

AP Calculus AB Course Syllabus

COURSE DESCRIPTION: AP Calculus AB is equivalent to a semester of college-level calculus. This Advanced Placement course introduces limits, differentiation, and integration of functions. Students find and evaluate finite and infinite limits graphically, numerically, and analytically. They find derivatives using a variety of methods including The Chain Rule and Implicit Differentiation. They use the First Derivative Test and The Second Derivative Test to analyze and sketch functions.

Subsequently, students will find antiderivatives using a variety of methods including substitution. They will evaluate integrals using a variety of methods including numerical integration. They will understand and apply Riemann sums, definite integrals, and The Fundamental Theorem of Calculus. In particular, they will differentiate and integrate logarithmic, exponential, and inverse trigonometric functions. They will solve simple differential equations that can be solved by separation of variables and use them to solve applied problems. They will use integration to determine the area between two curves and the volume of solids.

COURSE OBJECTIVES:

- Find and evaluate finite and infinite limits graphically, numerically, and analytically.
- Find derivatives using a variety of methods including The Chain Rule and Implicit Differentiation.
- Find extrema and apply Rolle's Theorem and the Mean Value Theorem.
- Use the First Derivative Test and The Second Derivative Test to analyze and sketch functions.
- Find antiderivatives using a variety of methods including substitution.
- Understand and apply Riemann sums, definite integrals, and The Fundamental Theorem of Calculus.
- Evaluate integrals using a variety of methods including substitution and numerical integration.
- Differentiate and integrate logarithmic, exponential, and inverse trigonometric functions.
- Solve simple differential equations that can be solved by separation of variables.
- Use simple differential equations that can be solved by separation of variables to solve applied problems.
- Use integration to determine the area between two curves and the volume of solids.

COURSE LENGTH: Two Semesters

REQUIRED MATERIALS: *Calculus*, 8/E Larson | ©2006 | Houghton Mifflin

Graphing calculator

COURSE OUTLINE:

Unit 1 – Limits

Evaluate a limit graphically, numerically, and analytically.
Use limits to describe the continuity of a function at a point.

- Section 1 - Finding Limits Numerically and Graphically
- Section 2 - Finding Limits Analytically
- Section 3 - Continuity and One-Sided Limits

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Unit 2 – Differentiation

Understand the concept of the derivative as it relates to the tangent line to a curve at a point.

Use a variety of techniques to calculate the derivative of a function.

Use derivatives with respect to time to solve rates of change problems.

- Section 1 - The Derivative
- Section 2 - Differentiation
- Section 3 - Implicit Differentiation

Unit 3 - Graph Behavior

Understand and use the concepts of the Mean Value Theorem,

Identify all relative and absolute extreme values of a function on a given domain interval.

Describe the increasing/decreasing behavior, concavity, and end-behavior of a function.

- Section 1 - Extrema and the Mean Value Theorem
- Section 2 - Increasing, Decreasing, and Concavity Behavior
- Section 3 - Limits at Infinity and Curve Sketching

Unit 4 - Applications of Differentiation

Describe the characteristics of an object moving along a linear path.

Use optimization in applied minimum and maximum problems.

Calculate and use differentials to approximate change in a quantity.

- Section 1 - Linear Motion
- Section 2 - Optimization and Differentials

Semester 1 Exam

Unit 5 – Integration

Find the antiderivative of a function as a indefinite integral.

Calculate areas using definite integrals.

Use the Fundamental Theorem of Calculus.

Approximate and evaluate definite integrals.

- Section 1 - Antiderivative and Area
- Section 2 - Riemann Sums and Definite Integrals
- Section 3 - The Fundamental Theorem of Calculus
- Section 4 - Substitution and Trapezoidal Methods

Unit 6 – Transcendentals

Find derivatives and integrals involving exponential functions.

Find derivatives and integrals involving logarithmic functions.

Find the derivative of an inverse function.

Find derivatives and integrals involving inverse trigonometric functions.

- Section 1 - Natural Logarithm
- Section 2 - Inverse and Exponential Functions
- Section 3 – Exponential, Logarithmic, and Inverse Trigonometric Functions

Unit 7 - Differential Equations

Find solutions to a variety of differential equations.

Draw connections between slope fields and differential equations.

Identify indeterminate forms of differential equations.

Evaluate indeterminate limits using l'Hôpital's Rule.

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- Section 1 - Slope Fields
- Section 2 - Growth and Decay
- Section 3 - Separation of Variables and l'Hôpital's Rule

Unit 8 – Applications

Find the area between two curves.

Find the volume of a solid of revolution.

Find the volume of a solid with known cross sections.

- Section 1 - Area Between Two Curves
- Section 2 - Solids of Revolutions
- Section 3 - Cross Sections

Semester 2 Exam

INSTRUCTIONAL STRATEGIES:

In this course students use their calculators in a variety of ways: to conduct explorations, graph functions with arbitrary windows, solve equations numerically, analyze and interpret results, and justify and explain results of graphs and equations. At the beginning of the course, students are given an introduction to using their graphing calculator and some short practice activities.

Students also practice answering free response problems by working collaboratively in groups to formulate responses and then individually to perfect and finalize their answers for submission. In other activities, students answer free response problems individually and share their solutions with classmates who create rubrics and score the responses as AP readers might score them.

ASSESSMENT STRATEGIES:

Students are assessed using quizzes and unit tests modeled after the types of questions typically seen on AP Calculus AB exams. All unit tests include a free response portion made up of appropriate of free response questions from released AP exams or in the style of AP exam questions. Students must provide written responses to these questions to explain and justify their answers.

SAMPLE ASSIGNMENT:

GRAPH BEHAVIOR LAB

The purpose of this activity is to assess your understanding of the graphical analysis presented in Unit 3. Below are sixteen different rational functions. Your instructor will assign to you one of these functions for the activity outlined below.

	A	B	C	D
1	$f(x) = \frac{x}{x^2 - 1}$	$f(x) = \frac{5}{2x^2 - 9}$	$f(x) = \frac{3x^2}{4 - x^2}$	$f(x) = \frac{x}{x^3 + x}$
2	$f(x) = \frac{x^2 - 2}{x^2 - 4}$	$f(x) = \frac{x^3 + 1}{x + 1}$	$f(x) = \frac{x}{x^2 + 1}$	$f(x) = \frac{x^2}{x^2 + 1}$
3	$f(x) = \frac{x^2 - x}{x^3 - 4x^2 - x + 4}$	$f(x) = \frac{x^2}{x^4 + 1}$	$f(x) = \frac{x^3}{x^2 - 4}$	$f(x) = \frac{x^3 - 1}{x}$

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4	$f(x) = \frac{x}{x^3 + 1}$	$f(x) = \frac{x-1}{x^2 + x}$	$f(x) = \frac{x^2}{x^3 + 1}$	$f(x) = \frac{x^2}{x^5 - 1}$
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Your assignment is to perform the tasks listed here, recording your answers into a single document.

1. Find $f'(x)$ and $f''(x)$. You may include intermediate steps in your answer, but only the final derivative functions are required.
2. Graph f , f' , and f'' . You may do so in a single coordinate plane or in three different planes, but label appropriately and make sure the window settings are reasonable.
3. Identify any x - and/or y -intercepts of f . State the intercepts as coordinates.
4. Identify any vertical, horizontal, and/or other end-behavior asymptotes of f .
 - Use limits to verify all vertical and/or horizontal asymptotes.
 - If there is a non-constant end behavior (such as a slant asymptote), describe it as a function of x .
5. Identify any removable discontinuities in f . Describe how f could be redefined to eliminate the hole in the graph.
6. State the intervals of increase and decrease of f .
7. State the intervals of upward and downward concavity of f .
8. Identify any relative extrema of f . State the extrema as coordinates.
9. Identify any absolute extrema of f . State the extrema using function notation.
10. Identify any points of inflection of f . State the points as coordinates.

A calculator is required for some functions, and you should round all numerical answers correctly to three decimal places.

Note that your assigned function will not have every graphical characteristic listed above. For example, your function may not have a relative maximum. When this is the case, please state "none" in your answer instead of leaving a blank.