Course Name: AP Calculus BC

Duration: ☐ 1 Semester ☒ Full Year

Grade Level: ☒ 9th ☒ 10th ☒ 11th ☒ 12th (check all that apply)

Are there any prerequisites for the course?

Passing grade in both semesters of Precalculus REQUIRED. A grade of B or higher in Honors Precalculus *highly recommended*.

WHAT this course is about:

This class covers two semesters (three quarters) of college Calculus.
Calculus BC is concerned with developing the students' understanding of the concepts of calculus and providing experience with its methods and applications. The courses emphasize a multi-representational approach to calculus, with concepts, results, and problems being expressed graphically, numerically, analytically, and verbally. The connections among these representations also are important.

Broad concepts and widely applicable methods are emphasized. The focus of the courses is neither manipulation nor memorization of a list of functions, curves, theorems, or problem types. Although problems with manipulation and computational competence are important they are not the core of the course.

Technology will be used regularly to reinforce the relationships among the multiple representations of functions, to confirm written work, to experiment, and to assist in interpreting results.

Through the use of the unifying themes of derivatives, integrals, limits, approximation, and applications and modeling, the course becomes a cohesive whole rather than a collection of unrelated topics.

WHY take this course:

Take this course if you are wanting to challenge yourself in mathematics or are planning on studying Science, Engineering, or Mathematics in college.

WHAT you'll learn:

Limits: Students must have a solid, intuitive understanding of limits and be able to compute one-sided limits, limits at infinity, the limit of a sequence, and infinite limits. They should be able to apply limits to understand the behavior of a function near a point and understand how limits are used to determine continuity.

Derivatives: Students should be able to use different definitions of the derivative, estimate derivatives from tables, and graphs, and apply various derivative rules and properties. Students should also be able to solve separable differential equations, understand and be able to apply the

Mean Value Theorem, and be familiar with a variety of real-world applications, including related rates, optimization, and growth and decay models.

Integrals and Fundamental Theorem of Calculus: Students should be familiar with basic techniques of integration, including basic antiderivatives and substitution, and properties of integrals. Students should also understand area, volume, and motion applications of integrals, as well as the use of the definite integral as an accumulation function. It is critical that students understand the relationship between integration and differentiation as expressed in the Fundamental Theorem of Calculus.

Series: Students should be familiar with various methods for determining convergence and divergence of a series, Maclaurin series for common functions, general Taylor series representations, radius and interval of convergence, and operations on power series. The technique of using power series to approximate an arbitrary function near a specific value allows for an important connection back to the tangent line problem.

WHAT you'll do:

You will learn to connect multiple representations of concepts expressed graphically, numerically, analytically, and verbally. The connections between these representations are important.

You will learn to communicate mathematically. Not only to solve a problem but to properly justify your answer.

You will learn to identify the level and type of practice you need to be successful at understanding concepts. Practice is chosen from a menu of options that are from electronic sources (Khan Academy, AP Classroom), our textbook, or worksheets. Reflecting on the accuracy of your work and learning to correct mistakes are also important to your learning in this course.

WHERE this could take you:

With a score of 3 or better on the AP Calculus BC test you could earn up to 2 semesters (3 quarters) of credit for calculus at many universities. You will also receive an AP Calculus AB subscore which can earn you up to a semester (2 quarters) of calculus at many universities.

Most LC students who finish AP Calculus BC in their Freshmen, Sophomore, or Junior years go on to take AP Statistics, do Running Start, or enroll at Gonzaga to take Multi-Variate Calculus (aka Calculus 3) and beyond. Seniors typically go on to the university and enroll in either Calculus 2 or Calculus 3 depending on their AP score and confidence in the material.

Most Business, Science, Technology, Engineering, and Mathematics majors require at least one semester of college calculus. This class could satisfy this requirement while still in High School.

OPTIONAL Course Outline ("scope and sequence", sequence chart, etc.)

I. Semester 1
   a. Unit 1 – Limits & Derivatives
      i. Summer Assignment
         1. Limits – Algebraically, Numerically, Graphically
         2. Continuity
         3. Definition of a Derivative
         4. Basic Derivative Properties – Power, Product, Quotient, Sums & Differences
         5. Differentiability
      ii. Chain Rule
      iii. Implicit Differentiation
      iv. Related Rates
      v. L'Hospital's Rule
      vi. Inverse Derivatives
   b. Unit 2 – Graph Analysis aka "The Calc House"
      i. MVT
      ii. EVT
      iii. Calc House with Polynomials
      iv. Optimization
      v. Motion along a Line - Derivatives
   c. Unit 3 – Definite Integral
      i. Reimann Sums
      ii. Evaluating Definite Integrals – $F(b) - F(a)$
      iii. Fundamental Theorem of Calculus (FTC)
      iv. Integration by Substitution (U-Substitution)
      v. Integration by Parts
      vi. Integration by Partial Fractions
   d. Unit 4 – Differential Equations
      i. Slope Fields
      ii. Differential Equations
      iii. Euler's Method
      iv. Exponential and Logistic Growth
   e. Unit 5 – Integration Applications
      i. Area between 2 Curves
      ii. Volume of Cross Sections
      iii. Volume of Revolutions – Washer & Disk

II. Semester 2
   a. Unit 6 - Parametric & Polar Functions
      i. Derivatives of Parametric Functions
      ii. Motion along a Line (integrals)
      iii. Derivatives of Polar Functions
      iv. Motion along a Curve
      v. Length of a Curve
      vi. Area of Polar Curves
   b. Unit 7 – Sequences & Series

i. Summation Notation
ii. Geometric Sums
iii. Geometric Power Series
iv. Manipulating the Geometric Power Series
v. Writing Series
    1. Maclaurin Series
    2. Taylor Series
vi. Testing Convergence
    1. Alternating Series Test
    2. Ratio Test
    3. Integral Test/Improper Integrals
vii. Error Bound

c. Unit 8 – AP Review

Unit 9 – Post Calculus Project