Two Curves<br>(2 days) | ▪ Find the area of a region between two curves using integration.<br>▪ Find the area of a region between intersecting curves using integration.<br>▪ Describe integration as an accumulation process. | ✓ Teacher-made tests/quizzes consisting of questions from book test bank<br>✓ Teacher-made worksheets<br>✓ Questions during class<br>✓ In-class discussions<br>✓ Appropriate homework assignment with follow-up discussions |
| | 6.2 Volume: The Disk Method<br>(6 days) | ▪ Find the volume of a solid of revolution using the disk method.<br>▪ Find the volume of a solid of revolution using the washer method.<br>▪ Find the volume of a solid with known cross sections. | |

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| **April** | **Review for AP Exam** | ▪ Students will review using old AP exams and a test-preparation review book.<br>▪ Students will become familiar with the format of the AP Exam. | ▪ Collect and grade practice exams. |
| **May** | **AP Exam**<br><br>**Individual Research Projects** | ▪ Students will take the AP Exam.<br><br>▪ Students will choose a calculus topic not covered in class, and will prepare an oral presentation and written report. (Topics may include Hyperbolic Functions, Error Analysis, the Shell Method, Arc Length, Surfaces of Revolution, etc.) | ▪ AP Exam results<br><br>▪ Teacher will monitor students' progress as needed. |
| **June** | **Presentations of Projects** | ▪ Students will give oral presentations and submit their written report. | ▪ Students will be assessed based on a rubric evaluating both the oral and written components of the project. |