**Curriculum**

**Advanced Placement Calculus AB**

**Course Overview**

This is a full-year course for those students who have successfully completed a full-year Pre-Calculus course with at least a "B-" average. The course includes a study of limits, and differential and integral calculus of elementary functions and their applications. This course prepares students for the Advanced Placement Calculus AB Examination in May. A TI-83+ or TI-84+ is required for this course.

**Department Standards**

Students will be able to comprehend mathematical concepts.

Students will apply mathematical procedures accurately, efficiently, and appropriately.

Students will be able to formulate, represent, and solve mathematical problems.

Students will develop logical mathematical thought and precise mathematical communication.

**Benchmarks**:

Students will be able to:

manipulate functions represented in a variety of forms;

understand the meaning of the derivative in terms of linear approximation; instantaneous rate of change, and be able to use derivatives to solve problems from multiple disciplines;

understand the meaning of the definite integral in terms of Riemann Sums and net accumulation of change and be able to solve problems from multiple disciplines;

understand the connection between the definite integral and the derivative as stated in the Fundamental Theorem of Calculus;

appropriately communicate mathematics;

create mathematically appropriate models for given basic physical phenomena.

Students should be able to check answers against several criteria e.g. sign, size, units;

use technology when appropriate; and

develop an appreciation of calculus as a coherent body of knowledge and as a human accomplishment.

**Performance Indicators**

First Quarter

Students will be able to:

define a sequence and the limit of a sequence;

compute the limits of basic sequences;

state the sequential definition of the limit of a function and use it to guess the limit of certain functions numerically using tables. (Note: This is not the epsilon-delta definition of the limit of a function.); state the limit laws and the conditions for which the laws are applicable;

use limit laws to compute the limiting value of a function for a given limit point as appropriate;

define the one-sided limit of a function in terms of the the sequential definition of the limit of a function to guess limit values;

state and use theorems for infinite limits and limits at infinity in terms of one-sided limits;

define the continuity of a function at a point and on a closed interval;

state the Extreme Value and Intermediate Value theorems and their implications for continuous functions on closed intervals;

define the derivative for both as h approachs 0 and as x approaches a;

compute the derivative values of functions for specific values;

derive the general equation of the derivative of a function, particularly for sine, cosine and tangent, using the definition;

explain the geometric significance of the derivative of a function at a particular point, as well as writing the equation of the line tangent to the graph of the function at a particular point;

state the differentiation laws and the conditions for which the are applicable, as well as using them for computing the derivative values of functions at certain points or for determining general derivative equation for various functions;

and

compute higher derivatives.

Second Quarter

Students will be able to:

utilize or apply quarter 1 performance indicators in an appropriate manner;

specify intervals for which a function is monotonic by using the definition of monotonicity and the function's first derivative;

specify intervals on which a function is concave up, concave down or neither by using the definition of concavity and the second derivative test;

find local and absolute extrema through appropriate analysis including the first and second derivative tests; Determine possible graphs of f, f', or f'' when given the graph of f, f', or f'';

perform appropriate analysis to sketch the graphs of certain functions without the aid of technology;

solve various types of optimization problems such as finding the maximum area of a rectangle given a fixed perimeter; Compute related rates using 1, 2 or 3 constraint equations;

describe the properties and relationships of position, velocity and acceleration for an object undergoing one-dimensional motion; and

determine or compute position, velocity and acceleration functions for an object undergoing one-dimensional motion using principles from calculus.

Third Quarter

Students will be able to:

identify the region defined by a particular definite integral;

construct some infinite sums to compute the value of certain definite integrals;

explain that an integral is the limit of the Upper Darboux Sum and the Lower Darboux sum as... or the limit of the Riemann sums as the norm of the partition approaches zero;

explain the relationship between integration and differentiation using the Fundamental Theorem of Calculus and consequently, can explain why the Fundamental Theorem is so important and hence, "fundamental";

compute definite integral values using the Fundamental Theorem of Calculus;

integrate indefinite integrals by antidifferentiating as established by the Fundamental Theorem of Calculus;

integrate definite and indefinite integrals using the technique of integration by substitution;

draw slope fields and explain their relationship to the differential equation that generated it and the solutions to the differential equation;

find general or particular solutions to given separable differential equations; and

derive the exponential growth/decay function from its separable differential equation.

Fourth Quarter

Students will be able to:

complete review for AP Calculus AB Exam;

compute integral values using Integration by Parts;

compute integral values using Integration by substitution;

identify improper integrals and explain why the integral is improper;

determine the convergence or divergence of an improper integral; and

compute integral values of convergent improper integrals.

**Assessments**

Homework

Weekly quizzes

Test 1 emphasizing limits. Some precalculus concepts included.

Test 2 Differentiation. Some precalculus concepts included.Test 3 Differentiation. All tests are hierarchical and may include any prior knowledge.

Test 4 Differentiation and Its Implications. All tests are hierarchical and may include any prior knowledge.Test 5 Integral Calculus

Test6 Integral Calculus and Differential Equations, Comprehensive Preparatory ExamsMock AP Examination

AP Examination

Test over integration techniques

More Tests may be given as appropriate

**Core Topics**

Functions

Limits

Derivatives

Differentiation and function propertiesIntegral Calculus

Differential Equations, AP Exam ReviewReview for AP Exam

Integration by Parts

Improper Integrals

Integration by Partial Fractions.

**Specific Content**

Sequences and the definition of the limit of a sequence.

The sequential definition of the limit of a function.

Limit laws.

Continuity.

Vertical and Horizontal Asymptotes defined in terms of the limit of a function.

The definition of the derivative.

The differentiation laws.

Quarter 1 content as appropriate.

Function properties defined in terms of its first and second derivatives.

Rolle's Theorem and the Mean Value Theorem.

The relationship between the values and graphs of f, f', f''.

Curve Sketching.

Optimization.

Differentials & Implicit Differentiation.

Related Rates.

Application problems with particular emphasis from physics.

Quarter 1 and 2 content.

Construction and Definition of the Integral Fundamental Theorem of Calculus.

Antiderivatives.

Integration by Substitution.

Separable Differential equations.

Exponential Growth and Decay.

Application problems from physics and as appropriate selected by the teacher.

Quarter 1, 2 and 3 content.

Final preparations for AP Calculus AB exam.

Integration by Parts.

Integration by Partial Fractions.

Improper Integrals.

**Resources**

throughout the year:

www.wolframalpha.com.

graphing calculator.