AP CALCULUS BC SYLLABUS

INSTRUCTOR

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PRIMARY TEXT

CALCULUS – GRAPHICAL, NUMERICAL, ALGEBRAIC, Pearson Education, Inc., 2007

COURSE PERSPECTIVE

Calculus is one of the supreme accomplishments of mankind in that it provides the mathematical tools to describe, predict, and model how the real world changes. Till then, the field of mathematics was limited to describing the "static" world. This was adequate for building many structures (e.g., bridges, cathedrals, etc.), but insufficient for the vast majority of technology innovations starting with the Industrial Revolution. This ability to model how manmade and natural processes (e.g., weather, spacecraft, chemical refineries, economic systems, etc.) change with time is a key that has unlocked many doors in what has become the modern world.

The general format of the course is designed for the accelerated student who has a solid background in mathematics and is consistent with Advanced Placement Calculus guidelines used through the United States. The intent is to provide adequate instruction for those students who wish to take the AP Calculus BC exam in May. If the student receives a satisfactory grade on this test, he/she can receive credit from most colleges and universities for a two semester Calculus course.

Students are also expected to explain their mathematical reasoning both in class discussion and on written assessments. During class, emphasis is taken off the actual answer and instead placed on students' ability to articulate why an answer is correct and the process by which it was discovered. In written assessment, students must also justify their answers in complete sentences. This is especially a challenge early in the year, but as students become more comfortable discussing mathematics in the classroom, they become more capable of justifying their answers in writing.

The curriculum is rigorous and students will be expected to keep up with the pace of the course. Ask questions frequently and do not fall behind. I am available in the AP Teacher's Office any time I am not in class. My teaching schedule is posted in the AP Teacher's Office. I am also available the second hour of Lunch most days.

GOALS

For each student to:

- Be able to solve problems.
- Understand and relate functions presented analytically, graphically, numerically, and verbally (Rule of Four).
- Understand the fundamental concepts of calculus as it applies to limits, derivatives and integrals.
- Appreciate how these concepts can be used to solve real-life problems.
- Have the mathematical skills to be successful in college.

COURSE CONDUCT

A course unit (chapter or portion of chapter) will typically be covered every 2-5 weeks. A strong focus will be placed on understanding key concepts and the Rule of Four mentioned above. This will result in more emphasis on verbal skills (e.g., being able to present a problem and its solution in writing).

Each unit will close with a test. There will also be periodic unannounced quizzes. There will be a total of two semester exams, and each will cover only those topics presented during that semester. The grading policy discussed below places considerable emphasis on student attendance, effort, and homework.

Cooperative learning approaches will be used throughout the course, and it is expected that students will assist one another to improve their understanding of the material.

REQUIRED EQUIPMENT

A course binder or folder is required of each student, must be brought to each class, and must be large enough for one semester (1 inch wide or larger). The binder or folder must have clearly marked sections for: Notes, Homework, Quizzes, and Tests.

A TI-89+ graphing calculator will be required.

Graphing Calculator

The students are not expected come to BC Calculus having operated a graphing calculator. Basic calculator functions are covered explicitly very early in the course, such as graphing a function in a proper sized window, solving basic equations, or examining a function using the table feature.

Students are expected to bring their calculator to class each day, as we will be using them on a daily basis to explore patterns, connect equations to their graph, and evaluate expressions. Some limited programming of the calculator will also be covered. The calculator will also be used to interpret results and support conclusions.

As students advance in the course, they are encouraged to write programs and some simple programs are dissected in class. Students adapt quickly to using their calculators in clever ways, experimenting to find possible answers and solutions to problems, and interpreting results that are solved analytically.

The instruction "support graphically" has become an often-used tool since it is so quick to do and gives students confidence in their conjectures and answers. Some students are quick to say, "my calculator tells me so," and we try to turn the question around to "and what do you think about that?" or "why does the calculator give that result?"

GRADING POLICY

Quarter 1&2		Semester	
Attendance & Class Participation	10%	First/Third Quarter Grade	35%
Homework & Homework Quizzes	15%	Second/Fourth Quarter Grade	35%
Quizzes	30%	Semester Exam	30%
Tests	50%		

All grades will be submitted and recorded as "numeric grades" only. That is, progress reports and report cards will show only numeric grades without a letter designation. However, the equivalent letter grade can be determined by the chart below.

Letter Grade Determination	
90 – 100%	A
80 – 89%	B
70 – 79%	C
60 – 69%	D
59.9% and Below	F

Tests

- There will typically be 2 to 3 tests per quarter.
- Calculators cannot be shared during a test.
- Some tests will have "with calculator" and "without calculator" sections.
- A student who misses a test due to an excused absence must reschedule the test with Mr. Shadock and will receive full credit.
- A student who misses a test with an unexcused absence will take the makeup test and receive 70% credit unless this is a repeat offense. A zero score will be given for any repeat offenses.

Consistent with the Code of Academic Honesty, any student:

a) **receiving or offering assistance during a test/quiz or**
b) **using any material not authorized for a test/quiz (e.g., a "cheat" sheet) will receive a "zero" score that cannot be "made-up" unless he/she receives permission otherwise from the AP Center Principal.**

Quizzes

- Short quizzes (announced and unannounced) will be given frequently throughout the course. They will be based upon recent homework assignments but not the material covered on the day before the quiz.
- Some quizzes will have "with calculator" and "without calculator" sections.
- At the discretion of Mr. Shadock, a student who misses a quiz due to an excused absence will receive a "bye" for the quiz or will have to make it up.
- A student who misses a quiz due to an unexcused absence will receive a "zero" for the quiz.

Homework

- Homework will typically be given as a daily problem set. It is expected that students keep up with the homework throughout the week.
- Homework assignments will be checked each week.
- Problem statement must be written before the solution. Longer problems can be abbreviated by writing "Given" and "Find."
- Three missed homework assignments per quarter will automatically result in reviewing the student's performance, as well as 4 points off the quarter grade automatically. **Late homework assignments will not be accepted**.
- Homework rubric (0-10 scoring system is used; examples shown below).

0	4	7	9	10
Homework not submitted, or late.	A few questions attempted, submitted on time, below class expectations.	Some questions attempted, submitted on time, meets class expectations.	Most questions attempted, submitted on time, meets class expectations.	All questions attempted, submitted on time, exceeds class expectations.

Attendance

- Each student is expected to be in class and in appropriate dress by the class bell.
- Any student who misses more than 25% of the classes per quarter will be asked to drop the course since the likelihood of failure due to low quiz and test scores is quite high. The Dipont AP Center principal will make the final decision in this regard.
- **Any student who leaves early or returns late from school breaks (e.g., Chinese New Year, etc.) will receive a "0" attendance and participation scores for days missed.**

- Attendance rubric (0-10 scoring system is used; examples shown below).

0	3	6	8	10
Cut (no show).	Present after 10 minutes of class in clean school dress. Later than 10 minutes is considered a cut.	Present after 2 minutes of class in clean school dress. This is considered tardy or late. Four tardies equals one cut.	Present within 2 minutes of class in clean school dress.	Present on time in clean school dress.

Class Participation

- Student is prepared with all necessary material.
- Student is attentive during class discussion/activities, has a positive attitude, and behaves in a constructive manner.
- Student uses appropriate language and respects classroom environment & material.
- Student displays strong effort to do well.

- Class Participation rubric (0-10 scoring system is used; examples shown below; weekly grade).

5 or lower	6	7	8	10
Poor	Marginal	Fair	Good	Excellent

All work should be done in pencil, be neat and be easily readable. Otherwise, the class participation score will be lowered at Mr. Shadock's discretion.

Unit I. Limits (2 weeks)

Lab: Computing limits graphically, algebraically, and numerically

- Informal concept of limit
- Language of limits, including notation and one-sided limits
- Calculating limits using algebra
- Properties of limits
- Limits at infinity and asymptotes
- Estimating limits numerically and graphically
- Comparing growths of logarithmic, polynomial, and exponential functions
- Idea of continuity and the limit definition
- Types of discontinuities
- The Intermediate Value and Extreme Value Theorems
- Local and global behavior
- Rate of change concept
- Tangent lines, including using the tangent line to approximate a function

Unit II. The Derivative (2-3 weeks)

Lab: The derivative and differentiability

- Linear functions and local linearity
- Slope–intercept, point slope, and Taylor forms of linear equations
- Difference quotient definition of derivative; computing the derivative at a point using the definition
- Estimating the derivative from tables and graphs
- Relationship between differentiability and continuity
- Symmetric difference quotient definition
- The derivative as a function; computing derivative functions from the definition
- Derivative as a rate of change
- Rules for computing derivatives; formulas for all relevant functions, including implicitly defined functions

Unit III. Applications of Derivatives (2-3 weeks)

Lab: An Investigation into the Accuracy of the Tangent Line Approximation

- Finding extrema
- Increasing and decreasing behavior
- The Mean Value Theorem
- Critical values and local extrema
- The first and second derivative tests
- Concavity and points of inflection
- Comparing graphs of f, f', and f''
- Modeling and optimization
- Particle motion; position, velocity, and acceleration functions
- Linearization and the Taylor form of the equation of a line
- Newton's method
- Related rates problems

Review for Semester Exam (5 days)

Unit IV. The Definite Integral (2-3 weeks)

"Car" Lab: Speedometer readings and distance traveled
Lab: Accumulation Functions (from College Board Professional Development Workshop) Materials Special Focus: The Fundamental Theorem
Lab: Riemann Sums (from Texas Instruments' *Calculus Activities*)
Lab: The Fundamental Theorem (from College Board Professional Development Workshop Materials Special Focus: The Fundamental Theorem

- Area under a curve and distance traveled
- Summation notation and partitions
- Riemann sum
- Definition of the definite integral as the limit of a Riemann sum
- Linearity properties of definite integrals
- Average value of a function
- Definition of antiderivative
- The idea of area function; discovering the fundamental theorem
- The First and Second Fundamental Theorems of Calculus and their uses
- The Mean Value Theorem for Integrals, and using the Fundamental Theorem to connect the two Mean Value Theorems
- Numerical integration techniques: left endpoint, right endpoint, midpoint, trapezoid, and Simpson's rules

Unit V. Differential Equations and Mathematical Modeling (2-3 weeks)

Lab: Using Slope Fields (from Texas Instruments *Calculus Activities*)

- Translating verbal descriptions into differential equations
- Antiderivatives and slope fields
- Solving initial value problems visually using slope fields
- Linearity properties of definite integrals
- Techniques of antidifferentiation: substitution and integration by parts
- Solving separable differential equations analytically
- The domain of the solution of a differential equation
- Solving initial value problems by Euler's method
- Exponential growth and decay problems
- The logistic model and antiderivatives by partial fractions

Unit VI Applications of Definite Integrals (3 weeks)

- Integral of a rate of change gives net change
- Measuring area under and between functions; Cavalieri's principle
- Measuring volume of solids of known cross-sectional area and solids of revolution
- Applications to particle motion—net and total distance traveled
- Arc length of function graphs

Review for Semester Exam (5 Days)

Unit VII. Sequences (3 weeks)

- Idea and notation for sequences; arithmetic, harmonic, alternating harmonic, and geometric sequences
- Definitions of convergence and divergence
- Bounded, monotonic, oscillating sequences
- Limit properties of sequences
- L'Hôpital's Rule and indeterminate forms $\left(\frac{0}{0}, \frac{\infty}{\infty}, \infty - \infty, 1^{\infty}, 0^{0}, \infty^{0}\right)$
- Relative rates of growth of functions
- Improper integrals and the comparison test

Unit VIII. Parametric, Vector, and Polar Functions (2-3 weeks)

- Length of parametrically defined curves
- Vectors and vector-valued functions
- Calculus of vector functions
- Calculus of polar functions, including slope, length, and area

Unit IX. Series (4 weeks)

Lab: An Investigation into the Accuracy of Polynomial Approximations to Transcendental Functions

- Definition and notation of series; sequence of partial sums; telescoping, geometric, harmonic, alternating harmonic series
- Repeating decimals expressed as infinite geometric series; using substitution and antidifferentiating to calculate series for ln(1+x) and arctan(x) from geometric series
- Terms of series as areas of rectangles; relationship to the integral test
- Power series; interval and radius of convergence defined
- Taylor series
- Maclaurin series for e^x, sin x, cos x, and
- Functions defined by series
- Taylor polynomials
- Taylor's theorem with Lagrange form of the remainder
- Alternating series error bound
- Linearity properties of series
- Radius of convergence: nth term test; direct comparison test; absolute and conditional convergence; ratio test
- Interval of convergence and testing endpoints; integral test; p-series; limit comparison test; alternating series test

AP Exam Review (3 weeks)