**AP®Calculus AB**

**Syllabus**

**Course Overview**

My main objective in teaching AP®Calculusis to enable students to appreciate the beauty of calculus and receive a strong foundation that will give them the tools to succeed in future mathematics courses. Students know that they will work harder than ever, and our expectation is that this hard work will enable them to succeed in the course. We will work together to help students discover the joys of calculus.

**Course Profile**

Successful completion of the AP Calculus AB course will require students to have excellent attendance as well as good study habits and a willingness to participate in class discussions, both verbally and in writing. It is the goal of this course to assist students with development in the following areas:

• To become familiar with the four ways of representing a function: verbally, visually (using graphs), numerically, and analytically, with a deeper understanding of the relationship between these concepts.

• To improve on the ability to explain solutions to problems verbally and in written form, using proper terminology.

• To become familiar with the derivative of a function and use derivatives to solve problems.

• To recognize the connection between the derivative and the definite integral.

• To model problems using a function, differential equation, or by integration.

• To utilize graphing technology when problem-solving, in explorations, and to investigate results of data and other information.

• To support, confirm, or discredit the accuracy of solutions.

• To learn about early mathematicians and their role in the development of calculus.

• To build a strong foundation in preparation for the rigor of college mathematics.

• To learn team-building skills and cooperative techniques in problem-solving.

The current trend in mathematical instruction concentrates on four areas in the development of

problem-solving skills. These are:

1) Numerical analysis involving data;

2) Graphical analysis;

3) Analytic or algebraic analysis involving manipulation of expressions; and

4) Verbal and written expression, incorporating validation of individual thought processes in problem-solving. [c3]

It is my hope that the course will assist students with personal growth in each of these areas.

**Textbook:**

Finney, Ross L., Franklin D. Demana, Bert K. Waits, and Daniel Kennedy.

*Calculus-Graphical, Numerical, Algebraic.* Prentice Hall, 2010.

C3= The course provides Students with the opportunity

to work with functions

represented in a variety of ways- graphically, numerically, analytically, and verbally-and

emphasizes the connections among these representations \_

**Supplemental materials:**

Smith, Robert T., and Minton, Roland B. AP Calculus AB/BC Instructor’s Resource

Guide to accompany *Calculus-Early Transcendental Functions.* 3rd ed. McGraw Hill,

2007.

This resource guide provides a rich source of student activities designed to enhance student understanding of the topics and applications of AB Calculus.

**Technology Requirement**

The students will be required to have a Tl-83 or Tl-84 graphing calculator for use in the classroom and at home. The Tl-89 and TI-Nspire will also be recommended for use. There are a limited number of Tl-83 and Tl-84 calculators available for classroom use. We will use the calculator to conduct explorations, graph functions within arbitrary windows, solve equations numerically, analyze

and interpret results, and to justify and explain results of graphs and equations. [C5]

C5-The course teaches

students how to use graphing calculators to help solve problems, experiment, interpret results, and support conclusions.

**Course Planner**

Students are expected to complete Chapter 1of the textbook, Prerequisites for Calculus, during the summer months prior to the beginning of the school year. This chapter includes a review of lines, functions and graphs, exponential functions, parametric equations, logarithms,

and trigonometric functions. A review of the topics will be conducted during the first week of school.

Chapter 2: Limits and Continuity (3-4 weeks) [C2] C2- The course

2.1 Rates of Change and Limits teaches

• Average Speed all topics associated with Functions,

• Instantaneous Speed Graphs,

• Properties of Limits as x c and Limits; Derivatives,

• Limits at a Point Integrals, and

 Polynomial

• One-sided and Two-sided Limits Approximations and

• Sandwich Theorem Series as delineated in the Calculus Topic Outline in the *AP Calculus Course Descriptions*

Supplemental Material-AP Calculus Instructor's Resource Guide-Student Activities.

• How Many Fish in the Lake, [C4]

• Order of Magnitude of a Function [C3] [C5]

2.2 Limits Involving Infinity

• Horizontal and Vertical Asymptotes

• Properties of limits as x±∞

• Visualizing limits (graphical analysis)

• End behavior models

Supplemental Material-AP Calculus Instructor's Resource Guide­ Calculus AB/BC Topics - Multiple Choice Questions

C4-The course

teaches students

how to communicate mathematics and explain

solutions to problems both verbally, and in written sentences.

2.3 Continuity

• Continuity at a point

• Continuous functions

• Discontinuous functions

• Removable discontinuity

• Jump discontinuity

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• Infinite discontinuity

2.4 Rates of Change and Tangent Lines

• Average rate of change

• Tangent line to a curve

• Slope of a curve (algebraically and graphically)

• Normal line to a curve (algebraically and graphically)

• Instantaneous rate of change

Supplemental Material-AP Calculus Instructor's Resource Guide-Student Activity

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• The Slope Function

Chapter 2 Test

Chapter 3: Derivatives (6 weeks) IC2l

3.1 Derivative of a Function

• Definition of derivative (difference quotient)

• Derivative at a Point

• Notations for the derivative

• Relationships between the Graphs off and f'

• Graphing the Derivative from Data

• One-sided derivatives

C2- The course teaches

all topics associated with Functions, Graphs,

and Limits; Derivatives; Integrals; and Polynomial Approximations and Series as delineated

in the Calculus Topic

Outline in the *AP Calculus*

*Course Description.*

Supplemental Material-AP Calculus Instructor's Resource Guide-Student Activities:

• **Visualizing Derivatives with a Calculator and on the Board [C5**]

3.2 Differentiability

• How F '(a) -the derivative-Might Fail to Exist

• Differentiability Implies Local Linearity

• Derivatives on a Calculator

• Symmetric Difference Quotient (Analytical investigation)

• Differentiability Implies Continuity

• Intermediate Value Theorem for Derivatives

Supplemental Material-AP Calculus Instructor's Resource Guide-Student Activity:

• Differentiability and Local Linearity [C5]

3.3 Rules for Differentiation

• Constant, Power, Sum, Difference, Product, and Quotient Rules

• Negative Integer Powers of x

• Second and Higher Order Derivatives

Supplemental Material-AP Calculus Instructor's Resource Guide-

Calculus AB/BC Topics- Multiple Choice and Free-Response Questions [C4l

3.4 Velocity and Other Rates of Change (Applications of the Derivative)

• Instantaneous Rates of Change

• Motion along a Line

• Speed, Acceleration, Free-fall Constants

• Particle motion

• L'HOpital's Rule

• Derivatives in Economics

• Marginal Cost and Marginal Revenue

Supplemental Material-AP Calculus Instructor's Resource Guide-Student Activities:

• Reasoning from a Graph -Matching Game [C3]

C5- The course teaches students how to use graphing calculators to help solve problems, experiment, interpret results, and support conclusions.

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• Demonstrating Particle Motion on a Line [C5]

3.5 Derivatives of Trigonometric Functions

• Derivatives of Sine and Cosine

• Simple Harmonic Motion and Jerk

• Derivatives of the Other Basic Trigonometric Functions

3.6 Chain Rule

• Applications

• Power Chain Rule

Supplemental Material-AP Calculus Instructor's Resource Guide­ Multiple Choice and Free-Response Questions

3.7 Implicit Differentiation

• Differential Method

• Lenses, Tangents, and Normal Lines

• y' Method

3.8 Derivatives of Inverse Trigonometric Functions

3.9 Derivatives of Exponential and Logarithmic FunctionsSupplemental Material-AP Calculus Instructor's Resource Guide­ Multiple Choice and Free-Response Questions [C4l

Chapter 3 Test

Chapter 4: Applications of Derivatives (6 weeks) [C21

4.1Extreme Values of Functions

• Absolute and Local Extrema

• Extreme Value Theorem

• Definition of critical point

• Finding extreme values graphically, analytically, and numerically

4.2 Mean Value Theorem

• Rolle's Theorem

• Applications

• Physical Interpretations

• Increasing and decreasing functions

• Definition of Antiderivative

4.3 Connecting f ' and f " with the Graph off

• First Derivative Test for Local Extrema

• Concavity

• Concavity Test

• Inflection points

• Second Derivative Test for Local Extrema

• Behavior off' and f"

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in the Calculus

Topic Outline in the

*AP Calculus Course*

*Description.*

**4.4 Modeling and Optimization**

• Examples from Business and Industry:

• Fabricating a Box

• Designing a Can

• Strategies for Solving Max-Min Problems

• Examples from Mathematics and Economics

• Maximizing Profit

• Minimizing Cost

**4.5 Linearization and Newton's Method**

• Local linearization

• Tangent line approximation

• Differentials

**4.6 Related Rates**

* ***Tootsie Roll Pops Lab (see student activity 2)***

**Chapter 4 Test**

**Chapter 5: The Definite Integral (4 weeks)** [C2]

**5.1Estimating with Finite Sums**

• Rectangular Approximation Method (RAM)

• Left sums (LRAM) and Right sums (RRAM)

• Midpoint sums (MRAM)

• Velocity and Volume problems

**5.2 Definite Integrals**

• Riemann sums

• Terminology and Notation

• Area Under a Curve

• Integrals on a Calculator [C5]

• Discontinuous Functions

**5.3 Definite Integrals and Antiderivatives**

• Properties of Definite Integrals

• Mean Value Theorem for Definite Integrals

• Connecting Differential and Integral Calculus

Exploration Activity: Finding the Derivative of an lntegral [C3]

**5.4 The Fundamental Theorem of Calculus**

• Part 1

• Part 2

• Graphing Integral Functions

• Applications

Supplemental Material-AP Calculus Instructor's Resource Guide­ Student Activity-What's an Accumulator?

Calculus AB/BC Topics Multiple Choice and Free-Response Questions [C4l

**5.5 Trapezoidal Rule**

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• Trapezoidal Approximations

• Simpson's Rule

• Error Analysis

**Chapter 5 Test**

**Chapter 6: Differential Equations and Mathematical Modeling (4 weeks)** [C2l

**6.1 Antiderivatives and Slope Fields**

• Constructing Slope Fields

• Antiderivatives and Indefinite integrals

• Indefinite Integral Formulas and Properties

• Applications

• The Tank Problem

• The Projectile Model

Supplemental Material-AP Calculus Instructor's Resource Guide-Student Activity:

• Investigating Slope Fields

**6.2 Integration by Substitution**

• Trigonometric formulas

• Substitution in Indefinite and Definite Integrals

• Solving by Separation of Variables

Supplemental Material-AP Calculus Instructor's Resource Guide-

Calculus AB/BC Topics Multiple Choice and Free-Response Questions [C4]

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written sentences.

6.3 **Integration by Parts (after AP exam)**

Supplemental Material-AP Calculus Instructor's Resource Guide-Student Activity:

• Tabular Integration by Parts

**6.4 Exponential Growth and Decay**

• Law of Exponential Change

• Continuously Compounded Interest

• Radioactivity

• Newton's Law of Cooling

• Resistance Proportional to Velocity

• Coasting

**6.5 Population Growth**

• Exponential Model

• Logistic Growth Model

• Logistic Regression

**6.6 Numerical Methods**

• Euler's Method and Improved Euler's Method

• Numerical Solutions

• Finding Graphical Solutions [C3][C5]

**Chapter 6 Test**

**Chapter 7: Applications of Definite Integrals (4 weeks) [**C2]

**7.11ntegral as Net Change**

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• Calculating Distance Traveled (particle motion)

• Consumption over Time

• Net Change from Data

• Work

7.2 **Areas in the Plane**

• Area Between Curves

• Area Between a Curve and an Axis

• Integrating With Respect To *x*

• Integrating With Respect To *y*

7.3 **Volumes**

• Geometric Cross Sections (Square, Circular)

• Cylindrical Shells

• Washers

**7.4 Lengths of Curves**

• A Sine Wave

• Length of a Smooth Curve

• Vertical Tangents, Corners, and Cusps

7.5 **Applications from Science and Statistics**

• Work

• Fluid Force and Fluid Pressure

• Probability

**Chapter 7 Test**

**Review/Test Preparation (4 weeks).**

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**(Return This Page Only)**

I have read the expectations, the grading procedures, discipline, and other important rule. I will definitely contact the teacher if there are any concerns.

Parent(s)/Guardian (s) Printed Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Parent(s)/Guardian(s) Signature\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Student’s Printed Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Student’s Signature\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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