Booker T. Washington High School

Advanced Placement Calculus AB

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Course Description: Calculus AB is primarily concerned with developing the students' understanding of the concepts of calculus and providing experience with its methods and applications. The course emphasizes a multi-representational approach to calculus, with concepts, results, and problems being expressed graphically, numerically, analytically, and verbally. The connections among these representations also are important. Broad concepts and widely applicable methods are emphasized. The focus of the course is neither manipulation nor memorization of an extensive taxonomy of functions, curves, theorems, or problem types. Thus, although facility with manipulation and computational competence are important outcomes, they are not the core of this course.

Major Textbook: Stewart, James. Franklin D. Demana, Bert K. Waits, and Daniel Kennedy. *Calculus.* 6th ed. Thomson Brooks/Cole, 2008.
Cost: $138.90

Supplementary Material:

Kahn, David, *The Princeton Review Cracking The AP Calculus AB & BC Advanced Placement Exam.* 2000 -2001 Edition Random House, Inc. New York

Hockett, Shirley O. and Bock, David, *Barron's How To Prepare For The AP Calculus Advanced Placement Examination.* 7th Edition. Barron's Educational Series, Inc., 2002

CollegeBoard AP Central at Http://apps.apcentral.collegboard.com

Partnership for Reform in Science and Mathematics at PRISM-Evaluation@usg.edu

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Course Expectations:

- Students should be able to work with functions represented in a variety of way; graphical, numerical, analytical, or verbal.
- Students should understand the meaning of the derivative in terms of a rate of change and local linear approximation and should be able to use derivatives to solve a variety of problems.
- Students should understand the meaning of the definite integral both as a limit Reimann sums and as the net accumulation of change and should be able to use integrals to solve a variety of problems.
- Students should understand the relationship between the derivative and the definite integral as expressed in both parts of the Fundamental Theorem of Calculus.

- Students should be able to communicate mathematics orally and in well-written sentences and should be able to explain solutions to problems.
- Students should be able to model a written description of a physical situation with a function, a differential equation, or an integral.
- Students should be able to use technology to help solve problems, experiment, interpret results, and verify conclusions.
- Students should be able to determine the reasonableness of solutions, including sign, size, relative accuracy, and units of measurement.
- Student should develop an appreciation of calculus as a coherent body of knowledge and as human accomplishment.

Course Content:

Prerequisites for Calculus

1. Determine and set appropriate viewing windows for indicated points and complete graphs of linear, quadratic and cubic equations.
2. Estimate graphically and confirm algebraically the coordinates of the intercepts and any high and low points of graph.
3. Write the equation of a line given specific information and sketch a complete graph.
4. Find the distance from a line to a point not on the line.
5. Identify a relation or function from a graph or equation and determine its domain and range.
6. Identify and describe symmetries in graphs and equations and relate those symmetries to those of even and odd functions.
7. Use the sum, difference, product and quotient properties to write and evaluate the composition of two functions.
8. Interpret and find formulas for piecewise-defined functions.
9. Determine the graph of a function by applying geometric transformation.
10. Describe and analyze the sequence of geometric transformations needed to obtain the graph of a function.
11. Solve equations and inequalities using algebraic and graphical techniques.
12. Determine the algebraic representation and geometric representation of a function and its inverse, and state whether a function is one to one.
13. Manipulate and interpret the equation and geometric representation of a circle.
14. Convert between radians and degrees and find arc length.
15. Find values for six trigonometric functions and explore various transformations upon these graphs.
16. Generate the graphs of the trigonometric functions and explore various transformations upon these graphs.

Limits and Continuity

1. Define and calculate limits for function values.
2. Use the concept of limit to test functions for continuity.
3. Define continuity and apply the tests for continuity for functions.
4. Write composites of continuous functions.
5. Define and apply the Sandwich Theorem to determine some limits.
6. Demonstrate what is means for the values of a function to approach infinity.
7. Demonstrate what it means for a function f (x) to have a limit as x approaches infinity.
8. Use a graph to determine how to control the variable x in order to keep the function f (x) within some predetermined target value.
9. Use algebra to confirm that the variable x should be controlled in order to keep the function f (x) within some predetermined value.
10. Define limit.

11. Test the definition of limits by application.
12. Find deltas for given epsilons.

Derivatives

1. Estimate the slope of a curve at an indicated point.
2. Use the definition of the derivative to find the slope of the tangent line to a point on a curve and determine the equation of the tangent line.
3. Approximate derivatives numerically.
4. Construct graphs of derivatives using numerical approximations.
5. Use the rules of differentiation to calculate derivatives.
6. Apply derivatives in straight- line motion and other rates of change problems.
7. Use the rule or differentiating the six basic trigonometric functions.
8. Differentiate composite functions using the Chain Rule.
9. Find the derivative using implicit differentiation.
10. Find the derivative using the power rule for fractional exponents.
11. Investigate the linearization of a function at a point.
12. Estimate change in a function value with differentials.

Applications of Derivatives

1. Determine the local extreme of a function.
2. Determine the intervals where a function increases or decreases.
3. Determine the concavity of a function and locate points of inflection by analyzing the second derivative.
4. Use the First and Second Derivative Tests for determining the local extrema of a function.
5. Determine the complete graph of a function by analyzing the first and second derivatives.
6. Apply previously established curve-sketching techniques to polynomial functions.
7. Use Newton's method to approximate the zeros of a function.
8. Develop a strategy to solve maxima or minima problems that model real situations.
9. Sketch complete graphs of rational functions.
10. Solve optimization problems that occur in industry and economics.
11. Analyze and graph functions whose expressions involve radical, trigonometric, logarithmic, or exponential functions.
12. Solve maxima or minima problems that model radical trigonometric, logarithmic, or exponential functions, using numerical derivations if necessary.
13. Solve related rate problems.
14. Find general anti-derivatives and linear combinations of certain functions.
15. Solve initial value problems.

Integration

1. Approximate the area under the graph of a nonnegative continuous function by using rectangle approximation methods.
2. Find the sum of a series written in sigma notation.
3. Express the definite integral as a limit of Riemann sums.
4. Express the area under a curve as a definite integral.
5. Compute the area under a curve using a numerical integration procedure.
6. Apply the rules of definite integrals to evaluate integrals and find areas under curves.
7. Find the average value of a function over a closed interval.
8. Compute the area under a curve using antiderivatives.

9. Use the Fundamental Theorem of Calculus to establish the link between differential and integral calculus.
10. Compute the definite integral by using the Fundamental Theorem of Calculus.
11. Apply definite integrals in business applications.
12. Apply the formulas and rules for indefinite integrals and antiderivatives.
13. Apply indefinite integrals to solve initial value problems.
14. Apply the power rule to compute indefinite and definite integrals.
15. Find indefinite and definite integrals of trigonometric integrands.
16. Use the substitution method of integration to find antiderivatives.
17. Approximate the definite integral by using the Trapezoidal rule.

Applications of Definite Integrals

1. Find the area between two curves.
2. Find the volume of a solid of revolution using the disk method.
3. Find the volume of a solid of revolution using the washer method.
4. Find the volume of a solid revolution using the shell method.
5. Compute the length of a curve.
6. Find the surface area of revolution about the x-axis.
7. Find the surface area of revolution about the y-axis.
8. Find the volume of a solid with known cross-section.
9. Compute the total distance traveled by a particle along a coordinate line.
10. Apply the definition and properties of natural logarithms in problem solving.
11. Calculate derivatives involving the natural logarithms.
12. Perform logarithmic differentiation.
13. Use integration techniques involving natural logarithms.
14. Apply the definition and properties of exponential functions in problem solving.
15. Solve logarithmic and exponential equations.
16. Differentiate and integrate expressions involving exponential functions.
17. Solve applied problems involving exponential change.
18. Apply the definition and properties of exponential and logarithmic functions in any base to problem solving.
19. Differentiate and integrate exponential and logarithmic functions to any base.
20. Apply the law of exponential change to problem situations.
21. Find limits of indeterminate forms using L'Hopital's rule.
22. Determine, investigate, and compare rates of growth.
23. Apply the definitions and properties of the inverse trigonometric functions.
24. Evaluate expressions involving inverse trigonometric functions.
25. Differentiate inverse trigonometric functions.
26. Compute integrals leading to inverse trigonometric functions.
27. Evaluate indefinite integrals by using substitution.
28. Evaluate indefinite integrals by completing the square.
29. Evaluate indefinite integrals and support results numerically.
30. Use integration by parts to evaluate indefinite and definite integrals.
31. Construct slope fields using technology and interpret slope fields as visualizations of differential equations

Course Content Plan/Pacing Guide:

Topic	Days

Prerequisites for Calculus	5
Limits and Continuity **Approaching Limits Activity**	7
Derivatives (Rules/Trig. Functions/Chain Rule/Implicit) **Local Linearity Activity**	12
Rectilinear Motion **Position, Velocity, Acceleration Activity**	3
Related Rates	3
Linear Approximations/Differentials	1
Extrema/Mean Value Theorem **Graphing Relationships Activity**	3
Concavity/Asymptotes **Find My Derivative Activity**	3
Optimization Problems **Cylinder Problem**	3
Antiderivatives **Find My Function Activity**	2
Indefinite Integrals	5
Integral/ Area **The Pump and The Airplane Activity**	5
Definite Integrals (FTC/ Substitution)	5
Area Between Curves	3
Volumes of Revolution	5
Inverse/Logarithmic Functions (Differentiation)	2
Inverse Trigonometric Functions	2
Differential Equations/Slope Fields	2
AP Calculus Exam Review	12

Graphing Calculator Content Plan:

A student enrolled in an AP Calculus class must be able to perform certain operations on the calculator. The student's conceptual understanding of the mathematics is necessary to perform the operations. Use of the graphing calculator is essential throughout the year to ensure that the students fully understand the required objectives. Listed below is the time frame for certain topics for the calculator portion of the AP Exam.

Finding the zeros of a function
Finding the coordinates of the vertex of parabolas.
Finding the points of intersection of two curves.
Calculating limits using the table function.
Finding the intercepts of a function.
Find the value of x for which a function equals a particular value of y.
Finding the numerical derivative of a function in Y1.
Graphing the first and second derivative of a function in Y1.
Drawing a tangent line to a curve using the DRAW function.
Finding the value of "c" satisfying the Mean-Value Theorem for a given function and given integral.
Finding the numerical value of an integral.
Calculating the area under the curve.
Calculating the $L_{f,}$ U_f, midpoint sum, right sum, left sum and trapezoidal sum.
Calculating the area between two curves.
Calculating the average value of a function over a given interval.
Calculating the average value of a function over a given interval.
Calculating volumes of revolution.
Graphing slope fields
Graphing the solutions to differential equations on a given slope field.

Teaching Strategies: Instructional methods will include the rule of four: students are expected to demonstrate their understanding verbally, numerically, analytically, and graphically. Students will be taught to use the TI-84 graphing calculator and technology-based explorations, modeling, and applications are emphasized throughout the course. The relationship between these representations will also be integrated in the lessons. To ascertain what topics need further discussion and which individuals require additional help, students will solve problems on the board and explain them to their classmates. They are expected to work problems using proper notation and explain solutions using correct vocabulary terms. There will be a combination of direct instruction, hands on and exploration activities that encourage discovery learning, cooperative learning situations, and real-world problem solving. Students are strongly urged to form study groups.

Student Activities:

1. **Approaching Limits:** Students' will investigate, both graphically and numerically, the limit of a function at a point. They will examine how a function behaves as the input approaches a particular value. They will estimate limits from graphs, and tables of values.

2. **Local Linearity:** Students will graph $y = \sin x$ and zoom in on a point a few times until they see that the graph becomes linear. Student will investigate functions. Student will try to find a function that does not become linear. Student will write the equation of the line that goes through the point at which they are zooming in, and has the same slope as the apparent slope of the line that appears after linearity is observed.

3. **Graphing Relationships:** Students explore information about a graph based on the first and second derivatives. They learn that a function's derivative is positive when the function increases and negative when the function decreases. They learn that the second derivative is positive when the graph is concave upward and negative when the graph is concave downward.

4. **Find My Derivative:** Prepare a set of graphs of functions and their derivatives. Each function and each derivative is graphed in the same window and printed on the card. Give each student the graph of a function and place the graphs around the room. Each student's job is to find the derivative of his or her function.

5. **Position, Velocity, Acceleration:** Students will model the motion of the particle based on the graph of the velocity.

6. **Cylinder Problem:** Students will build a family of cylinders and discover the relation between the dimensions of the generating rectangle and the resulting pair of cylinders. They will order the cylinders by their volumes and draw a conclusion about the relation between a cylinder's dimensions and its volume. They will also calculate the volumes of the family of cylinders with constant area. Finally, they will write the volumes of the cylinders as a function of radius and, using derivatives, find the cylinder with the greatest volume, given a fixed perimeter.

7. **The Pump and the Airplane:** Students will analyze data in given in a table and determine how many gallons of water are in the tank after a specified time interval. Students will analyze date in a given table and determine how far an airplane travels in three hours. Working in groups, students will intuitively find the answer. Discuss the methods of solution the students used. The groups must explain to the class what they did, why they did it, and how they can justify doing it that way.

8. **Find My Function:** Prepare a set of graphs of the function and the antiderivative. Each function and each antiderivative is graphed in the same window and printed on the card. Give each student the graph of the function and place the graphs around the room. Each student's job is to find the antiderivative of his or her function.

Grading Procedure:

The final grade for <u>AP Calculus AB</u> is computed as follows:

Class Work/Participation	25% (at least 18 per semester)
Homework/Notebook	10% (at least 18 per semester)
Quizzes	10% (at least 15 per semester)
Unit Tests	15% (at least 3 per semester)
Projects	20% (at least 2 per semester)
Final Exam	20% (1 per semester)

Grading Scale:

A: 90 – 100 B: 80 – 89 C: 70 – 79 F: 0 – 69

Deficiency Notices: A deficiency notice will be issued when a student's grade is 70 or less. These will be issued at least twice during the semester for these students. Expect a phone call to be made to your home in order to ensure that your parent/legal guardian has received the notice. Your progress can also be monitored through the parent portal of Infinite Campus. If you are struggling in class, you may be assigned a "mandatory tutorial" so we can address the concerns and help you get back on track. This tutorial session will be assigned for Tuesday after school. Deficiency notices will be given September 8th, November 11th, February 9th, and April 27th.

Parent Conferences: Weekly Parent Teacher Conference Day will be held on Thursdays 3:30p.m .–4:00p.m.

Parent Conference Night will be held on September 9th, November 11th, February 11th, and April 25th.

Rules & Expectations: Non Negotiables

1. **Students must enter classroom with all supplies.** Students will not be able to go to their locker to retrieve materials.
2. **Students must enter *on time* and *be on task when bell sounds.*** Students are expected to enter quietly and complete the sponge. Tardy students will not be allowed in class without a pass and will be upheld to the tardy policy.
3. **Students must be actively engaged in class 100% of the time** (this means student has their head up and is on task). Students not in compliance with this policy will face the following sequence of consequences:
    - Warning
    - Phone call home
    - Detention

4. No electronic devices should be visible during instruction time unless it is being used instructional for the lesson prepared by the teacher.

5. The "20/20 Rule" - Students may not leave the classroom during the first and last 20 minutes of class.

Attendance Policy: Students are expected to be in class on time, every day. Any day that a student is absent, he/she is expected to complete the class work and homework that was assigned on that day. **It is *the student's responsibility* to obtain all missed assignments!** All make-up work must be completed within a week of the absence.

I have read and understand the AP Calculus Course Syllabus.

Student's Printed Name:_____

Student's Signature: _____ Date:_____

Parent's/Guardian's Signature: _____ Date: _____

Parent's/Guardian's Printed Name: _____

Parent's/Guardian's Home Phone Number: _____

Parent's/Guardian's Cell/Alternate Phone Number: _____

Parent's/Guardian's Email: _____

Please write any comments or concerns in the space provided below.