SPRING GROVE AREA SCHOOL DISTRICT

PLANNED COURSE OVERVIEW

Course Title: Advanced Placement Calculus AB	**Length of Course:** 30 cycles
Grade Level(s): 11 - 12	**Periods Per Cycle:** 9
Units of Credit: 1.5	**Length of Period:** 43 minutes
Classification: Elective	**Total Instructional Time:** 193.5 hours

Course Description

This is an advanced course designed to prepare students for the Advanced Placement (AP) Calculus AB 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; 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	Flexible Groups	Projects
Assessments	Graphic Organizers	Teacher Demonstrations
Bell Ringers	Guided Practice	Technology Integration
Class Discussions	High-Level Questioning	Videos/DVD's
Closure	Homework	Wait Time
Critical Thinking	Posted Objectives	

Assessments

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

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

Adopted: 5/21/2012
Revised: 5/20/2019

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Functions and Relations/Trigonometry

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
Functions and Relations/Trigonometry <u>Related Vocabulary:</u> function piecewise function trigonometric function even/odd function inverse function unit circle domain/range trigonometric identity end behavior <u>Essential Questions</u>: How do you sketch different types of functions, including piecewise and trigonometry functions?	**2.8.11.J** - Demonstrate the connection between algebraic equations and inequalities and the geometry of relations in the coordinate plane. **2.8.11.O** - Determine the domain and range of a relation, given a graph or set of ordered pairs. **2.8.11.Q** - Represent functional relationships in tables, charts and graphs. **2.8.11.S** - Analyze properties and relationships of functions (e.g., linear, polynomial, rational, trigonometric, exponential, and logarithmic). **2.8.11.T** - Analyze and categorize functions by their characteristics. **2.10.11.B** - Identify, create, and solve practical problems involving right triangles using the trigonometric functions and the Pythagorean Theorem. The students will be able to: • Evaluate functions • Determine if a relation is a function • Evaluate piecewise functions • Graph piecewise functions • Find the domain and range of a function • Define ‘even’ and ‘odd’ functions • Find the inverse of a function given its equation • Find the inverse of a function given a table of values • Transform functions graphically given their equation • Define coterminal angles • Memorize the unit circle • Use the unit circle to evaluate trigonometry functions • Memorize trigonometric formulas • Simplify trigonometric expressions • Evaluate inverse trigonometric functions • Graph trigonometric functions

Equations, Limits, Continuity	
CONTENT/KEY CONCEPTS	**OBJECTIVES/STANDARDS**
Limits Continuity <u>Related Vocabulary:</u> limit continuous Extreme value theorem maximum/minimum Intermediate value theorem limit table one-side limit <u>Essential Questions:</u> What is the limit of a function and how do you test for it? How do you determine if a function is continuous?	The students will be able to: • Find limits using a table • Evaluate limits analytically • Define continuity • Find discontinuities of functions • Find a value to make a piecewise function continuous • State the Extreme value theorem. • Use the Extreme value theorem to find maximums and minimums • State the Intermediate value theorem • Use the Intermediate value theorem to go solve problems involving continuous functions

Limits, Derivatives

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
Limits Involving Infinity Special Limits Derivatives <u>Related Vocabulary</u>: vertical asymptote infinite limits difference quotient derivative tangent line instantaneous rate of change average rate of change product rule quotient rule one-side limit <u>Essential Questions:</u> What are the strategies that should be used when evaluating limits? What is the derivative of a function?	The students will be able to: • Find where functions have vertical asymptotes • Find limits as x approaches infinity • Determine where a function has a vertical asymptote • Find limits involving variable exponents (e) • Apply limit as a -> 0, (sina/a) = 1 to trigonometric limits • Apply limit as a-> 0, (cosa – 1)/a = 0 to trigonometric limits • Evaluate limits with a graphing calculator • State the difference quotient • Apply the difference quotient to find slope of tangent line • Define the derivative as the instantaneous rate of change • Find the average rate of change of a function • Find where the derivative fails to exist • Memorize common derivatives • Apply the power rule when taking the derivative • Apply the product rule when taking the derivative • Apply the quotient rule when taking the derivative

Derivatives, Differentiation

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
Derivatives Differentiation <u>Related Vocabulary:</u> derivative chain rule implicit differentiation normal lines inverse function linear approximation higher order derivative <u>Essential Questions:</u> What is the derivative of a function? How do you find the derivative of a function using the limit process? What are some strategies that can be used when finding the derivative of a function?	The students will be able to: • Apply the chain rule when taking the derivative • Find higher order derivatives • Approximate derivative given a table of values • Find numerical derivative on a calculator • Take the derivative of one variable with respect to another • Find the implicit derivative of a function • Apply implicit differentiation to find the slope of a tangent line • Find the derivative of an inverse function • Find the linear approximation of a function • Use L'Hopital's rule to find limits using derivatives of quotients

Derivative, Integration

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
Applications of the Derivative Integration <u>Related Vocabulary:</u> implicit differentiation related rates Mean Value Theorem first derivative test second derivative test position velocity acceleration integration optimization rate of change instantaneous rate of change average rate of change Riemann sum Fundamental Theorem of Calculus <u>Essential Questions:</u> What is a related rates problem and how do you solve it? How do you find extreme of a function? What is optimization and what process should be used when solving an optimization problem? What is integration and what does it calculate?	**2.11.11.A** - Determine maximum and minimum values of a function over a specified interval. **2.11.11.B** - Interpret maximum and minimum values in problem situations. **2.11.11.E** - Estimate areas under curves using sequences of areas. The students will be able to: • Use implicit derivatives to solve related rates problems • State Rolle's theorem • State the Mean Value Theorem • Use the Mean Value Theorem to find where the zeros of a function exist • Use the first derivative test to describe a function • Use the second derivative to find the concavity of a function • Apply the first and second derivative test to solve problems involving motion • Use the first derivative in problems involving optimizing • Model particles movement with a graphing calculator • Find basic antiderivatives using the power rule • Use rules of integration to find antiderivatives • Approximate the area of a region using Riemann sums • Approximate the area of a region using the trapezoidal rule • State the Fundamental Theorem of Calculus (FTC) • Use the Fundamental Theorem of Calculus to find the exact area under a curve • Use Second FTC to evaluate accumulating functions

Integration

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
Integration Advanced Methods of Integration <u>Related Vocabulary:</u> average value Second Fundamental Theorem of Calculus definite integral u-substitution inverse trigonometric functions antiderivative exponential function logarithmic function integration by parts <u>Essential Questions:</u> What is integration and what does it calculate? What strategies should be followed when integrating a function?	The students will be able to: • State the Mean Value Theorem for integration • Use the Mean Value Theorem to find the average value of a function • Use U-substitution to evaluate integrals • Integrate inverse trigonometric functions • Evaluate definite integrals with graphing calculators • Use trigonometric substitution to find an antiderivative • Split an integral into parts to find an antiderivative • Use algebraic long division to find an antiderivative • Complete the square to find an antiderivative • Add equal values to find an antiderivative • Integrate exponential functions • Integrate logarithmic functions • State the Integration by Parts formula • Use integration by parts to find an antiderivative • Find the derivative of a higher order trigonometry function • Use partial fractions to find an antiderivative • Solve improper integrals • Draw integrations and derivative graphs with a calculator

Integration, Equations

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
Applications of Integration Differential Equations <u>Related Vocabulary:</u> slope field exponential growth/decay differential equation <u>Essential Questions:</u> What is a differential equation and how do you solve it? How do you create a slope field and what does it show? How do you find the area between two curves?	**2.11.11.C** - Graph and interpret rates of growth/decay. **2.11.11.E** - Estimate areas under curves using sequences of areas. The students will be able to: • Separate variables to find a function given its derivative • Draw a slope field given differential equation • Analyze a slope field given its graph • Use differential equations to solve exponential growth and decay problems • Use differential equations to solve logistic growth problems • Find the area between two curves

Shell/Disc Method for Integration

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
Integration Volumes of Solids <u>Related Vocabulary:</u> disc method washer method shell method cross section axis volume revolution integration with respect to an axis transformation <u>Essential Questions:</u> How do you calculate volumes of solids revolving around an axis? When do you use the disc, washer, and shell methods? How do you use cross sections to calculate volume?	**2.11.12.E** - Describe the method for estimating the area under curves and apply to real world situations. The students will be able to: • Use the disc and washer method to find volume • Use the shell method to find volume • Use cross sections to find volume

AP Exam Practice

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
AP Exam Practice Limits Derivatives Integration <u>Related Vocabulary:</u> open response qwerty keyboard set up but don't evaluate written explanation <u>Essential Questions:</u> How do you approach an open response question? How do you approach the multiple choice calculator/non-calculator questions on the AP exam? How do you derive/integrate/solve equations on your graphing calculator?	**2.11.11.A** - Determine maximum and minimum values of a function over a specified interval. **2.11.11.B** - Interpret maximum and minimum values in problem situations. **2.11.11.C** - Graph and interpret rates of growth/decay. **2.11.11.D** - Determine sums of finite sequences of numbers and infinite geometric series. **2.11.11.E** - Estimate areas under curves using sequences of areas. The students will be able to: • Solve open response questions on past AP exams • Solve multiple choice questions on past AP exams without a calculator • Solve multiple choice questions on past AP exams with a calculator

Beyond the Exam

CONTENT/KEY CONCEPTS	OBJECTIVES/STANDARDS
Newton's Method Newton-Raphson Method Summation <u>Related Vocabulary:</u> zero of a function index lower bound upper bound <u>Essential Questions:</u> What is Newton's Method? What is the Newton-Raphson Method? How is summation used in calculus?	**2.11.12.D** - Create, write, and solve real-world application problems that demonstrate an under-standing of arithmetic and geometric sequences and series. The students will be able to: • Use Newton's Method to approximate the zeros of a function • Find the sum of a series