AP Calculus AB

INSTRUCTOR: Mr. Dennis Peterson
E-MAIL: dpeterson@helenaschools.org
PHONE: 324-2556
MATERIALS: Calculus Single Variable, Scientific Calculator

Course Description: 3401 CALCULUS (Sr) (1 Credit)

This Honors course is designed for high ability mathematics students planning to take calculus as college freshmen.
Prerequisites: A or B in Honors Pre-Calculus and recommendation of instructor.

Course Materials

Textbook

Larson, Ron and Paul Battaglia. *Calculus for AP*. Cengage Learning 2017

Calculator

Each class has a set of TI-84 PLUS CE calculators. Many of students have their own calculator of equal or higher power. These calculators are used on a regular basis and students are proficient with them upon arriving in Calculus.

Grade Breakdown:

Tests & Quizzes (80%), Homework (20%)
Semester Grade: Quarter 1 (40%), Quarter 2 (40%), Exam (20%)

Class Rules: The Bruin Basics (standard rules of Capital High) are posted in the classroom.

Grading Scale:

91 – 100 = A	78 – 79.99 = C+	62 – 67.99 = D
90 – 91.99 = A-	72 – 77.99 = C	60 – 61.99 = D-
88 – 89.99 =B+	70 – 71.99 = C-	59.99 AND BELOW = F
82 – 87.99 = B	68 – 69.99 = D+	

I. Functions, Graphs, and Limits

A. Analysis of Graphs

With the aid of technology, graphs of functions are often easy to produce. The emphasis is 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 (incl. one-sided limits)

- An 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. (For example, contrasting exponential growth, polynomial growth, and logarithmic growth.)

D. Continuity as a Property of Functions

- An intuitive understanding of continuity. (The function values can be made as close as desired by taking sufficiently close values of the domain.)
- Understanding continuity in terms of limits.
- Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem).

II. Derivatives

A. Concept of the Derivative

- Derivative presented graphically, 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. Examples are emphasized, including points at which there are vertical tangents and points at which there are 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. Verbal descriptions are translated into equations involving derivatives and vice versa.

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 the notions of monotonicity and concavity.
- 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 the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration.
- Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations.

F. Computation of Derivatives

- Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions.
- Basic rules for the derivative of sums, products, and quotients of functions.
- Chain rule and implicit differentiation.

III. Integrals

A. Interpretations and Properties of Definite Integrals

- Definite integral as a limit of Riemann sums.
- Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval.
- Basic properties of definite integrals. (Examples include additively and linearity.)

B. Applications of Integrals

Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve other similar application problems. Whatever applications are chosen, the emphasis is on using the integral of a rate of change to give accumulated change or using the method of setting up an approximating Riemann sum and representing its limit as a definite integral. To provide a common foundation, specific applications should include finding the area of a region, the volume of a solid with known cross sections, the average value of a function, and the distance traveled by a particle along a line.

C. Fundamental Theorem of Calculus

- Use of the Fundamental Theorem to evaluate definite integrals.
- Use of the Fundamental Theorem 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 (including change of limits for definite 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 $y' = ky$ and exponential growth.

F. Numerical Approximations to Definite Integrals

- Use Riemann sums (using left, right, and midpoint evaluation points). Students will be able to relate the notation for a definite integral to that of the limit of a Riemann sum.

- Use trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values.

Institutional Competencies addressed by this course:

Communicate effectively: The student will read with critical comprehension; write clearly and coherently; and practice effective speaking and listening skills.

Apply critical analysis and problem-solving skills: The student will use acquired skills or methods to recognize, analyze, adapt, and apply critical thinking to solve problems and make informed decisions.

Develop quantitative literacy: The student will be able to reason analytically and quantitatively, think critically and independently about mathematical situations, and make informed decisions that involve quantitative skills.

Apply information/technology literacy across disciplines: The student will learn to locate needed information, managing and evaluating the extracted information and using it critically and ethically; and the student will use appropriate technology to access, manage, integrate, or create information, and/or use technology to effectively accomplish a given task.

Develop practical skills through applied disciplinary learning: The student will integrate knowledge from academic disciplines and applied programs of study into progressively more complex problems, projects, and standards of performance in a chosen discipline

Course Goals:

- Extend knowledge and understanding of mathematical concepts, specifically in the study of differential and integral calculus.
- Develop skills in formulating and solving problems involving differential and integral calculus.
- Design mathematical models using calculus and basic differential equations to capture the essence of real-world patterns and phenomena.
- Interpret mathematical models and their solutions in the context of their real-world applications.
- Critique mathematical models to identify their strengths and weaknesses and modify them to make them better models.
- Expand knowledge and understanding of the world through mathematical analysis.

- Develop skills to effectively use modern computing, information, and communication technologies.
- Develop skills to effectively communicate mathematical ideas orally and in writing.