AP Calculus BC

This AP Calculus BC course is providing the students with an experience that they will have in a full year of single variable calculus in college. I will teach the students the necessary information for them to have a good grip on the methods and applications of calculus. This course will cover the topics associated with Functions, Graphs, and Limits; Derivatives; Integrals; and Polynomial Approximations and Series. This course will also help students explain solutions verbally and in a written form. Another thing that the students will learn is how to use a calculator and how to interpret the results.

First Semester

Chapter 1: Limits and Their Properties

(10 days—one test)

- An introduction to limits, including an intuitive understanding of the limit process
- Using graphs and tables of data to determine limits
- Properties of limits
- Algebraic techniques for evaluating limits
- Comparing relative magnitudes of functions and their rates of change
- Continuity and one-sided limits
- Geometric understanding of the graphs of continuous functions
- Intermediate Value Theorem
- Infinite limits
- Using limits to find the asymptotes of a function

Section Project: Graphs and Limits of Trigonometric Functions

Chapter 2: Differentiation

(19 days—two tests)

- Understanding of the derivative: graphically, numerically, and analytically
- Approximating rates of change from graphs and tables of data
- The derivative as: the limit of the average rate of change, an instantaneous rate of change, limit of the difference quotient, and the slope of a curve at a point
- The meaning of the derivative—translating verbal descriptions into equations and vice versa
- The relationship between differentiability and continuity
- Functions that have a vertical tangent at a point
- Functions that have a point on which there is no tangent
- Differentiation rules for basic functions, including power functions and trigonometric functions
- Rules of differentiation for sums, differences, products, and quotients
- The chain rule
- Implicit differentiation
- Related rates

Section Project: Optical Illusions

Chapter 3: Applications of Differentiation

(19 days—two tests)

- Extrema on an interval and the Extreme Value Theorem
- Rolle's Theorem and the Mean Value Theorem, and their geometric consequences
- Increasing and decreasing functions and the First Derivative Test
- Concavity and its relationship to the first and second derivatives
- Second Derivative Test

Section Project: Rainbow

- Limits at infinity
- A summary of curve sketching—using geometric and analytic information as well as calculus to predict the behavior of a function
- Relating the graphs of *f, f' and f''*
- Optimization including both relative and absolute extrema
- Tangent line to a curve and linear approximations
- Application problems including position, velocity, acceleration, and rectilinear motion

Chapter 4: Integration

(15 days—two tests)

- Antiderivatives and indefinite integration, including antiderivatives following directly from derivatives of basic functions
- Basic properties of the definite integral
- Area under a curve
- Meaning of the definite integral
- Definite integral as a limit of Riemann sums
- Riemann sums, including left, right, and midpoint sums
- Trapezoidal sums
- Use of Riemann sums and trapezoidal sums to approximate definite integrals of functions that are represented analytically, graphically, and by tables of data
- Use of the First Fundamental Theorem to evaluate definite integrals
- Use of substitution of variables to evaluate definite integrals
- Integration by substitution

Section Project: Demonstrating the Fundamental theorem

- The Second Fundamental Theorem of Calculus and functions defined by integrals
- The Mean Value Theorem for Integrals and the average value of a function

Chapter 5: Logarithmic, Exponential, and Other Transcendental Functions

(16 days—two tests)

- The natural logarithmic function and differentiation
- The natural logarithmic function and integration
- Inverse functions
- Exponential functions: differentiation and integration
- Bases other than *e* and applications

Section Project: Using Graphing Utilities to Estimate Slopes

- Solving separable differential equations
- Applications of differential equations in modeling, including exponential growth
- Use of slope fields to interpret a differential equation geometrically
- Drawing slope fields and solution curves for differential equations
- Euler's method as a numerical solution of a differential equation
- Inverse trigonometric functions and differentiation
- Inverse trigonometric functions and integration

First Semester Exam *(two review days)*

The exam will consist of Limits, Differentiation, Integration, Logarithmic, Exponential, and other Transcendental Functions.

Second Semester

Chapter 6: Applications of Integration

(10 days—one test)

- The integral as an accumulator of rates of change
- Area of a region between two curves
- Volume of a solid with known cross sections
- Volume of solids of revolution

Section Project: Saturn

- Arc length
- Applications of integration in physical, biological, and economic contexts
- Applications of integration in problems involving a particle moving along a line, including the use of the definite integral with an initial condition and using the definite integral to find the distance traveled by a particle along a line

Chapter 7: Integration Techniques, L'Hopital's Rule, and Improper Integrals

(17 days—two tests)

- Review of basic integration rules
- Integration by parts
- Trigonometric integrals

Section Project: Power Lines

- Integration by partial fractions
- Solving logistic differential equations and using them in modeling
- L'Hopital's Rule and its use in determining limits
- Improper integrals and their convergence and divergence, including the use of L'Hopital's Rule

Chapter 8: Infinite Series

(17 days—two tests)

- Convergence and divergence of sequences
- Definition of a series as a sequence of partial sums
- Convergence of a series defined in terms of the limit of the sequence of partial sums of a series
- Geometric series and applications
- The nth-Term Test for Divergence
- The Integral Test and its relationship to improper integrals and areas of rectangles
- Use of the Integral Test to introduce the test for *p*-series

Section Project: The Harmonic Series

- Comparisons of series
- Alternating series and the Alternating Series Remainder
- The Ratio and Root Tests
- Taylor polynomials and approximations: introduction using the graphing calculator
- Power series and radius and interval of convergence
- Taylor and Maclaurin series for a given function
- Maclaurin series for $\sin x$, $\cos x$, e^x, and $\frac{1}{1-x}$
- Manipulation of series, including substitution, addition of series, multiplication of series by a constant and/or a variable, differentiation of series, integration of series, and forming a new series from a known series
- Taylor's Theorem with the Lagrange Form of the Remainder (Lagrange Error Bound)

Chapter 9: Conics, Parametric Equations, and Polar Coordinates

(10 days—one test)

- Conics and Calculus
- Plane Curves and Parametric Equations
- Parametric Equations and Calculus
- Polar Coordinates and Polar Graphs

Section Project: Anamorphic Art

- Area and Arc Length in Polar Coordinates
- Polar Equations of Conics and Kepler's Laws

Chapter 10: Vectors and the Geometry of Space

(6 days—one test)

- Vectors in the Plane
- Space Coordinates and Vectors in Space
- The Dot Product of Two Vectors
- The Cross Product of Two Vectors in Space
- Lines and Planes in Space

Section Project: Distances in Space

After the AP Exam:

Appendix A: Differential Equations

(6 days—one test)

- Definitions and basic concepts of differential equations
- First order linear differential equations

Chapter 5: Hyperbolic Functions

(4 days—one test)

- Hyperbolic functions and applications

Second Semester Exam *(two review days)*

The exam will consist of applications of Integration, Integration Techniques, L'Hoptial's Rule, Improper Integrals, Infinite Series, Conics, Parametric and Polar Equations, and Vectors.

Graphing Calculator

Much of the AP Calculus BC course requires the use of calculators. Most of the students use the TI-84 graphing calculator and we have weekly sessions on how to use the calculator with calculus problems. It is expected that not all problems are done with the use of a calculators as the AP exam allows calculators for only half of the test. The list of calculators that can be used for the AP exam are the following:

Casio	**Hewlett-Packard**	
FX-6000 series	HP 9G	
FX-6200 series	HP 28 series	**Texas Instruments**
FX-6300 series	HP 48 series	TI-73

FX-6500 series	HP 49 series	TI-80
FX-7000 series	HP 38G	TI-81
FX-7300 series	HP 39 series	TI-82
FX-7400 series	HP 40G	TI-83/TI-83 Plus
FX-7500 series	HP 50 series	TI-83 Plus Silver
FX-7700 series		TI-84 Plus
FX-7800 series	**Radio Shack**	TI-84 Plus Silver
FX-8000 series	EC-4033	TI-85
FX-8500 series	EC-4034	TI-86
FX-8700 series	EC-4037	TI-89
FX-8800 series		TI-89 Titanium
FX-9700 series	**Sharp**	TI-NSpire CAS+
FX-9750 series	EL-5200	
CFX-9800 series	EL-9200 series	**Other**
CFX-9850 series	EL-9300 series	Datexx DS-883
CFX-9860 series	EL-9600 series	Micronta
CFX-9950 series	EL-9900 series	Smart^2
CFX-9970 series		
FX 1.0 series		
Algebra FX 2.0 series		

Three Before Me Policy

Every student is expected to ask three other students for help before they ask the teacher for assistance. This is done so that students can learn from each other and so that the students that are teaching can review the material again. If none of the three students can answer the question, then I will go ahead and assist the class in solving the problem so that everyone has an understanding of the problem in question.

AP Review

I try to allot a minimum of five weeks before the AP Exam to devote to review. During this five-week period, students work on the sample questions from free-response questions from AP Calculus BC Released Exams. Some of these are assigned for homework, while others are given as a quiz or test.

Primary Textbook

Larson, Ron, Robert P. Hostetler, and Bruce H. Edwards. *Calculus with Analytic Geometry*. 7th ed. Boston: Houghton Mifflin, 2002.

Web Resources

AP Calculus BC Syllabus 4 from the *AP CollegeBoard Website* found at
http://apcentral.collegeboard.com/apc/members/courses/syllabi/index.html

Calculus BC Course Requirements found at
http://apcentral.collegeboard.com/apc/public/courses/teachers_corner/51042.html

AP Calculus Course Description found at
http://apcentral.collegeboard.com/apc/members/repository/05836apcoursdesccalc0_4313.pdf