SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW

Course Title: Advanced Placement Calculus BC	**Length of Course:** 30 cycles
Grade Level(s): 12	**Periods Per Cycle:** 6
Units of Credit: 1	**Length of Period:** 43 minutes
Classification: Elective	**Total Instructional Time:** approx. 130 hours

Course Description

This is an advanced course designed to prepare students for the Advanced Placement (AP) Calculus BC College Board examination. The course goals in compliance with College Board include the following: Working with functions represented in a variety of ways: graphical, numerical, analytical, or verbal; understanding the meaning of the derivative in terms of rate of change and local linear approximation and using derivatives to solve a variety of problems; understanding the meaning of the definite integral both as a limit of Riemann sums and as the net accumulation of change and using integrals to solve a variety of problems; understanding the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus; working with parametric, polar, and vector functions; understanding polynomial approximations and series; communicating mathematics both orally and in well-written sentences and learning how to explain solutions to problems; modeling a written description of physical situation with a function, a differential equation, or an integral; using technology to help solve problems, experiment, interpret results, and verify conclusions; determining the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement; and ultimately developing an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.

Instructional Strategies, Learning Practices, Activities, and Experiences

Anticipatory Sets
Assessments
Bell Ringers
Class Discussions
Closure
Critical Thinking
Flexible Groups
Graphic Organizers
Guided Practice
High-Level Questioning
Homework
Posted Objectives
Projects
Teacher Demonstrations
Technology Integration
Videos/DVD's
Wait Time

Assessments

Assessments (Teacher-Created, College Board)
Higher-Level Questioning
Projects
Classwork

Materials/Resources		
Calculus of a Single Variable: Eighth Edition (Larson, Hostetler, Edwards)	Internet Resources	College Board Materials

Adopted: 5/20/13
Revised: 5/20/2019

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I. Functions, Graphs, and Limits

The Standards of Mathematical Practices

Make sense of problems and persevere in solving them.	**Reason abstractly and quantitatively.**
Construct viable arguments and critique the reasoning of others.	**Model with mathematics.**
Use appropriate tools strategically.	**Attend to precision.**
Look for and make use of structure.	**Look for and express regularity in repeated reasoning.**

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
(A) Analysis of Graphs	1. Use analytic information to predict and explain graphical behaviors.
(B) Limits of Functions (Including one-sided Limits)	1. Develop an intuitive understanding of the limiting process. 2. Calculate limits using Algebra. 3. Estimate limits from graphs, tables, and data.
(C) Asymptotic and Unbounded Behavior	1. Describe asymptotes in terms of graphical behavior. 2. Describe asymptotic behavior in terms of limits involving infinity. 3. Compare relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth).
(D) Continuity as a Property of Functions	1. Develop an intuitive understanding of continuity. 2. Describe continuity in terms of limits. 3. Demonstrate knowledge of the Extreme Value Theorem and the Intermediate Value Theorem.
(E) Parametric, Polar, and Vector Functions	1. Demonstrate knowledge of parametric, polar, and vector functions.

II. Derivatives

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
(A) Concept of the Derivative	1. Represent the derivative graphically, numerically, and analytically. 2. Interpret the derivative as an instantaneous rate of change. 3. Use the limit process to define the derivative. 4. Explain the relationship between differentiability and continuity.
(B) Derivative at a Point	1. Find the slope of a curve at a point (with emphasis on points where there are vertical tangents and points which there are no tangents). 2. Determine the tangent line to a curve at a point. 3. Calculate local linear approximation. 4. Calculate instantaneous rate of change as the limit of average rate of change. 5. Approximate the rate of change from graphs, and tables of values.
(C) Derivative as a Function	1. Describe corresponding characteristics of graphs of f and f'. 2. Explain the relationship between the increasing and decreasing behavior of f and the sign of f'. 3. Utilize the Mean Value Theorem and its geometric interpretation. 4. Translate verbal descriptions into equations involving derivatives and vice versa.

II. Derivatives (continued)	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
(D) Second Derivative	1. Explain the corresponding characteristics of the graphs of $f, f', and\ f''$. 2. Describe the relationship between the concavity of f and the sign of f''. 3. Determine points of inflection and state the places where concavity changes.
(E) Applications of Derivatives	1. Analyze curves, including the notions of monotonicity and concavity. 2. Analyze planar curves given in parametric form, polar form, and vector form, including velocity and acceleration. 3. Solve optimization problems, both absolute (global) and relative (local) extrema. 4. Model rates of change, including related rates. 5. Use implicit differentiation to find the derivative of an inverse function. 6. Interpret the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration. 7. Use geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations. 8. Use Euler's method to find a numerical solution of differential equations. 9. Use L'Hospital's Rule, including its use in determining limits and convergence of improper integrals and series.

II. Derivatives (continued)

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
(F) Computation of Derivatives	1. Demonstrate knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions. 2. Use derivative rules for sums, products, and quotients of functions. 3. Use the chain rule and implicit differentiation. 4. Calculate the derivatives of parametric, polar, and vector functions.

III. Integrals

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
(A) Interpretations and Properties of Definite Integrals	1. Evaluate a definite integral as a limit of Riemann sums. 2. Use basic properties of definite integrals (examples include additivity and linearity).
(B) Applications of the Integral	1. Adapt knowledge of integrals to solve other similar application problems (applications should include finding the area of a region, the volume of a solid with known cross sections, the average value of a function, the distance traveled by a particle along a line, the length of a curve, as well as a curve given in parametric form, and accumulated rate of change).
(C) Fundamental Theorem of Calculus	1. Use the Fundamental Theorem of Calculus to evaluate definite integrals. 2. Use the Fundamental Theorem of Calculus to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined.
(D) Techniques of Antidifferentiation	1. Solve antiderivatives following directly from derivatives of basic functions. 2. Solve antiderivatives by substitution of variables (including change of limits for definite integrals), parts, and simple partial fractions. 3. Evaluate improper integrals.

III. Integrals (continued)

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
(E) Applications of Antidifferentiation	1. Find specific antiderivatives using initial conditions, including applications to motion along a line. 2. Solve separable differential equations and use them in modeling (including the study of the equation $y' = ky$ and exponential growth). 3. Solve logistic differential equations and use them in modeling.
(F) Numerical Approximations to Definite Integrals	1. Use Riemann sums (left, right, and midpoint evaluation points) and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values.

IV. Polynomial Approximations and Series	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
(A) Concept of Series	1. Define a series. 2. Define a convergence. 3. Explore convergence and divergence through technology.
(B) Series of Constants	1. Explore motivating examples, including decimal expansion. 2. Explore geometric series with applications. 3. Work with the harmonic series. 4. Explain the area of rectangles and their relationship to improper integrals, including the integral test and its use in testing the convergence of a p-series. 5. Use the ratio test for convergence and divergence. 6. Compare series to test for convergence and divergence.

IV. Polynomial Approximations and Series (continued)

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
(C) Taylor Series	1. Explain polynomial approximation with graphical demonstration of convergence. 2. Explore Maclaurin series and the general Taylor series centered at $x = a$. 3. Explore Maclaurin series for the functions $e^x, \sin x, \cos x, and\ \frac{1}{1-x}$. 4. Formal manipulation of Taylor series and shortcuts to computing Taylor series, including substitution, differentiation, antidifferentiation, and the formation of new series from known series. 5. Work with functions defined by power series. 6. Work with radius and interval convergence of power series. 7. Calculate Lagrange error bound for Taylor polynomials.

V. Technology

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
(A) Graphing Calculators	1. Use the zoom feature to reveal local linearity. 2. Construct a table of values to conjecture a limit. 3. Develop a visual representation of Riemann sums approaching a definite integral. 4. Graph Taylor polynomials to understand intervals of convergence for Taylor series. 5. Use the calculator to draw a slope field.