# AP Calculus

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AP Calculus

| Content | Skills | Learning Targets | Assessment | Resources & Technology | Standard |
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| **CEQ:**<br>**What are the roles of limits in developing calculus?**<br>**What is the meaning of derivative as a rate of change and how can it be used to model and solve problems?**<br>**What role do derivatives and the theorems of calculus play in connecting and understanding functions graphically, numerically, analytically and verbally?** | | | | Calculus:<br><br>**TextBook:** Tenth Edition by Larson and Edwards.<br><br>**Graphical Technology:** TI- 84 plus | Course is taught following College Board guidance at this link. |

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| *UEQ:*<br><br>*What are the relationships between Functions and their graphs?*<br><br>*What are some special functions and their applications?*<br><br>**A: Foundations for Calculus**<br><br>A1: Lines and Slopes<br>A2: Functions and Graphs<br>A3: Exponential Functions<br>A4: Inverse Functions and Logarithms<br>A5: Trigonometric Functions | **A: Foundations for Calculus**<br><br>A1: Generate equations for lines using the slope/intercept and point/slope forms.<br><br>A2: Identify functions from their graphs<br>A2: Identify the domain and range of functions from graphs and equations including piecewise defined functions.<br>A2: Identify situations in which graphing technology may fail<br>in determining domains and ranges of functions.<br>A2: Understand the relationship between the graphs of functions classified as odd or even.<br>A2: Understanding the use of composite functions.<br><br>A3: Understand the | **A: Foundations for Calculus**<br><br>LT1:<br>I can write linear equations from points, slopes and graphical representations of data.<br><br>LT2:<br>I can identify types of functions as well as their domains and ranges including, but not limited to, piecewise defined functions.<br><br>LT3:<br>I can recognize, understand, and create graphs of various functions through the use of the properties unique to different families of functions. i.e. symmetry, asymptotes and various graph transformations<br><br>LT4: | **A: Foundations for Calculus**<br><br>CFA -( Mid - Unit Quiz )<br><br>CSA - (Unit Test) | **A: Foundations for Calculus**<br><br>Required:<br>TI 84 or Equivalent Graphing Calculator<br><br>Optional:<br>Geometer's' Sketchpad<br>TI-Nspire Calculators | |

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| *UEQ:*<br><br>*What is the definition of and properties for working with limits?*<br><br>*What is the connection between 2-sided limits and continuity?* | shape and uses for exponential functions and the number **e**.<br><br>A4: Determine whether a function is one-to-one and whether or not an inverse exists.<br>A4: Understand the graphical connection between a function and its inverse.<br>A4: Use logarithms and their properties to solve equations.<br><br>A5: Understand the connections between trigonometric equations and their graphs.<br>A5: Apply graph transformations to periodic functions.<br>A5: Identify the relationship between a trigonometric function and its inverse.<br>A5: Explore domain restrictions as they relate to trigonometric functions. | I can use graphing technology to generate graphs of functions and draw inferences about their properties including grapher limitations.<br><br>LT5:<br>I can use function notation to combine functions with mathematical operators including composite functions.<br><br>LT6:<br>I can apply properties of inverse functions and generate graphs showing under standing of the connections between the domain and range of these functions.<br><br>LT7:<br>I can work with applications of different function families and use them to make future | | | |

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| *How can limits and continuity be used to determine the rate of change for a function at a given point?*<br><br>*(Tangent Line?)*<br><br>**B: Limits and Continuity**<br><br>B1: Definition and properties of Limits<br>B2: One and Two sided limits<br>B3: Limits involving infinity<br>B4: Continuity and functions<br>B5: Tangent and Normal lines | A1-5: Work with applications of each function type including exponential growth/decay, production and future projections.<br><br>**B: Limits and Continuity**<br><br>B1: Explore average and instantaneous speed as they relate to slope and limits.<br>B1: Understand the definition and six properties of Limit.<br>B1: Determine the limits of polynomials and other rational functions by graphing and confirming analytically.<br><br>B2: Explore limits from the right and left handed sides.<br>B2: Determine if a limit at a particular x-value exists by using two sided Limits.<br>B2: Understand the Sandwich (Squeeze) | projections.<br><br>**B: Limits and Continuity**<br><br><u>LT1</u>:<br>I can distinguish between the average and instantaneous rates of change as they apply to slope and limits.<br><br><u>LT2:</u><br>I can use the Properties of Limits as they apply to polynomials to evaluate Limit Values.<br><br><u>LT3</u>:<br>I can Determine the existence of a limit and it's value through Graphical and Analytic methods.<br><br><u>LT4:</u><br>I can determine left | **B: Limits and Continuity**<br><br>CFA -( Mid - Unit Quiz )<br><br>CSA - (Unit Test) | **B: Limits and Continuity**<br><br>See Above | |

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| *UEQ:*<br><br>*What are derivatives?* | Theorem and what functions it can be applied.<br><br>B3: Understand the behavior of a function's limit when it approaches positive and negative infinity.<br>B3: Determine the horizontal asymptotes of a function, if any.<br>B3: Apply End Behavior Models to appropriate functions.<br><br>B4:. Determine a function's Continuity at a certain point.<br>B4: Understand the properties of continuous functions.<br>B4: Identify Continuous functions.<br>B4: Understand composite functions in regards to continuity.<br>B4: Understand and apply the Intermediate Value Theorem to continuous functions.<br><br>B5: Understand Secant Slope as the | and right handed limits.<br><br><u>LT5</u>:<br>I can apply end behavior models to polynomial functions to determine horizontal asymptotes.<br><br>LT6:<br>I can determine continuity at a point and expand it to identify continuous functions.<br><br>LT7:<br>I can apply continuity to composite functions.<br><br>LT8:<br>I can apply the intermediate value theorem.<br><br>LT9:<br>I can Explain the difference between a Secant and Tangent line as they relate to a curve. | | | |

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| *How do you find derivatives of different functions.*<br><br>*What are the rules for differentiation?*<br><br>**C: Derivatives**<br><br>C1: Definition of Derivative as a Limit.<br>C2: Derivative at a point<br>C3: Graphs of Derivatives and Functions<br>C4: One-Sided Derivatives<br>C5: Non-differentiable points<br>C6: Intermediate Value Theorem<br>C7: Differentiation Rules for functions<br>C8: Velocity, Acceleration and other Rates of change.<br>C9: Economic Applications of Derivatives<br>C10: Derivatives of | average rate of change.<br>B5: Understand Tangent Line as the instantaneous rate of change.<br>B5: Find the Secant and Tangent lines to a point on a curve.<br>B1-B5: Find the instantaneous and average rates of change for various science, business applications.<br>**C: Derivatives**<br><br>C1: Apply the definition of derivative to determine the rate of change of a function at a given point.<br>C2: Differentiate between the graph of a function and the graph of its derivative using key features.<br>C3: Identify non-differentiable points for a function and explain why they are not differentiable.<br>C4: Apply the | LT 10:<br>I can Find the Secant and Tangent lines to a point on a curve.<br><br>LT 11:<br>I can determine average and instantaneous rates of change in science and business applications.<br><br>**C: Derivatives**<br><br><u>LT1</u>:<br>I can apply the definition of derivative to determine the rate of change of a function at a given point.<br><br><u>LT2:</u><br>I can differentiate between the graph of a function and the graph of its derivative using key features.<br><br><u>LT3</u>:<br>I can identify non- | **C: Derivatives**<br><br>CFA -( Mid - Unit Quiz )<br><br>CSA - (Unit Test) | **C: Derivatives**<br><br>See Above | |

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| Trig Functions<br>C11: Differentiation of Composite Functions (Chain Rule)<br>C12: Implicit Differentiation<br>C13: Derivatives of Inverse functions<br>C14: Derivatives of Exponential and Logarithmic Functions. | intermediate value theorem to determine whether a function's derivative will take on a given value.<br>C5: Develop the rules of differentiation (Sum, Difference, Constant Multiple, Product, Quotient, and Power.<br>C6: Apply the differentiation rules to various families of functions.<br>C7: Discover the relationship among position, velocity and acceleration of a body in motion.<br>C8: Apply differentiation rules to Economics (marginals)<br>C9: Discover the differentiation rules for the trigonometric family of functions.<br>C10: Construct the Chain Rule for differentiating compos ite functions.<br>C11: Develop an understanding of | differentiable points for a function and explain why.<br><br><u>LT4:</u><br>I can apply the intermediate value theorem to determine whether a function's derivative will take on a given value.<br><br><u>LT5</u>:<br>I can apply the differentiation rules to various families of functions.<br><br>LT6:<br>I can determine the relationship among position, velocity and acceleration of a body in motion.<br><br>LT7:<br>I can apply differentiation rules to Economics<br><br>LT8:<br>I can apply it the differentiation rules | | | |

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| | implicit differentiation and its role in computing derivatives of equations that are not functions.<br>C12: Examine derivatives of the inverse trigonometric functions.<br>C13: Apply rules for computing derivatives of Exponential and Logarithmic functions.<br>C1-13: Combine all of the derivative rules to determine locations of points where the derivative would be zero and to find the equation of Tangent and Normal Lines. | for the trigonometric family of functions..<br><br>LT9:<br>I can use the chain rule to differentiate.<br><br>LT 10:<br>I<br>can differentiate inver se trigonometric functions.<br><br>LT 11:<br>I can differentiate logarithmic and exponential functions.<br><br>LT 12:<br>I can locate points where Tangent values are zero and create both the Tangent and Normal equations at that point. | | | |

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| **CEQ:**<br>*What is the relationship between differential calculus and integral calculus?*<br><br>*How can word problems and real life problems be solved through the use of calculus?*<br><br>*UEQ:*<br>*What are the extreme values of a function and how can they be calculated?*<br><br>*How can extreme values and derivatives be applied to real world applications?*<br><br>**D: Applications of Derivatives**<br><br>D1: Extreme Values of Functions<br>D2: Increasing and Decreasing functions.<br>D3: First and Second Derivative tests for Extreme Values<br>D4: Concavity and Inflection Points<br>D5: Modeling and Optimization<br>D5: Related Rates<br><br>**UEQ:**<br>*How does integral calculus relate to "areas under curves"?*<br><br>*What is the relationship between finding slopes of tangent lines(differential calculus) and finding areas under* | **D: Applications of Derivatives**<br><br>D1: Define the extreme values of a function<br>D2: Appy the extreme Value Theorem to various functions and their graphs.<br>D3: Investigate the Mean Value Theorem and its applications to graphs of functions.<br>D4: Compare various Acceleration, velocity and position functions to develop the concept of andtidifferentiation.<br>D5: Connect the graphs of f ' and f " to the graphs of f using first and second derivative tests.<br>D5: Develop the concept of concavity and how to interpret this in relation to a function.<br>D6: Solve optimization problems using first and second derivatives.<br>D7: Combine optimization and implicit differentiation to solve problems involving related rates. | **D: Applications of Derivatives**<br><br>Ch 4 Test<br><br>Ch. 1-4 Final Exam (optional) | |

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| *curves(integral calculus)?*<br><br>**E. The Definite Integral(Chapter 5)**<br><br>E1: Distance Traveled<br>E2: Definite Integrals<br>E3: Definite Integrals and Antiderivatives<br>E4: Fundamental Theorem of Calculus<br>E5: Trapezoidal Rule<br><br>**UEQ:**<br>*How are differential equations recognized, then solved?*<br><br>*What are slope fields and how are they connected to differential equations?*<br><br>*How is "u-substitution" used to find anti-derivatives, analytically?* | **E. The Definite Integral(Chapter 5)**<br><br>E1: Explore the concept of the area under the curve as an accumulator for a velocity function.<br>E1: Compare different techniques(RRAM, MRAM, LRAM) for estimating the area under the curve.<br><br>E2: Examine the notation used to define definite integrals.<br>E2: Investigate the use of the graphing calculator to compute indefinite integrals.<br><br>E3: Investigate the properties of definite integrals.<br>E3: Explore and understand the "Mean Value Theorem" and its uses.<br>E3: Make a connection between differential and integral calculus.<br>E3: Investigate how to find the derivative of an integral.<br><br>E4: Learn how to apply the "Fundamental Theorem of Calculus".<br>E4: Learn how to apply "The Fundamental Theorem of Calculus, Part 2".<br>E4: Investigate methods for finding "total area", analytically.<br><br>E5: Learn how to use the "Trapezoid Rule" to estimate the area under a curve. | **E. The Definite Integral(Chapter 5)**<br><br>CFA -( Mid - Unit Quiz )<br><br>CSA - (Unit Test) | |

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| **F. Differential Equations and Mathematical Modeling(Chapter 6)**<br><br>F1: Slope Fields and Differential Equations<br>F2: Antidifferentiation by Substitution<br>F3: Exponential Growth and Decay<br><br>**UEQ:**<br>*How is total distance traveled calculated?*<br><br>*How is the area between curves calculated?*<br><br>*What is the method for calculating volumes of solids with specific cross-sections and volumes of solids formed by revolving regions?*<br><br>**G. Applications of Definite Integrals (Chapter 7)**<br><br>G1: Integral as Net Change<br>G2: Areas in the Plane<br>G3: Volumes<br><br>**UEQ:**<br>*What are the expectations of the College* | **F. Differential Equations and Mathematical Modeling(Chapter 6)**<br><br>F1: Investigate how to solve a differential equation.<br>F1: Investigate how to solve an "initial value" problem.<br>F1: Explore and construct slope fields.<br><br>F2: Learn how to evaluate an "indefinite integral", analytically.<br>F2: Investigate how to verify antiderivative formulae.<br>F2: Develop techniques to solve definite integrals by the use of "u-substitution".<br><br>F3: Explore how to solve differential equations using "separation of variables".<br>F3: Explain how calculus is used to derive the formula for exponential growth and decay.<br>F3: Apply the formula for exponential growth and decay to solve problems.<br><br>G1: Calculate the total distance traveled by a particle.<br>G1: Analyze graphs to answer questions regarding position, velocity, acceleration, and distance traveled.<br><br>G2: Develop method for finding the area between curves.<br>G2: Learn how to integrate with respect to y.<br><br>G3: Calculate volumes of solids knowing | **F. Differential Equations and Mathematical Modeling(Chapter 6)**<br>CFA -( Mid - Unit Quiz )<br><br>CSA - (Unit Test) | |

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| *Board in writing the AP Calculus Test?*<br><br>*What advice is helpful in taking the AP Calculus Exam?*<br><br>**H. Review and Prepare for AP Calculus Exam.** | the shape of the cross-sections of the solid.<br>G3: Use various techniques including "disc method, washer method, and shell method, to calculate volumes of solids formed by revolving regions on the coordinate plane. | | |