AP Calculus AB Course Outline
Brookings High School in Brookings, South Dakota

Textbook used: Calculus Eighth Edition by Larson, Hostetler, Edwards

PART ONE; TOPICS STUDIED IN THE BOOKINGS HIGH SCHOOL AP CALCULUS AB CLASS

Unit I: REVIEW

(1). A review of key Pre-calculus concepts.

Unit II: LIMITS AND THEIR PROPERTIES

(1). Find limits graphically, numerically, and by using tables.
(2) Non-existence of a limit
(3) Prove limits by using the epsilon-delta definition.
(4) Develop the algebra of limits.
(5) Compute limits by dividing out and using the rationalization technique.
(6) Develop the squeeze theorem to use with limits.
(7) Continuity at a point and on an open interval.
(8) One sided limits and continuity on a closed interval.
(9) Intermediate Value Theorem
(10) Computing infinite limits, algebra of limits, and vertical asymptotes.
(11) Problem solving with limits.

Unit III: DIFFERENTIATION

(1) The derivative and the tangent line problem.
(2) Use the limit definition of a derivative.
(3) Relationship between continuity and differentiability.
(4) Basic differentiation rules (constant rule, power rule, constant multiple rule, sum and difference rules, derivative of sine and cosine functions) and rates of change.
(5) Product and quotient rules as well as higher order derivatives.
(6) Derivatives of the trigonometric functions.
(7) Higher order derivatives.
(8) The chain rule and general power rule.
(10) Implicit differentiation.
(11) Related rates and applications.

Unit IV: APPLICATIONS OF DIFFERENTIATION

(1) Extrema, critical numbers, extrema on an open interval and closed interval.
(2) Extreme Value Theorem, Rolle's Theorem and the Mean Value Theorem.
(3) Increasing functions, decreasing functions, first derivative test.
(4) Concavity, point of inflection and the second derivative test.
(5) Limits at infinity and horizontal asymptotes.
(6) Curve sketching techniques.
(7) Application problems with maximums and/or minimums.
(8) Newton's Method.
(9) Differentials and the tangent line approximation
(10) Compare delta y and dy.
(11) Application problems using differentials.

Unit V: INTEGRATION

(1) Anti-derivatives and Indefinite Integration
(2) General solution of a differential equation, indefinite integral notation.
(3) Basic integration rules corresponding to the differentiation rules.
(4) Particular solution of a differential equation.
(5) Area with upper and lower sums using sigma notation.
(6) Area with right side, left side, midpoint, trapezoidal and Simpson's approximations.
(7) Riemann sums and the algebra of sigma notation.
(8) Fundamental Theorems of Calculus on a closed interval, Mean Value Theorem for Integrals and the average value of a function on a closed interval.
(9) Second Fundamental Theorem of Calculus
(10) Integration by substitution (pattern recognition, change of variables, general power rule, change of variables, integrating even and odd functions).
(11) Numerical integration (trapezoidal rule and Simpson's rule)

Unit VI: LOGARITHMIC, EXPONENTIAL, AND TRANSCENDENTAL FUNCTIONS

(1) Log rule for integration of rational functions.
(2) Integrating trigonometric functions.
(3) Integrating by substitution.
(4) Inverse functions and their derivatives.
(5) Exponential functions (derivatives and integrals.)
(6) Derivatives and Integrals of exponential functions with bases other than e.
(7) The power rule for real exponents.
(8) Application problems using (1) thru (7).
(9) Derivatives of the Inverse Trig Functions.
(10) Integrals involving the Inverse Trig Functions.

Unit VII: DIFFERENTIAL EQUATIONS

(1) General and Particular Solutions of Differential Equations
(2) Slope Fields
(3) Differential Equations (exponential and decay models)
(4) Newtons Law of Cooling
(5) Separation of variables and a particular solution.
(6) Finding Orthogonal Tragectories.
(7) Application Problems
(8) Limits having indeterminant forms and L'Hospital's Rule

Unit VIII: APPLICATIONS OF INTEGRATION

(1) Area between curves
(2) Volume using disks, washers, and shells.
(3) Volume with known cross-sections.
(4) Arc Length
(5) Work problems

Unit IX: TEST PREPARATION

(1) Review of course and practice tests

Review of Pre-calclulus

P1. Objectives:

1. Sketch the graph of an equation.
2. Find the intercepts of a graph.
3. Test for symmetry in an axis and the origin.
4. Find the points of intersection of two graphs.
5. Interpret mathematical models for real-life data.

P2. Objectives:

1. Find the slope of a line through two points.
2. Write the equation of a line given a point and the slope.
3. Interpret slope as a ratio or as a rate in a real-life application.
4. Sketch the graph of a linear equation in slope-intercept form.
5. Write the equations of lines that are parallel or perpendicular to a given line.

P3. Objectives:

1. Use function notation to represent and evaluate a function.
2. Find the domain and range of a function.
3. Sketch the graph of a function.
4. Identify the different types of transformations of functions.
5. Classify functions and recognize combinations of functions.

P4. Objectives:

1. Fit a linear model to real-life data.
2. Fit a quadratic model to real-life data.
3. Fit a trigonometric model to real-life data.

PART THREE: GENERAL SUMMARY

A. The Brookings High School AP Calculus AB course teaches all topics associated with functions, graphs, limits, derivatives, integrals as delineated in the Calculus AB topical outline. It also contains additional topics. See the topics included from part one of this document.

B. The course provides the student with the opportunity to work with functions in a variety of ways by graphing, numerically, analytically, and verbally. Several problems of this nature are assigned throughout the course. Some of these problems are presented to the class by an individual student. Others are presented to the class by cooperative groups. Many word problems are assigned throughout the course.

C. The course teaches students how to communicate mathematics and explain solutions to problems both verbally and in written sentences. Students are asked to present solutions in

front of the entire class. The student must analyze a problem and explain their analysis. This is typically done during each class period by at least one student. Also, it is a common practice to have study groups where students must communicate their mathematics both verbally and in written form.

D. The course teaches students how to use graphing calculators to help solve problems, experiment, interpret results and support conclusions. Calculators are used daily and are an integral part of the course. Note that calculator 'required' problems are specifically noted within the text book being used.

E. All students are required to correctly complete all problems that are assigned. Their papers are not accepted until all problems are done correctly. There are no exceptions to this rule. When this has been completed, their paper is accepted and graded. For students who are unable to do this, the teacher will give some guided practice until the student is able to complete the problems. Study groups are used extensively to help meet the needs of the students.

F. Comprehensive tests are given four times each quarter to help evaluate student progress. These are tests given to individual students rather than groups of students.

G. All students are required to take the final AP Calculus AB exam. If a student is unable to afford the testing fee, then the instructor (on a voluntary basis) pays the fee.