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HOME OF THE COUGARS

2024-2025 COURSE SYLLABUS

Advanced Placement Calculus BC

Instructor:

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Textbook:

Calculus for AP, Ron Larson and Paul Battaglia, 2017 [**CR4]**

Supplemental Resources:

AP Classroom-Calculus (website)
Barron’s AP Calculus Test Preparation

Course Description:

This is a college-level Calculus course designed to meet the Advanced Placement curricular requirements to Calculus BC (equivalent to two terms of college Calculus courses). The major topics covered in this course are limits, derivatives, integrals, the Fundamental Theorem of Calculus, and series. These concepts will be developed using reasoning with definitions and theorems, algebraic and computational processes, and the use of graphing calculators when appropriate. Students in this class will be asked to demonstrate competency verbally, through writing, with notational fluency, and be required to connect concepts graphically, numerically, analytically, with tabular data, and through written words.

Technology Requirement:

Graphing calculators will be used in class and for at-home assignments regularly. All in-class calculator demonstrations will be on a TI-84 Plus CE, however, any AP-approved calculator is acceptable. Since scientific calculators are not permitted on the AP exam, their use will not be permitted in class. Most class assessments will include both a calculator and non-calculator exam. Those students who cannot provide their own calculator will be given the opportunity to check one out for the school year from the instructor **[CR3a]**. Students are expected to bring a charged school-issued Chromebooks or a personal laptop to class each day.

Additional Support:

Tutoring will be available before school from 8am until the first bell, during C-Building lunch, and after school until 4pm on available days (which will be posted and updated regularly).

Final Exams:

At the end of the first semester and before the AP exam in the second semester, students will participate in a final exam to demonstrate overall content knowledge acquired during the year.

Grading Scale:

A	89.5-100%
B	79.5-89.4%
C	69.5-79.4%
D	59.5-69.4%
F	0-59.4%

2024-2025 COURSE SYLLABUS

Grading Categories:

90% Assessments
10% Assignments

Late Work Policy:

Assignments submitted after the posted due date are subject to a point deduction not exceeding 50%. However, all unit assignments must be submitted before the unit test is administered to be graded.

Missed Assessment Policy:

If an assessment is missed due to unpreventable circumstances, it is the student's responsibility to contact the teacher as soon as they know they will/have missed the assessment in order to discuss any possible make-up opportunities.

Plagiarism Policy:

Any instances of plagiarism will result in a missing assignment/assessment.

Academic Expectations:

Students are expected to engage fully in all classroom activities as well as advocate for their own learning needs and taking advantage of additional opportunities/resources for full comprehension. Students will utilize information posted in the classroom and on Google Classroom to ensure they are aware of class expectations on any given day, whether they are present in class or working at home. Students will work towards increasing their concept mastery each day, understanding that opportunities to demonstrate this mastery and thus earn a passing grade will not cease until semester grades are final. Students will seek out assistance from the teacher, their peers, or family members whenever necessary to reach success.

Topic Outline:

Unit 1: Limits and Continuity **[CR1a]**

1.2 Finding Limits Graphically and Numerically
1.3 Evaluating Limits Analytically
1.4 Continuity and One-Sided Limits
1.5 Infinite Limits
1.6 Limits at Infinity

Unit 2: Derivatives **[CR1b]**

2.1 The Derivative and the Tangent Line Problem
2.2 Basic Differentiation Rules and Rates of Change
2.3 Product and Quotient Rules and Higher-Order Derivatives
2.4 The Chain Rule
2.5 Implicit Differentiation
2.6 Derivatives of Inverse Functions
2.7 Related Rates

Unit 3: Applications of Derivatives **[CR1b]**

2024-2025 COURSE SYLLABUS

3.1 Extrema on an Interval
3.2 Rolle's Theorem and the Mean Value Theorem
3.3 Increasing and Decreasing Functions and the First Derivative Test
3.4 Concavity and the Second Derivative Test
3.6 Optimization Problems
3.7 Differentials

Unit 4: Integrals **[CR1c]**
4.1 Antiderivatives and Indefinite Integration
4.2 Area
4.3 Riemann Sums and Definite Integrals
4.4 The Fundamental Theorem of Calculus
4.5 Integration by Substitution
4.6 The Natural Logarithmic Function: Integration
4.7 Inverse Trigonometric Functions: Integration
+ Riemann Sums and Trapezoidal Sums with Unequal Subintervals

Unit 5: Differential Equations
5.1 Slope Fields and Euler's Method
5.2 Differential Equations: Growth and Decay and Newton's Law of Cooling
5.3 Separation of Variables
5.4 The Logistic Equation

Unit 6: Volume
6.1 Area of a Region Between Two Curves
6.2 Volume: The Disk and Washer Methods
6.3 Volume: The Shell Method
6.4 Arc Length and Surfaces of Revolution
+ Cross-Sectional Volume

Unit 7: Techniques of Integration and Improper Integrals
7.1 Basic Integration Rules
7.2 Integration by Parts
7.3 Trigonometric Integrals
7.4 Trigonometric Substitution
7.5 Partial Fractions
7.7 Indeterminate Form and $L'Hôpital's$ Rule
7.8 Improper Integrals

Unit 8: Series **[CR1d]**
This unit will begin in the first semester following unit 1, then reviewed fully and completed in the

2024-2025 COURSE SYLLABUS

second semester.

8.1 Sequences
8.2 Series and Convergence
8.3 The Integral Test and p-Series
8.4 Comparisons of Series
8.5 Alternating Series
8.6 The Ratio Test
8.7 Taylor Polynomials and Approximations
8.8 Power Series
8.9 Representation of Functions by Power Series
8.10 Taylor and Maclaurin Series

Unit 9: Calculus of Curves Defined by Polar Equations, Parametric Equations, and Vector-Valued Functions

9.1 Conics and Calculus
9.2 Plane Curves and Parametric Equations
9.3 Parametric Equations and Calculus
9.4 Polar Coordinates and Polar Graphs
9.5 Area and Arc Length in Polar Coordinates
9.6 Vectors in a Plane
9.7 Vector-Valued Functions
9.8 Velocity and Acceleration

Activities Relating to the Six Mathematical Practices and Technology Requirement:

[CR2a] This course provides opportunities for students to reason with definitions and theorems.

- Given a table of values for a function or the derivative of a function, students will be asked such questions as 'does the function have any zeros on the given interval', 'does the function reach a particular value on the given interval', or 'are there any points at which the function has a horizontal tangent line on the given interval'. These questions will require complete justification using the Intermediate Value Theorem, the Mean Value Theorem, or Rolle's Theorem.
- Given the graph of the derivative of as function and a single value from the original function, students will have to apply the Fundamental Theorem of Calculus to find another value on the graph of the original function.

2024-2025 COURSE SYLLABUS

- Students will prove basic differentiation formulas by applying the limit definition of the derivative.

[CR2b] This course provides opportunities for students to connect concepts and processes.

- Students will be asked to sketch graphs of functions based on information given only about the derivatives of these functions.
- Students will have to solve a variety of accumulation problems by applying basic integrals and the Fundamental Theorem of Calculus.
- Students will regularly be asked to solve problems related to particle motion by applying derivatives, the average rate of change, indefinite and definite integrals, and vector-valued functions.

[CR2c] This course provides opportunities for students to implement algebraic/computational processes.

- Students will regularly perform sophisticated algebraic simplification in derivative functions and indefinite integrals.
- Students will complete an activity that has them compute and compare left Riemann sums, right Riemann sums and trapezoidal sums.
- Students will apply formulas and compute volume of both solids of revolution and solids formed by defined cross sections.

[CR2d] This course provides opportunities for students to engage with graphical, numerical, analytical, and verbal representations and demonstrate connections among them.

- Students will be given problems describing a solid formed by defined cross sections in a region bound by the graphs of functions. For each of the problems they will be asked to draw and shade the region defined in the problem, then write an expression containing one or more integrals that can be solved to find the volume of the solid built.
- Students will regularly be asked to derive general information about a function given only certain information that may be contained in a table of values, a written description, and equation for the derivative or antiderivative of a function, or a graph of the derivative or antiderivative of the function.
- In an activity that considers the functions f, f', and f'' in which one of those graphs is given, students will be asked to create a sign chart for each of the functions, then sketch a possible graph of each of the functions, then answer some graphical analysis questions about each of the functions and to justify their reasoning.

[CR2e] This course provides opportunities for students to build notational fluency.

- Given the graph of a function $f(x)$, students will have to answer questions about the related function $g(x)=\int_0^x f(x)dx$ such as its value at a given value of x and the value of its derivative at a certain value of x.

- Students will be asked to translate growth/decay problems written in the form 'the rate of change of y is proportional to ____' into a separable differential equation of the form $\frac{dy}{dt} = ?$. In order to finish the in-context problem, they will need to solve their differential equation by separating the differentials dy and dt.
- Given the graph of a piecewise-defined function, students will have evaluate the one- and two-sided limits of the value of x that is the boundary of the domain of the different functions. They will then have to discuss the continuity of the function at this given value of x.

[CR2f] This course provided opportunities for students to communicate mathematical ideas in words, both orally and in writing.

- When applying the Mean Value Theorem, Intermediate Value Theorem, or Rolle's Theorem on assignments and tests, students will be required to write a full explanation of how they know the theorem applies and the conclusion that can be made with that theorem.
- On every unit test, at least one question will ask them to write a full justification of the calculation they performed and conclusion reached. These justifications must always include units and intervals of time, when appropriate. When using the First Derivative Test to find relative extrema, students will always be required to write a complete sentence justifying the location of the relative extrema.
- Students will regularly asked to interpret the meaning, in words, of a given integral expression such as $\frac{1}{5}\int_0^5 |v(t)|\,dt$, where $v(t)$ is the velocity of an object orally in small group discussions. This explanation will have to include both units and an interval of time. On assignments and tests, questions like this will require a written interpretation with the same guidelines.
- In partner discussions, given a graph of f, f', or f'', students will have to describe each of the characteristics they see on the graph and the interpretation of what that implicates about the related derivative and antiderivative graphs. This discussion will be followed by each student drawing a possible graph of the related derivative and antiderivative functions.
- When learning about limits students will be asked to give an oral description, in their own words, about the meaning of a limit in general and in the context of particular questions about limits that include graphs, tables of values, or functions.
- At the beginning of each class, we will go over some solutions to homework problems that part of the group had trouble solving. While going over these questions, students will orally present various strategies they used to solve the problems and then discuss which strategies seem the most efficient and effective.

[CR3b and CR3c]

- Students will use graphing calculators to solve problems that involve graphing functions, calculating the zeros of a function, finding the intersection of functions, calculating the relative extrema of a function, calculating the derivative of a function at a point, graph the derivative of function, calculating a definite integral, and storing calculated values for later use.

2024-2025 COURSE SYLLABUS

- Students will graph the equation of a derivative for which they are unable to find the antiderivative with the techniques learned in this class. From their graph, they will create a sign chart for the derivative function, then make conclusions about the original function (such as its increasing/decreasing behavior, its concavity, and its relative extrema).
- Students will apply the Fundamental Theorem of Calculus to functions for which they cannot easily find the antiderivative by using the graphing calculator's ability to calculate definite integrals.
- In learning about infinite limits, students will use their graphing calculators to create a table of values for a function (this function must be complex enough as to not be able to be graphically visualized by the students without the use of technology) and then make a conjecture about the limit of the function as x approaches an asymptote or as x approaches ∞.

Before learning the method of evaluating limits of rational functions that are undefined at a given value of x, students will use their graphing calculators to compare a table values for the function with the graph of the function and make conjectures about when the limit will exist.