AP Calculus BC Scope & Sequence

Grading Period	Unit Title	Learning Targets
Throughout the School Year	*Apply mathematics to problems in everyday life *Use a problem-solving model that incorporates analyzing information, formulating a plan, determining a solution, justifying the solution and evaluating the reasonableness of the solution *Select tools to solve problems *Communicate mathematical ideas, reasoning and their implications using multiple representations *Create and use representations to organize, record and communicate mathematical ideas *Analyze mathematical relationships to connect and communicate mathematical ideas *Display, explain and justify mathematical ideas and arguments	
First Grading Period	Preparation for Calculus	Pre Calculus Review
	Limits and Their Properties	● An introduction to limits, including an intuitive understanding of the limit process and the formal definition for limits of functions ● Using graphs and tables of data to determine limits of functions and sequences ● Properties of limits ● Algebraic techniques for evaluating limits of functions ● Comparing relative magnitudes of functions and their rates of change (comparing exponential growth, polynomial growth and logarithmic growth) ● Continuity and one-sided limits ● Geometric understanding of the graphs of continuous functions ● Intermediate Value Theorem ● Infinite limits ● Understanding asymptotes in terms of graphical behavior

		• Using limits to find the asymptotes of a function, vertical and horizontal
	Differentiation	• Tangent line to a curve and local linearity approximation • Understanding of the derivative: graphically, numerically and analytically • Approximating rates of change from graph and table of data • The derivative as: the limit of the difference quotient, the slope of a curve at a point and interpreted as an instantaneous rate of change • The meaning of the derivative translating verbal descriptions into equations and vice versa • The relationship between differentiability and continuity • Functions that have a vertical tangent at a point and points at which there are no tangents • Instantaneous rate of change as the limit of average rate of change • Approximate rate of change from graphs and table of values • Differentiation rules for basic functions, including power functions and trigonometric functions • Rules of differentiation for sums, differences, products and quotients • The Chain rule • Implicit differentiation • Related rates, modeling rates of change
	Applications of Differentiation	• Extrema on an interval and the Extreme Value Theorem • Rolle's Theorem and the Mean Value Theorem and their geometric consequences • Increasing and decreasing functions and the First Derivative Test • Concavity and points of inflections and the relationship with the 2nd derivative • Points of inflection as places where concavity changes • Second Derivative Test • Limits at infinity • Summary of graphing techniques, analysis of curves, including the notions of monotonicity and concavity

		● Relating the graphs of f, f', and f'' ● Optimization including both relative and absolute extrema ● Differentials, tangent line to a curve, linear approximations and Newton's Method of approximating zeros ● Application problems including position, velocity, acceleration, and rectilinear motion
Second Grading Period	Integration	● Antiderivatives and indefinite integration, including antiderivatives following directly from derivatives of basic functions ● Basic properties of the definite integral ● Area under a curve ● Meaning of the definite integral ● Definite integral as a limit of Riemann sums ● Riemann sums, including left, right and midpoint sums ● Use of the First Fundamental Theorem of Calculus to evaluate definite integrals ● Use of the Fundamental Theorem of Calculus to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined ● The Second Fundamental Theorem of Calculus and functions defined by integrals ● Use of substitution of variables to evaluate definite integrals ● Integration by substitution ● The Mean Value Theorem for Integrals and the average value of a function ● Trapezoidal sums ● Use of Riemann sums and trapezoidal sums to approximate definite integrals of functions that are represented analytically, graphically and by tables of data

		• Define the natural logarithmic function as a definite integral • The natural logarithmic function: differentiation and integration • Inverse functions and the use of implicit differentiation to find the derivative of an inverse function • Exponential functions: differentiation and integration • Bases other than e and applications • Solving separable differential equations • Applications of differential equations in modeling, including exponential growth • Use of slope fields to interpret a differential equation geometrically • Drawing slope fields and solution curves for differential equations • Inverse trig functions and differentiation • Integrals yielding inverse trig functions
Third Grading Period	Applications of Integration	• The integral as an accumulator of rates of change • Area between 2 curves • Volume of solids of revolution by disc, washer and shell method • Volume of solids of known cross sections • Arc length and surface area • Problems from past AP tests involving setting up an approximating Riemann sum and representing its limit as a definite integral • Average value of a function • Applications of integration in problems involving a particle moving along a line, including the use of the definite integral with an initial condition and using the definite integral to find the distance traveled by a particle along a line
	Integration Techniques, L'Hopital and Improper Integrals	• Review of basic integration rules • Integration by parts • Trigonometric integrals • Trigonometric substitution

		• L'Hopital's Rule and its use in determining limits • Indeterminate forms • Relative rates of growth • Improper integrals and their convergence and divergence
Fourth Grading Period	Infinite Series	• Convergence and divergence of sequences • Definition of a series as a sequence of partial sums • Convergence of series defined in terms of the limit of the sequence of partial sums of a series • Geometric series and its applications • The nth Term Test for Divergence • The Integral Test to prove the convergence or divergences of the p-series (harmonic series as the p-series) • Error approximation for the integral test • Comparisons of series using both Direct and Limit Comparison Tests • Alternating Series and the Alternating Series Remainder • The Ratio and Root Tests • Taylor Polynomials and approximations: use the graphing calculator to view different Taylor Polynomials for sin *x* and cos *x* • Powers series and radius and interval of convergence • Representation of functions by power series • Taylor and Maclaurin series for a given function • Taylor and Maclaurin series for sin *x*, cos *x, e, and 1/1-x* • Formal manipulation of Taylor series and shortcuts to computing Taylor series, including substitution, differentiation, integration, addition of series, multiplication of series by a constant and /or a variable and the formation of

		new series from known series Taylor's Theorem with the Lagrange Form of the Remainder (Lagrange Error Bound)
	Plane Curves, Parametric Equation and Polar Curves: Special Topics: Numerical solution of differential equations using Euler's Method, Limits of Sums as definite integrals	● Plane curves and parametric equations and calculus ● Parametric equations and vectors: motion along a curve, position, velocity, acceleration, speed and distance traveled ● Analysis of curves given in parametric and vector form ● Polar coordinates and polar graphs ● Area of region bounded by polar curves ● Numerical solution of differential equations using Euler's Method ● Limits of infinite sums as definite integrals