Syllabus

AP Calculus AB

Course Overview.

The objectives of teaching this course are:

- To develop logical thinking skills
- To learn problem solving techniques
- To help students appreciate the great things calculus can do for them
- To help students get a strong foundation that will give them the tools to succeed in future mathematics courses
- And to help students understand that calculus is more than formulas, memorizing and advanced arithmetic, but also a complex but logical system.

It is hoped that by having these connections, students' understanding will flourish and they will banish math phobia. The vision in the Advanced Placement Course is for students to take the AP test and pass it with a sufficiently high score.

Course Planner

Course Description

The school day is comprised of seven class periods. The class will meet for fifty-five minutes per day for the entire year. All student are required to take the Advanced placement Examination in May. This course is intended for students who have a good knowledge of analytic geometry and elementary functions in addition to college preparatory algebra, geometry and trigonometry. The purpose of the course is to prepare students for advanced placement in college calculus. The standards incorporate the current College Board Advanced Placement Course Description Syllabus.

As mandated by The College Board, graphing calculators will be required for this course. In addition to using the calculator as a tool for discovery of concepts, students will also use it as a problem-solving tool. Students need to practice using the calculator to solve multiple-choice problems and free-response questions similar to those that they will see on the AP Examinations. A source that would be used is the book by Benjamin Levy listed under Technology Resources heading. Computers will be used where feasible by the student and by the teacher.

In general, the course is a strong treatment of the topics of elementary calculus. Algebraic, trigonometric, exponential, and logarithmic functions will be studied, with the emphasis on their properties and their limits. Differential calculus will be studied and will include defining the derivative, taking the derivative of functions, and applying the derivative to related rates problems and maxima minima problems.

The following topics of Integral Calculus will be studied: Anti-derivatives; applications of anti-derivatives – specifically, the area under a curve, velocity and acceleration, and volumes of solids of revolution; techniques of integration, the definite integral; and applications of the integral.

Preliminary (Prerequisites)

Students will complete a review of background material. This review work focuses attention on those aspects of algebra and trigonometry that will be most useful to students as they progress through calculus. The material contains review of basic properties of exponential, logarithmic and trigonometric functions. Students will be exposed to once again familiarizing themselves with the use of a graphing calculator or computer algebra system. At the end of this material, students will be exposed to a bridge to calculus, illustrating the ideas that distinguish calculus from precalculus.

Preparation for Calculus (Chapter P) (10 days)

1. Graphs and Models
2. Linear Models and Rates of Change

3. Functions and Their Graphs
4. Fitting Models To Data

Limits and Their Properties (Chapter 1) (10 days)

1. Finding limits Graphically and Numerically.
2. Evaluating Limits Analytically
3. Continuity and One-Sided Limits
4. Infinite Limits.

Differentiation (Chapter 2) (25 days)

1. The Derivative and the Tangent Line problem
2. Basic Differentiation Rules and Rates of Change.
3. The Product and Quotient Rules and Higher-Order Derivatives
4. The Chain Rule
5. Implicit Differentiation
6. Related Rates

Applications of Differentiation (Chapter 3) (25 days)

1. Extrema on an Interval
2. Rolle's Theorem and Mean Value Theorem
3. Increasing and Decreasing Functions and the First Derivative Test
4. Concavity and the Second Derivative Test
5. Limits at Infinity
6. A Summary of Curve Sketching
7. Optimization Problems
8. Differentials

Integration (Chapter 4) (30 days)

1. Antiderivatives and Indefinite Integrals

2. Area
3. Riemann Sum and Definite Integrals
4. The Fundamental Theorem of Calculus
5. Integration by Substitution
6. Numerical Integration

Logarithmic, Exponential, and Other Transcendental Functions (Chapter 5) (20 days)

1. The Natural Logarithmic Function: Differentiation
2. The Natural Logarithmic Function; Integration
3. Inverse functions
4. Exponential Functions: Differentiation and Integration
5. Differential Equations: Growth and Decay
6. Differential Equations: Separation of Variables
7. Inverse Trigonometric Functions: Differentiation
8. Inverse Trigonometric Functions: Integration

Applications of Integration (Chapter 6) (15 days)

1. Area of a region between two curves
2. Volume: The Disk Method
3. Volume; The Shell Method
4. Arc Length and Surface of Revolution

More Differential Equations *(Resource Material)* (5 days)

1. Slope Fields
2. Separation of Variables
3. Application and Modeling

Course Objectives

1. The student will define and apply the properties of elementary functions, including algebraic, trigonometric, exponential, and composite functions and their inverses, and graph these functions using a graphing calculator. Properties of functions will include domains, ranges, combinations, odd, even, periodicity, symmetry, asymptotes, zeros, upper and lower bounds, and intervals where the function is increasing or decreasing.
2. The student will define and apply the properties of limits of functions. This will include limits of a constant, sum, product, quotient, one-sided limits, limits at infinity, infinite limits, and nonexistent limits. The student will learn the rigorous definition of a limit.
3. The student will state the definition of continuity and determine where a function is continuous or discontinuous. This will include
    - Continuity at a point
    - Continuity over a closed interval
    - Application of the Intermediate Value Theorem
    - Graphical interpretation of continuity and discontinuity.
4. Given the appropriate information, the student will determine the slope of a curve using limits.
5. Given the equation of a curve, the student will determine the equation of the tangent and the normal to the curve.
6. The student will find the derivative of an algebraic function by using the definition of a derivative. This will include investigating and describing the relationship between differentiability and continuity.
7. The student will apply formulas to find the derivative of algebraic, trigonometric, exponential and logarithmic functions and their inverses.
8. The student will apply formulas to find the derivative of the sum, product, quotient, inverse, and composite (chain rule) of elementary functions.
9. The student will find the derivative of an implicitly defined function.

10. The student will find the higher order derivatives of algebraic, trigonometric, exponential, and logarithmic functions.
11. The students will use logarithmic differentiation as a technique to differentiate non-logarithmic functions.
12. The student will state Rolle's Theorem and apply it to functions.
13. The student will state (without proof) the Mean Value Theorem for derivatives and apply it both algebraically and graphically.
14. The student will apply the derivative to solve problems, including tangent and normal lines to a curve, curve sketching, velocity, acceleration, related rates of change, differentials and linear approximations, and optimization problems.
15. The student will identify the properties of the definite integral. This will include the Fundamental Theorem of Calculus.
16. The student will apply the definite integral to solve problems. These problems will include finding distance traveled on a line and velocity from acceleration with initial conditions, growth and decay problems, solutions of separable differential equations, the average value of a function, area between curves, volumes of solids of revolution about the axes or lines parallel to the axes using disk/washer and shell methods, and volumes of solids with known cross-sectional areas.
17. The student will compute an approximate value for a definite integral. This will include numerical calculations using Riemann Sums, the Trapezoidal Rule, and Simpson's Rule.

Student Evaluation

Students will be evaluated on a fortnightly basis and at the end of every six weeks. There will be homework assignments on a nightly basis. Students will also have the opportunity to work on AP free-response questions which I will assign every two weeks. Students will have the opportunity to work on their own or with each other. They can come to me for extra help. At the end of the

two weeks they will be quizzed on one of the two questions. They will also be quizzed on material that was covered from the text. Students will be graded as they would be on the AP Exam. As outlined on AP Central. In the second semester, students will work on multiple – choice sections of AP Calculus Released Exams. Again, students will have two weeks to complete a multiple-choice section. At the end of the two weeks they will be graded on the work that was done. They will also have a quiz on some of the multiple choice questions and material that was covered from the text.

An exam will be given at the end of each semester and will count 20% of the semester grade. The final Exam will be in the AP format and will be given on several days in April.

Teaching Strategies

Classes will begin with an activity that will be the theme for the lesson. This sets the tone for their learning. Throughout the course, students will work together on a regular basis, both formally and informally. At some times they will work together on a particular task. When students are working on a problem, it is expected that they will work alone initially, then turn to their peer to collaborate.

In discovering new concepts, the class will work as a whole. Technology will be used to make calculus concepts more real for the students.

A number of activities will be included throughout the school year to support and reinforce the concepts that the students will learn. These include:

- What is a Limit
- The Extreme Value Theorem
- The Intermediate Value Theorem
- Evaluating Limits with a Graphing Calculator
- Approximating Derivatives
- Finding Numerical Derivatives with the Calculator
- Linear Approximations

- Rolle's and Mean Value Theorems
- The First Derivative Test
- Approximating Area with Riemann Sums
- Accumulation Functions
- Evaluating Definite Integrals with the Calculator
- Drawing Derivative and Integral Graphs with the Calculator
- Area between Curves
- Separation Variables
- Slope Field

Texts and Resource Materials

Primary Text: Larson, Hostetler, Edwards, *Calculus of A Single Variable*. 7th. ed.

Supplemental Resources

Hughes-Hallett, Gleason, McCallum et al. *Calculus – Single and Multivariable.* New York, John Wiley & Sons

Smith, Robert, Minton, Roland, *Calculus* 2nd. ed.

Anton, Howard. Calculus new Horizon. 6th. ed New York

Kelly,Wilding, *Master AP Calculus AB & BC,* 2nd ed. Peterson's, a Nelnet Company, Lawrenceville N.J.

Advanced Placement Program, The College Board, *AP Calculus: AB & BCFree-Response Questions*

Advanced Placement Program, The College Board, *AP Calculus: Released Exams*

Larson, Hostetler, Edwards, *Themes for Advanced Placement Calculus* 7th. ed.

Technology Resource

Levy, Benjamin, *Graphing Technology Guide*, D. C. Heath and Company, Lexington, Mass., Toronto.