# AP Calculus BC

Syllabus

## Introduction:

Calculus is essentially the study of the relationships among changing quantities, and the curriculum of AP Calculus BC introduces the student to this study through single-variable functions.

Through exploration, class discussion, hands-on activities, and traditional lecture, students in this course will gain a better understanding of the foundational concepts of calculus so that they may be more successful in future mathematics courses. We will emphasize the connections among the four ways to represent functions.

This course, when applicable, approaches the content in four ways – analytically, numerically, graphically, and verbally – and not through computational rules alone. Students also practice appropriate communication of the mathematics, be it written or verbal, particularly in explaining their solutions. The students will use graphing calculators to help solve problems, experiment, interpret results, and support conclusions.

Technology also plays an important part in this course. All students need access to a graphing calculator throughout the semester, and many activities require the use of various computer software programs (graphing programs, computer algebra systems, spreadsheet applications, etc.) and CBL hardware. All of these can be provided to the student when needed.

## Prerequisite:

This particular section of AP Calculus BC assumes the students have a foundational understanding of the concepts of differential and integral calculus, either from AP Calculus AB of from Non-AP Calculus. These topics will be revisited when appropriate.

## Textbook and Calculator:

The primary textbook used in this course is Jon Rogawski's *Single Variable Calculus: Early Transcendentals*

In addition to the text, this course also requires the use of the TI-89 calculator. The TI-89 is preferred over the TI-83/84 for its greater built-in capabilities in solving problems, performing experiments, interpreting results, and supporting conclusions throughout the semester.

Course Plan:

Below is an outline of the topics presented in this course along with the approximate time spent on each unit.

I. Basic Calculus Review (present and assessed throughout the semester)

A. Limits and continuity
- i. Concept of a limit (numerical and graphical approaches)
- ii. Limit evaluation
- iii. Infinite limits (limit definitions of asymptotes)
- iv. Continuity, Intermediate Value Theorem, Extreme Value Theorem

B. Derivatives
- i. Concept of a derivative as the slope of the tangent line to a curve at a point
- ii. Instantaneous rates of change
- iii. Function derivatives (including the relationships among $f, f'$, and $f''$)
- iv. Differentiability
- v. Introduction to linearization
- vi. Introduction to graph behavior

C. Differentiation
- i. Differentiation rules
- ii Implicit differentiation
- iii. Rectilinear motion
- iv. Linear approximations
- v. Differentials

D. Applications of Differentiation
- i. Mean Value Theorem
- ii. Absolute and relative extreme values
- iii. Graph behavior
- iv. l'Hospital's Rule
- v. Related rates
- vi. Optimization
- vii. Antidifferentiation (slope fields)

E. Concept and application of the integral
- i. Relationship between area and definite integrals (Riemann sums)
- ii. Definite integrals as an accumulator function
- iii. Fundamental Theorem of Calculus
- iv. Approximation techniques
- v. Integration techniques
- vi. Area between curves
- vii. Cross-sectional volume
- viii. Average value

Course Plan (continued):

II. Integration Techniques (2 Weeks)

A. Review of antiderivatives and substitution
B. Integration by parts
C. Trigonometric functions
D. Rational functions (including long division and partial fraction decomposition)
E. Improper integrals

Assessments: Integration activity,
Exam

III. Differential Equations (2 Weeks)

A. Review of linearization
B. Slope fields
C. Euler's method
D. Separable differential equations
E. Logistic growth

Assessments: Euler's method activity (spreadsheet problem solving),
Disease lab (calculator experiment in logistic behavior),
Exam

IV. Infinite Series (3 Weeks)

A. Geometric, *p*-series, and telescoping series
B. Divergence test, integral test, and comparison tests for convergence
C. Alternative series, absolute convergence, and ratio test
D. Error bound for convergent alternating series

Assessments: Infinite series activities (CBL/calculator problem solving),
Exam

V. Taylor Polynomials and Power Series (3 Weeks)

A. Taylor polynomial approximation
B. Power series, radius of convergence, interval of convergence
C. Taylor and Maclaurin series
D. Differentiation and integration of power series
E. Error analysis (including Lagrange error bound)

Assessments: Taylor polynomial exploration (calculator problem solving),
Exam

Course Plan (continued):

VI. Parametric, Polar, and Vector Functions (2 Weeks)

A. Slope and area of parametrically-defined curves
B. Arc length
C. Slope and area of polar curves
D. Vector functions
E. Planar motion

Assessments: Motion exploration (graphing program problem solving), Exam

Additional Assessments:

In addition to the various activities, labs, and regular exams, this course also requires several full-length AP-style exams and one term project. The AP-style exams are used to periodically assess understanding of the calculus topics presented throughout this course (including the reviewed topics).

The term project is a collaborative activity that explores an open-ended, real-life problem involving concepts presented in this course. The project attempts to bridge the gap between single-variable and multi-variable calculus.

All activities and assessments require students to communicate the associated calculus concepts presented in written form.