AP CALCULUS (BC) SYLLABUS

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The purpose of the AP Calculus course is to develop students' understanding of the concepts of calculus and to provide experience with its methods and applications. The concepts, results, problems, and applications will be represented graphically, numerically, analytically, and verbally. The course is a unified study of functions, derivatives, integrals, limits, approximations, applications, and modeling and can be separated into three sub-topics:

1. Functions, graphs, and limits
2. Derivatives
3. Integrals

Students who successfully complete the course and AP examination may receive credit, advanced placement, or both (according to each individual institution's local policies).

The official AP EXAM is scheduled for Wednesday, May 6th. It is expected that ALL students enrolled in the class will take the test.

STUDENT REQUIREMENTS AND PREREQUISITES

- Students must successfully complete AP Calculus (AB) as a prerequisite.
- **Students will need a graphing calculator (TI-83+, TI-84+ or TI-89 recommended)** which performs the functions required by the AP College Board.
- **Students** are individually responsible for their own learning, and therefore are responsible for pursuing assistance, whether that be by coming to see me before or after school (or other available times) or by contacting other sources (tutors, peers, parents, etc.).

GRADING

Homework (20% of grade)

- Assigned and collected on a regular basis
- Must be done completely and legibly, on loose-leaf paper
- Make-up work in case of excused absence(s) is the student's responsibility; late work due to unexcused absences will NOT be given credit.
- Will be graded 60% on completion, 40% on accuracy and correctness
- In general, late work will not be accepted except for extenuating circumstances.

Quizzes and Tests (80% of grade)

- Administered on a regular basis
- Retests are not given
- Questions will often resemble those encountered on the AP exam
- Students who miss a test due to an absence will be required to take the test the day they return; students who are absent the day **before** a test (excused or unexcused) will still be required to take the test. Tests missed due to *unexcused* absences **CANNOT** be made up.

BE-ATTITUDES

Be here	Be on time	Be prepared	Be attentive
Be cooperative	Be respectful	Be courteous	Be responsible

<u>COURSE OUTLINE</u> (from the College Board AP web-site):

I. Functions, graphs, and limits

A. Analysis of graphs
- Emphasis 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

B. Limits of functions (including one-sided limits)
- Intuitive understanding of the limiting process
- Calculating limits using algebra
- Estimating limits from graphs or tables of data

C. 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

D. Continuity as a property of functions
- An intuitive understanding of continuity
- Understanding continuity in terms of limits
- Geometric understanding of graphs of continuous functions

E. * Parametric, polar, and vector functions

II. Derivatives

A. Concept of the derivative
- Derivative presented geometrically, 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

B. Derivative at a point
- Slope of a curve at a point (emphasizing points at which there are vertical tangents or 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

C. 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

D. 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

E. Applications of derivatives
- Analysis of curves, including notions of monotonicity and concavity
- * Analysis of planar curves given in parametric form, polar form, and vector form, including velocity and acceleration
- 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 derivative as rate of change in varied applied contexts
- Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations
- * Numerical solution of differential equations using Euler's method
- * L'Hospital's Rule, including its use in determining limits and convergence of improper integrals and series

F. Computation of derivatives
- Knowledge of derivatives of basic functions, including power, exponential, trigonometric, and inverse trigonometric functions
- Basic rules for the derivative of sums, products, and quotients of functions
- Chain rule and implicit differentiation
- * Derivatives of parametric, polar, and vector functions

III. Integrals

A. Interpretations and properties of definite integrals
- Computation of Riemann sums using left, right, and midpoint evaluation points
- Definite integral as a limit of Riemann sums over equal subdivisions
- 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 (e.g. additivity and linearity)

B. Applications of integrals
- Using appropriate integrals in a variety of applications to model physical, biological, social, or economic situations, and adapting knowledge and techniques to other similar application problems
- Emphasis on setting up an approximating Riemann sum and representing its limit as a definite integral
- Specific applications include:
  - Accumulation of change
  - Finding areas of regions (* including those bounded by polar curves)
  - Volumes of solids with known cross-sections
  - Average values of functions
  - * Distance traveled by a particle along a line
  - * Lengths of curves

C. Fundamental Theorem of Calculus
- Use of the Fundamental Theorem of Calculus to evaluate definite integrals
- Use of the Fundamental Theorem of Calculus to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined

D. Techniques of antidifferentiation
- Antiderivatives following directly from derivatives of basic functions
- Antiderivatives by substitution of variables
- * Antiderivatives by parts, simple partial fractions
- * Improper integrals

E. 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 $\frac{dy}{dx} = ky$ and exponential growth $y = y_0 e^{kt}$
- * Solving logistic differential equations and using them in modeling

F. Numerical approximations to definite integrals
- Use of Riemann and trapezoidal sums and Simpson's Rule to approximate definite integrals represented algebraically, geometrically, and by tables of values.

IV. * Polynomial Approximations and Series

A. Concept of series
- Defined as a sequence of partial sums
- Convergence defined in terms of the limit of the sequence of partial sums
- Using technology to explore convergence or divergence

B. Series of constants
- Motivating examples, including decimal expansion
- Geometric series with applications
- The harmonic series
- Alternating series with error bound
- Terms of series as areas of rectangles and their relationship to improper integrals, including the integral test and its use in testing the convergence of p-series
- The ratio test for convergence and divergence
- Comparing series to test for convergence or divergence

C. Taylor Series

- Taylor polynomial approximation with graphical demonstration of convergence (for example, viewing graphs of various Taylor polynomials of the sine function approximating the sine curve)
- Maclaurin series and the general Taylor series centered at $x = a$
- Maclaurin series for the functions e^x, $\sin x$, $\cos x$, and $\frac{1}{1-x}$
- Formal manipulation of Taylor series and shortcuts to computing Taylor series, including substitution, differentiation, antidifferentiation, and the formation of new series from known series
- Functions defined by power series
- Radius and interval of convergence of power series
- Lagrange error bound for Taylor polynomials

VISIT the class websites at http://home.comcast.net/~bskerbitz/apcalc.html