Lake Zurich High School
Mathematics Department

AP – Calculus BC

Course Description

Prerequisites: AP – Calculus AB
Open To: 12
Credit: 1 unit
Level: Advanced Placement

Advanced Placement Calculus BC is a continuation of Calculus AB and is designed to prepare the student to take the Calculus BC 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. Students completing this course have the equivalent to two semesters of college calculus. Topics include: logarithmic, exponential, hyperbolic, transcendental and inverse functions, area between curves, volumes of solids, work, fluid force, L'Hopital's Rule, special integration methods and their applications, polynomial approximation, series, parametric equations, polar and vector functions. Students are required to bring a graphing calculator to class on a daily basis. 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
Copyright date:	2006
ISBN number:	(0-618-50300-5) (978-0-618-50300-1)

Course Objectives

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

1. Evaluate limits with various techniques including , Delta-Epsilon definition and L'Hopital's Rule.
2. 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. Solve work, fluid force, moment, center of mass and centroid problems using integration.
10. Use differentiation and integration in working with Hyperbolic Functions and their inverses.
11. Find the volume of different shapes using the Disc Method. the Shell Method, and Cross-Sections.
12. Find the length of arcs and surface area of revolution with integration.
13. Evaluate the integrals of the functions by various methods, including: substitution, numerical integration, completing the square, integration by parts, trigonometric substitution, partial fractions, use of integration tables and using limits with improper integrals.
14. Solve sequence and series problems and test them for convergence and divergence.
15. Write functions as power series using Taylor and Maclaurin Series and then use the series to do approximations.
16. Solve problems involving parametric equations, problems relating to polar coordinate systems and differential equations using Euler's Method.

Course Syllabus

1st Semester

Chapter	Topic
1	Limits & Their Properties
2	Differentiation
3	Applications of Differentiation
4	Integration
5	Logarithmic & Exponential Functions
6	Differential Equations
7	Applications of Integration

2nd Semester

Chapter	Topic
8	Integration Techniques
9	Infinite Series
10	Plane Curves, Parametric Equations and Polar Coordinates
7	Applications of Integration
5	Transcendental Functions

Course Planner

Chapter 1 Limits & Their Properties

1.2 Introduction to Limits
--Look at numerically, graphically, analytically
--Existence Theorem.
--Ways that limits Do Not Exist
-- $\delta - \varepsilon$ proofs

1.3 Properties of Limits
--Indeterminant forms $\frac{0}{0}$ & $\frac{\infty}{\infty}$
--Techniques or Evaluating Limits
--Special cases of sin(x) and cos(x)
--Squeeze Thm.

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

Review & Test
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

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

Review and Test
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
3.5 Finished in Chapter 1
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, Δy, dx and Δx numerically & graphically
--Maximum error, relative error & percentage error
Review and Test
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
--Properties of definite integrals
--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
--Approx. Error in Simpson's &Trapezoid Rules
Review and Test
Calculator Lab Work
Program Calculators with Trapezoid & Simpson's Rule

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

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

Review and Test

Calculator Lab Work

Chapter 6 Differential Equations

6.1 Slope Fields and Euler’s Method
--Graph the field
--Initial Value Problems
--Calculator Programs for Slope Fields and Euler’s Method

6.2 Differential Equations
--Growth and Decay
--Newton’s Law of Cooling
--Compound and Continuous Interest

6.3 Separation of Variables
--Homogeneous Differential Equations
--Logistic Differential Equations

6.4 First-Order Linear Differential Equations
--Bernoulli Equation

Review and Test

Calculator Lab Work

Chapter 7 Applications 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 graphs
--Volumes with known Cross-Sections

7.3 Volume Using the Shell Method

7.4 Arc Length and Surface Area of Revolution

Calculator Lab Work

Review for Semester Exam and Exam

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

8.3 Trigonometric Integrals
--Same & Different Angles

8.4 Integration by Method of Trigonometric Sub.

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 indeterminant forms

8.8 Improper Integrals
--Test for Convergence & Divergence

Calculator Lab Work

Chapter 9 Infinite Series

9.1 Sequences
--Arithmetic & Geometric
--Sequence of Partial Sums
--Convergence or Divergence of a Sequence

9.2 Infinite Series
--Partial Sums Test
--Telescoping Test
--Geometric Test
--Nth Term Test for Divergence

9.3 Integral Test and the P-Series Tests
--Harmonic Series

9.4 Comparison of Series
--Direct Comparison Test
--Limit Comparison Test

9.5 Alternating Series
--Alternating Series Test
--Absolute and Conditional Convergence

9.6 The Ratio and Root Tests

9.7 Taylor Polynomials and Approximations
--Calculator Demonstration of Approx. a function
--LaGrange Form of the Remainder

9.8 Power Series
--Radius and Interval of Convergence

9.9 Representation a Function by a Power Series 2-days
--Geometric Power Series Centered at a given real #
--Operations with Power Series (+, $\times$, $\int$)

9.10 Taylor and MacClaurin Series
--Calculator Lab

Chapter 10 Plane Curves, Parametric Equations and Polar Coordinates

10.1 Plane Curves and Parametric Equations
--Eliminating a Parameter
--Finding Parametric Equations for a Given Graph

10.2 Parametric Equations and Calculus
--Differentiation and Parametric Form
--Arc Length in Parametric Form
-- Surface Area of Revolution in Parametric Form

10.3 Polar Coordinates and Polar Graphs
--Slope in Polar Form

10.4 Area and Arc Length in Polar Coordinates
--Area Bounded by a Single Curve
--Area Between Two Curves
--Surface Area of Revolution Formed by Curves in Polar Form

10.5 Polar Equations of Conics
--Sketching a Conic from its Polar Equation
--Kepler's Law

Chapter 12 Vectors

12.3 Vector Valued Functions (position, velocity, acceleration)

Work on Project of 6 AP Test

---Take 2 Previous Year Timed Exams
---Take AP Calculus BC Exam

After AP Exam

Chapter 7 Applications 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

Chapter 5 Transcendental Functions

5.8 Hyperbolic Functions
--Derivatives & Integrals
--Inverse Hyperbolic Functions

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 in Chalk Board Races. 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 (BC) Examinations --- 7th ed. --- D& S Marketing Systems, Inc. --- Brooklyn, NY --- 2005.

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