

# AP Calculus BC Syllabus

This syllabus is only an outline of the BC Calculus course we offer. The goal of the course is to teach the students college level calculus and to prepare them for Calculus III at the college level. The course utilizes the “Rule of 4” (Analytical, Graphical, Numerical, Verbal) methods along with daily problem solving and presentations of solutions to allow students to experience the calculus and mathematics completely. Graphing calculators and mathematical software are used to help students learn graphically and numerically. Proper written solutions are emphasized. Students work regularly in groups, and are expected to communicate the calculus with their fellow students.

Primary Text: Larson, Ron, Bruce H. Edwards, and Robert P. Hostetler. *Calculus, 6<sup>th</sup> Edition*. Boston: Houghton Mifflin.

## Chapter P: Preparation for Calculus (5 Days)

- Preview of Calculus: Slope of Tangent Line / Area Under Curve
- Elementary Functions
- Graphs of Functions
- Introduction to Graphing Calculators

## Chapter 1: Limits and Their Properties (8 Days)

- Limits: Graphically, Numerically, Analytically
- Continuity
- Infinite Limits
- Exploring Limits Graphically and Numerically Using the Calculator

## Chapter 2: Differentiation (12 Days)

- Definition of Derivative
- Tangent Line Problem
- Basic Derivative Rules: Power, Product, Quotient Rules
- Higher Order Derivatives
- Trigonometric Derivatives
- Chain Rule
- Implicit Differentiation
- Related Rates Problems
- Exploring Derivatives Graphically and Numerically Using the Calculator

Chapter 3: Applications of Differentiation (12 Days)

- Relative and Absolute Extrema
- Mean Value Theorem
- Increasing, Decreasing Functions and Concavity
- First and Second Derivative Tests
- Curve Sketching by Hand with a Calculator as a Check
- Optimization Problems
- Newton's Method
- Differentials
- Antiderivatives
- Motion: Position, Velocity, Acceleration

Chapter 4: Integration (10 Days)

- The Area Problem
- Riemann Sums
- Approximating Areas Numerically with the Help of a Calculator
- Definite Integral
- Fundamental Theorem of Calculus
- Integration by Substitution
- Definite Integral of a Rate as a Cumulative Function

Chapter 6: Applications of Integration (9 Days)

- Area Between Curves
- Volumes of Surfaces of Revolution: Discs and Washers
- Volumes of Solids with Known Cross Sections
- Arc Length
- Surface Area

Chapter 7 (7.1 – 7.6): Integration Techniques (10 Days)

- Integration by Parts
- Trigonometric Integrals
- Trigonometric Substitution
- Partial Fractions
- Integration Using Tables and Computer Algebra Systems

Chapter 5 (5.1 – 5.5, 5.8, and 5.9): Logarithmic and Exponential Functions (6 Days)

- Natural Log Function and Exponential Function
- Derivatives and Integrals
- Inverse Functions

- Bases Other Than  $e$
- Inverse Trigonometric Functions

Chapter 7 (7.7 – 7.8): Indeterminate Forms and L'Hopital's Rule (4 Days)

- Indeterminate Forms
- L'Hopital's Rule
- Improper Integrals

Chapter 5 (5.6, 5.7, and 15.1): Differential Equations (7 Days)

- Separation of Variables
- Growth and Decay, Exponential
- Logistic Growth
- Slope Fields
- Euler's Method
- Solving Differential Equations Graphically and Numerically Using a Calculator

Chapter 9 and 11.3: Parametric, Polar and Vectors (10 Days)

- Parametric Equations, Derivatives and Integrals
- Vectors: Position, Velocity, Acceleration, Speed, Arc Length
- Polar Equations: Area, Arc Length
- Using a Calculator to Explore Parametric and Polar Graphs

Chapter 8: Series (15 Days)

- Sequences and Series
- Convergence Tests
- Geometric Series
- Power Series
- Taylor and Maclaurin Series
- Lagrange Error Bound
- Radius and Interval of Convergence

## Review for AP Exam

The course content is finished approximately three weeks before the AP exam. The three weeks before the exam are filled with solving past AP questions, both free response and multiple choice questions. Past AP questions are also used throughout the year, but are solved in earnest leading up to the exam. Students work through several complete exams in class as Power-Quizzes and several complete exams at home for homework.

## Functions from Multiple Representations

The idea of the function is the main part of the course and the importance of representing functions numerically, analytically, and graphically is examined with the introduction of every topic: limits, derivatives, integrals, differential equations, infinite series, etc.

Traditional calculus books do an excellent job of teaching functions analytically, but it is only when students can also examine a topic numerically and graphically do they fully understand the foundations of many of the ideas of the calculus.

## Communicating Mathematics

It is extremely important not only for students to watch and copy mathematics, but to also be able to write out complete solutions and to be able to verbalize the mathematics to other students and to the class as a whole. Communication is a major part of our calculus course. As stated earlier, students daily are expected to write out complete solutions to problems with proper justifications using complete sentences. The course allows for a lot of time for students to work together on problems and to discuss solutions. Students also are given a lot of opportunities to present their solutions to the class. For a student to truly understand the calculus not only must they be able to solve problems, they must also be able to write out their work clearly with justifications and to be able to explain their work clearly to others.

## Graphing Calculators

Every student in our calculus course is required to own a graphing calculator. Most students use a TI-Calculator, both with and without a Computer-Algebra-System. Students use their graphing calculators nearly every single day in the course. They use the calculator to solve problems, experiment with a new concept, support conclusions, and interpret results. They become so adept at using it, that it really becomes just another “tool” that they can call on to explore a concept or solve a problem. Students also learn the limits of what a graphing calculator can do. They learn when it is advantageous to use a calculator, and when a “by-hand” solution is easier. Even though students are very adept at using their calculators, on tests they still solve the majority of questions (75%) without a calculator. They learn not to rely on the graphing calculator as a crutch for doing the calculus.

## Reference List

Larson, Ron, Bruce H. Edwards, and Robert P. Hostetler. *Calculus, 6<sup>th</sup> Edition*. Boston:

Houghton Mifflin.

Finney, Ross L., Franklin Demana, Bert K. Waits, and Daniel Kennedy. *Calculus: Graphical, Numerical, Algebraic: AP Edition*. Boston: Pearson Prentice Hall.

Stewart, James. *Single Variable Calculus: Concepts and Contexts*. Belmont, CA: Brooks/Cole.

Hughes-Hallet, Deborah, et al. *Calculus: Single Variable*. New York: John Wiley and Sons.