

# AP – Calculus AB

## Course Description

Prerequisites: H – Pre-Calculus

Open To: 11<sup>th</sup>, 12<sup>th</sup> Grade

Level: Advanced Placement

Advanced Placement Calculus AB is designed to prepare the student to take the Calculus AB Advanced Placement Examination (offered each May) in an attempt to receive advanced placement and/or credit in the freshman year of college. It is an advanced course for those students recommended by the Mathematics Department. This course is equivalent to a one-semester college calculus course. Topics covered include: functions, limits, derivatives and their applications, transcendental functions and special integration methods and their applications. Students are required to bring a graphing calculator to class on a daily basis. The TI-89 is the recommended calculator. A significant portion of the AP exam is calculator based and the TI-89 will be the most helpful. The TI-86, TI83 and TI-84 calculators are good alternatives.

### Textbook

Title: Calculus with Analytic Geometry – 8th Edition

Publisher: Houghton-Mifflin

Author(s) Larson, Hostetler, Edwards

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### Course Objectives

At the end of the course, the student will be able to:

1. Analyze basic function by the use of Pre-Calculus techniques.
2. Evaluate limits, perform operations with limits, determine the continuity of a function and the behavior of the function at places of discontinuity and at infinity.
3. Calculate the derivative of functions “explicitly” and “implicitly” by the use of the definition of a derivative, power rule, product rule, quotient rule and chain rule.
4. Solve problems that deal with straight line motion, change with respect to time, change with respect to output and optimization using derivatives.
5. Use the derivative and limit to analyze graphs of functions.
6. Use differentials to solve problems that deal with error and economics.
7. Find the area between two curves using the Riemann Sum and the Fundamental Theorem of Calculus.
8. Solve problems involving growth and decay using differentiation and integration.
9. Find the volume of different shapes using the Disc Method, the Shell Method, and Cross-Sections.
10. Evaluate the integrals of the functions by various methods, including: substitution, numerical integration, completing the square, integration by parts, trigonometric substitution, partial fractions and the use of integration tables.

### Chapter Topics

<u>1st Semester</u>	<u>2nd Semester</u>
P Cartesian Plane & Functions	5 Logarithmic & Exponential
1 Limits & Their Properties	6 Differential Equations
2 Differentiation	7 Application of Integration
3 Applications of Differentiation	8 Integration Techniques
4 Integration	7 Application of Integration

## Course Planner

### Prerequisites Cartesian Plane & Functions

- 1 & 2 Real number Line, Cartesian Plane
- 3 & 4 Graphs of Equations, Lines in a Plane
- 5 Functions
- 6 Review of Trigonometric Functions
- Calculator Lab Work

### Chapter 1 Limits & Their Properties

- 1.1 Introduction to Limits
  - Look at numerically, graphically, analytically
  - Existence Theorem.
  - Ways limits Do Not Exist
- 1.2 Properties of Limits
  - Indeterminant forms
- 1.3 Techniques for Evaluating Limits
  - Special cases of  $\sin(x)$  and  $\cos(x)$
- 1.4 Continuity and One-Sided Limits
  - Intermediate Value Theorem
  - Properties of Continuous Functions
- 1.5 Limits of Infinity
  - More determinant & indeterminant forms
- 3.5 (addition) Limits at Infinity
  - Review horizontal asymptotes
  - Graphing rational functions
- Limits Calculator Lab Work

### Chapter 2 Differentiation

- 2.1 The Derivative and the tangent line problem
  - Definition of a derivative
  - Criteria for existence of a derivative
  - Sketch Pad Demonstration of tangent line problem
- 2.2 Basic Rules of Differentiation
  - Application with position, velocity & acceleration
  - Derivative as the instantaneous rate of change
- 2.3 The Product and Quotient Rules
  - Proof of product rule
  - Discover product rule & quotient rule on TI-89
- 2.4 The Chain Rule
  - Derivative of absolute value functions
- 2.5 Implicit Differentiation
  - Comparison of explicit and implicit differentiation
  - Graphing  $f'$  and  $f''$  from the graph of  $f$  & visa versa
- 2.6 Related Rates
  - change with respect to time
- Differentiation Calculator Lab Work

## Chapter 3 Applications of Differentiation

- 3.1 Extrema on an Interval
    - Increasing & decreasing functions & slopes
    - Relative & Absolute Minimums & Maximums
  - 3.2 Rolle's Theorem and the Mean Value Theorem
  - 3.3 The First Derivative Test
  - 3.4 Concavity and The Second Derivative Test
  - 3.6 A Summary of Curve Sketching
    - Polynomial & Rational Functions
  - 3.7 Optimization Word problems
  - 3.8 Newton's Method
    - Approximating zeros & solving systems
  - 3.9 Differentials
    - Comparison of  $dy$ ,  $\Delta y$ ,  $dx$  and  $\Delta x$  numerically & graphically
    - Maximum error, relative error & percentage error work sheet Business and Economics Applications.
    - change with respect to output
    - Profit, revenue, cost, ave. cost, marginals, price elasticity Calculator Lab Work
- Program Calculators with Newton's Method

## Chapter 4 Integration

- 4.1 Anti-derivatives and Indefinite Integration
    - Properties of Indefinite Integrals
    - Application with position, velocity & acceleration functions
    - Introduction to integration by substitution
    - Introduction to differential equations
  - 4.2 Area Under a Curve
    - Summation notation & formulas
    - Using the "Limit Process" for finding area
  - 4.3 Riemann Sums and Definite Integrals 2-days
    - Finding area under a curve with Riemann Sums
    - Comparison of the Limit Process to Riemann Sums
  - 4.4 The Fundamental Theorem of Calculus
    - The second fundamental theorem of calculus
    - The Mean Value Theorem of integration
  - 4.5 Integration by Substitution
    - Total substitution
  - 4.6 Numerical Integration
    - Trapezoid & Simpson's Rule
- Calculator Lab Work  
Program Calculators with Trapezoid & Simpson's Rule

## Review for Semester Exam and Exam

## Chapter 5 Logarithmic & Exponential

- 5.1 The Natural Logarithmic Function and Diff.
  - properties of logarithmic functions
  - Logarithmic Differentiation
- 5.2 Integration of the Natural Logarithmic
  - Integration of the six basic trig. functions
- 5.3 Inverse Functions
  - The derivative of an inverse function
- 5.4 Diff. and Integration of Exponential Functions
- 5.5 Bases Other Than e and Applications
  - Newton's law of cooling
- 5.6 Inverse Trigonometric Functions
  - Graphs of inverse trig. functions
  - Solving equation with inverse trig. functions
  - The derivative of inverse trig. functions
- 5.7 Integration of Inverse Trig. Functions
- Calculator Lab Work

## Chapter 6 Differential Equations

- 6.1 Slope Fields and Euler's Method
  - Graphing the field
  - Initial value problems
- 6.2 Differential Equations
  - Growth and Decay
  - Compound and Continuous Interest
- 6.3 Separation of Variables
  - Homogeneous Differential Equations
  - Logistic Differential Equations
- 6.4 First Order linear Differential Equations
  - Bernoulli Equation
  - Calculator program for slope fields
- Calculator Lab Work

## Chapter 7 Application of Integration

- 7.1 Area of a Region between Two Curves
- 7.2 Volume Using the Disc Method
  - Graphing 3-D, given a bounded region & axis of rotation
  - Use "Best Grapher" program to verify 3-D graph
  - Volumes with known Cross-Sections
- 7.3 Volume Using the Shell Method
- 7.4 Arc Length and Surface Area of Revolution
- Calculator Lab Work
- Project to make a 3-D model from rotation or cross-sections

## Chapter 8 Integration Techniques

- 8.1 Basic Integration Rules
  - Review all previous methods of integration
  - Speed drill of basic 20 integration formulas
- 8.2 Integration by Parts
  - Tabular method
- 8.5 Integration by Method of Partial Fractions
  - Linear and Quadratic and repeated factors
- 8.6 Integration Tables
  - Speed drill with tables
- 8.7 L'Hopital's Rule
  - Review indeterminate forms
- Calculator Lab Work

## Work on Project of 6 AP Test

- Take 3 Previous Year Timed Exams
- Take AP Calculus AB Exam

--After AP Exam--

## Chapter 7 Application of Integration

- 7.5 Work
  - Schaum's outline additional work
- 7.6 Fluid Pressure and Fluid Force
  - Vertical & horizontal plates
- 7.7 Moments, Centers of Mass and Centroids
  - Schaum's outline additional work
  - 1-D, 2-D & 3-D Centroids

## Review for Second Semester Exam and Exam

**Teaching Strategies** --- The students are expected to form small study groups of three to four people to better learn the material by teaching others and for assistance when they are struggling. The expectations are high and all home work is to be completed before the test day or no test. A homework contract is signed by the student and a parent. If all the homework is completed on time for a chapter, then on the next chapter, the student may retake quizzes to improve their grade and to reinforce the material before the next test.

**Technology and Computer Software** --- The students and teacher use the TI-83, TI-86 or TI-89 graphing calculators for homework, test or presentations. Every student is required to have a graphing calculator and to work with the Visual Presenter to demonstrate solutions to problems and to verbally explain them, especially when going over old AP Test. The teacher also uses Best Grapher or Sketchpad software for demonstrations

**Student Evaluation** --- Quarter grades are computed using homework, class participation, quizzes and test. Each quarter is 40% of the semester grade and the final exam is 20%. The students are expected to be able to do most of their work long hand and to use the calculator as a check tool to verify the solutions or as another approach to finding a solution. They also are expected to be able to explain homework problems for class participation and to participate. On test they are expected to write answers in sentence form as a wrap-up procedure to explain how the solution was found when clarification is needed.

### **Teacher Resources --- Primary Textbooks**

Larson, Hostetler, and Edwards --- CALCULUS --- 8th ed. --- D. C. Heath and Company ---Lexington, Maine --- 2006.

David E. Heyd --- TECHNOLOGY LABORATORY GUIDE --- D. C. Heath and Company ---Lexington, Maine --- 2006.

David Lederman --- AP Calculus (AB) Examinations --- 8th ed. --- D & S Marketing Systems, Inc. --- 2004.

Murray Spiegel, Ph.D. --- Schaum's Outline Series --- McGraw-Hill Book Company --- 1971