Booker T. Washington Senior High School
Course Syllabus, 2020 - 2021

Course Title: AP Calculus AB/BC
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COURSE DESCRIPTION:
Advanced Placement Calculus consists of a full high school academic year of work that is comparable to a calculus course in colleges and universities. The course is primarily concerned with developing 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 are demonstrated through the unifying themes of derivatives, integrals, limits, approximation, applications, and modeling.

COURSE OBJECTIVES: (taken directly from College Board)
I. Functions, Graphs, & Limit
- **Analysis of graphs** With the aid of technology, graphs of functions are often easy to produce. The emphasis is on the interplay between the geometric and analytic information and on the use of calculus both to predict and to explain the observed local and global behavior of a function.
- **Limits of functions (including one-sided limits)**
  - An intuitive understanding of the limiting process
  - Calculating limits using algebra
  - Estimating limits from graphs or tables of data
- **Asymptotic and unbounded behavior**
  - Understanding asymptotes in terms of graphical behavior
  - Describing asymptotic behavior in terms of limits involving infinity
  - Comparing relative magnitudes of functions and their rates of change (for example, contrasting exponential growth, polynomial growth, and logarithmic growth)
- **Continuity as a property of functions**
  - An intuitive understanding of continuity. (The function values can be made as close as desired by taking sufficiently close values of the domain)
  - Understanding continuity in terms of limits
  - Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem)
- ➢ ***Assignment Preview***:
  - Through class and home learning assignments, students will explore limits at discontinuities in four ways: first, using the table feature on their calculators with decreasing increments; second, using algebraic techniques to "simplify" the expressions given as formulas; third, using the graph trace feature on their calculators; and fourth, using verbal descriptions of functions written in words to create graphs that match the verbal descriptions.

II. Derivatives
- **Concept of the derivative**
  - Derivative presented graphically, numerically, and analytically
  - Derivative interpreted as an instantaneous rate of change
  - Derivative defined as the limit of the difference quotient
  - Relationship between differentiability and continuity
- **Derivative at a point**

    - Slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are no tangents.
    - Tangent line to a curve at a point and local linear approximation
    - Instantaneous rate of change as the limit of average rate of change
    - Approximate rate of change from graphs and tables of values
- **Derivative as a function**
    - Corresponding characteristics of graphs of *f* and *f'*
    - Relationship between the increasing and decreasing behavior of *f* and the sign of *f'*
    - The Mean Value Theorem and its geometric consequences
    - Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa
- **Second derivatives**
    - Corresponding characteristics of the graphs of *f, f',* and *f''*
    - Relationship between the concavity of *f* and the sign of *f''*
    - Points of inflection as places where concavity changes
- **Applications of derivatives**
    - Analysis of curves, including the notions of monotonicity and concavity
    - Optimization, both absolute (global) and relative (local) extrema
    - Modeling rates of change, including related rates problems
    - Use of implicit differentiation to find the derivative of an inverse function
    - Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration
    - Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations
- **Computation of derivatives**
    - Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions
    - Basic rules for the derivative of sums, products, and quotients of functions
    - Chain rule and implicit differentiation

➢ ***Assignment Preview***:

- Through class and home learning assignments, students will explore the derivative function using the limit definition of the derivative at a point. For several points, students compute the difference quotient algebraically using the definition, using a table, and by using a graph on their calculators (or given graph) to evaluate the limits and interpret their results in terms of the definition to decide if the derivative does or does not exist at each point.
- Through class and home learning assignments, students will analyze graphs of a functions and create graphs of its derivative and vice versa. Using the graph of the derivative $f'(x)$, students determine key features of $f(x)$ (such as increasing/decreasing intervals, local extrema, points of inflection, and concavity intervals) and create a graph of $f(x)$, so students can draw conclusions about the relationship that exist between derivatives and its original function**.**
- Throughout the applications of derivatives unit, the class will compare and discuss their different possible solutions. Graphing calculators will be used to verify results. Students will, orally and in writing, discuss differences in their solutions and the solutions on the calculator and analyze those differences.
- Through the Related Rates Shoebox Project, students will write a related rates problem and solve the created problem using proper notation and algebraic solving. Students will have other students read their problem and check their work by solving the problem created. Once the problem statement and work has been verified, students will model the scenario within a shoebox to display. Each project must have a moving object to represent the rate that is changing. On presentation day, students will orally present their project (explaining the scenario, how rates are

related, and how to find the solution) to their classmates and invited math teachers and administrators.

III. Integrals

- **Interpretations and properties of definite integrals**
  - Definite integral as a limit of Riemann sums
  - Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval:

    $$\int_a^b f'(x)dx = f(b) - f(a)$$
  - Basic properties of definite integrals (examples include additivity and linearity)
- **Applications of integrals** Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a small sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve other similar application problems. Whatever applications are chosen, the emphasis is on using the method of setting up an approximating riemann sum and representing its limit as a definite integral. To provide a common foundation, specific applications should include using the integral of a rate of change to give accumulated change, finding the area of a region, the volume of a solid with known cross sections, the average value of a function, and the distance traveled by a particle along a line.
- **Fundamental Theorem of Calculus**
  - Use of the Fundamental Theorem to evaluate definite integrals
  - Use of the Fundamental Theorem to represent a particular anti-derivative, and the analytical and graphical analysis of functions so defined
- **Applications of antidifferentiation**
  - Finding specific antiderivatives using initial conditions, including applications to motion along a line
  - Solving separable differential equations and using them in modeling (in particular, studying the equation $y' = ky$ and exponential growth)
- **Numerical approximations to definite integrals** Use of Riemann sums (using left, right, and midpoint evaluation points) and trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values.

➢ ***Assignment Preview:***

- Through class and home learning assignments, Students write an expression for an approximation of the area between the horizontal axis and the graph of $f(x)$ for a particular function given as a formula on a specified interval as a left, right, and midpoint Riemann sum using n subdivisions. They then use a Desmos graph with slider to explore sums. The file superimposes rectangular areas on the graph of $f(x)$, showing the sum value. The software allows for left, right, and midpoint sums. The slider increases the number of partitions to explore precision. Finally, students write limits of their Riemann sums as n goes to infinity, then identify each as a definite integral, and use the Fundamental Theorem of Calculus to evaluate the integral.
- Through class and home learning assignments, Students will use a graphing calculator to proximate points of intersections of 2 or more functions in order to find the area between the curves or volume.
- Students will complete a write-pair-share activity which requires them to write a paragraph using well-written sentences about what the FTC means in the context of a given application problem.
- Throughout the applications of derivatives unit, the class will compare and discuss their different possible solutions. Graphing calculators will be used to verify results. Students will, orally and in

writing, discuss differences in their solutions and the solutions on the calculator and analyze those differences.

- Students will bring a small object from home that is an example of a solid of revolution. Students will measure their objects to create a graph whose rotation about the x-axis would produce their object. Then, they will use regression and multiple integrals to compute their object's theoretical volume. Students will then use displacement to determine the actual volume and calculate their percentage of error.

<u>Additional Topics that will be Included in the Course:</u>

- L'Hospital's Rule including its use in determining limits and convergence of improper integrals and series.
- Calculation of volume through use of cylindrical shells in addition to disk and washer methods.
- Integration by Parts
- Polar Calculus
- Vector Calculus
- Parametric Equations
- Euler's Method
- Sequences & Series
- Taylor Series & Taylor Polynomials

<u>REQUIRED MATERIALS:</u>

1. Three-ring binder for class notes and handouts with dividers (3 sections) and papers
2. Pencils
3. Graphing calculators (i.e. TI-84, etc.)
4. Headphones (for the computer)
5. Composition Notebook (for unit portfolio)

<u>CLASS/HOMEWORK:</u>

Daily class and homework is considered to be the major part of a student's learning experience. All assignments are to be completed on time. Please keep all classwork and homework assignments in your notebook and bring them to class every day. All notes should be dated and kept in a separate section in your notebook chronologically. All example problems worked in class should be included in your notes. **You will use your notes to study for tests and the quarter exams.** Mathematics is a subject that is ***learned by doing***, not by watching. Any difficulties with homework assignments may be discussed with the instructor.

<u>EXAMINATIONS AND QUIZZES:</u>

- UNIT TESTS: There will be end-of-unit test after the completion of each unit.
- QUIZZES: There will be numerous unannounced quizzes throughout the course. Your three lowest quiz scores will be dropped. You may **NOT** make up a MISSED quiz.
- QUARTER EXAM: This exam will be comprehensive (all topics from the entire year will be on the exam). Students can become EXEMPT from Quarter Exams if a student meets the following criteria:
    - Has an A, and has missed no more than 2 days of class in that quarter
    - Has a B, and has missed no more than 1 day of class in that quarter
    - Has a C, and had not missed any days of class in that quarter
- RE-TAKE TESTS: In order to take a retake, you must complete a unit study plan before scheduling a test. If you miss the day of an assessment, you forfeit your right to a re-take. You will not take the same assessment and testing format will not be multiple choice.
- MAKEUP TESTS: Make an appointment with the instructor to make-up the test. Make-up tests will follow the same format as a retest (please read retest policy)

GRADING:

AP Calculus is a college level course. As a result, the manner in which the overall course grade is determined varies from a typical high school mathematics course.

- Tests/Projects – 40%
- Quizzes – 35%
- Quarter Exam – 15%
- Assignments – 10%

AP Calculus AB & BC exams are scheduled for May 4, 2021

CLASSROOM POLICY

It is very important that the classroom environment is helpful for student learning. Students are expected to be **on time, ready to do mathematics**. All students are expected to be active learners in the classroom. Students should be **responsible** for their learning. Students should be **productive**. Students should **cooperate** in the classroom.

- ✓ ATTENDANCE: Class attendance is **strongly** advised.
- ✓ TARDINESS: Be in your seat when the bell rings. Otherwise, you will be marked late.
- ✓ CHEATING POLICY: Students found cheating on tests will receive an "0" for the assignment/assessment, and be subject to the BTWSHS' disciplinary procedures.
- ✓ CELL PHONES: These will be ***turned off or completely silent*** (vibrate mode is not silent) while inside my classroom. Cell phones cannot be used as the calculators.
- ✓ MANNER: 1) Do not disrupt the learning process.
  2) Raise your hands whenever you have math-related questions.
  3) Stay seated until the bell rings.
  4) Do not get up to sharpen your pencil(s) while I'm lecturing.
  5) No food or drink (except for water).

CONSEQUENCES

1st offense = Warning
2nd offense = Detention & Parent Contact
3rd offense = Office (referral)

TEACHER AVAILABILITY

Office Hours: by appointment

I will be available for extra help or other questions/concerns before/after school or by appointment. I can be reached by email or by text via Remind 101.

I look forward to this school year together.

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Dear Student and Parent/Guardian,

I am looking forward to helping you develop understanding of AP Calculus this year. It is important that you read and understand the course syllabus (online) because it provides information regarding my expectations for creating a successful learning experience. Please let me know that you have read and understood this course syllabus by completing this form and returning it to me.

By signing this page, you agree that you have read this syllabus and understand the classroom policies. You know how your citizenship and scholarship grade will be determined.

______________________________ ______________________________
Student Name (Printed) Student Signature

______________________________ ______________________________
Parent/Guardian Name (Printed) Parent/Guardian Signature

Telephone Number: ________________________ Best time(s) to call___________________

Student Email address: ____

Parent Email address: ____

Student, do you have any questions or concerns I should know about at this time?

Parent/Guardian, Is there anything I should know about your student at this time?