AP Calculus AB Syllabus

AP Calculus AB Curricular Requirements:

- The course teaches all topics associated with Functions, Graphs, and Limits; Derivatives; and Integrals as delineated in the Calculus AB Topic Outline. [C2]
- The course provides students with the opportunity to work with functions represented in a variety of ways -- graphically, numerically, analytically, and verbally -- and emphasizes the connections among these representations. [C3]
- The course teaches students how to communicate mathematics and explain solutions to problems both verbally and in written sentences. [C4]

- The course teaches students how to use graphing calculators to help solve problems, experiment, interpret results, and support conclusions. [C5]

Resource Requirements:

- The school ensures that each student has a college-level calculus textbook (supplemented when necessary to meet the curricular requirements) for individual use inside and outside of the classroom.
- The school ensures that each student has a graphing calculator for individual use inside and outside of the classroom, with all the required capabilities listed in the Calculus AP Outline

Methodology and Course Components:

Students will be taught using a variety of strategies including individual assessment on both free response and multiple choice style quizzes and test with both non-calculator and calculator based questions. Students will work in pairs, groups of four and whole class cooperatively.

Students will be assessed through the following curricular requirements. An example of each is included.

1) The course teaches all topics associated with Functions, Graphs, and Limits as delineated in the Calculus AB Topic Outline.

See the Unit 1 outline below.

2) The course teaches all topics associated with Derivatives as delineated in the Calculus AB Topic Outline.

See Unit 2 and 3 outline below.

3) The course teaches all topics associated with Integrals as delineated in the Calculus AB Topic Outline.

See Unit 4- 6 outline below.

4) The course provides students with the opportunity to work with functions represented graphically.

Students will be given graph sketches of functions and there first and second derivatives or even anti-derivatives without numerical values and asked to interpret the graphs to find local extrema, points of inflection, and concavity. Students will be asked to sketch and interpret slope fields as well and relate these representations to the appropriate differential equation.

5) The course provides students with the opportunity to work with functions represented numerically.

Students will be given a function as a table of values without the algebraic representation of the function and be asked to estimate the value of a limit, rate of change at a point, or definite integral on a closed interval. Students also evaluate numerically represented functions to reach conclusions about the Mean Value theorem.

6) The course provides students with the opportunity to work with functions represented analytically.

Given an algebraic function, students will use formulas such as the Chain Rule, Product Rule, Fundamental Theorem of Calculus to solve problems. Students will use the Limit definition to compute derivatives. Students will apply implicit differentiation, solve separable differential equations, and find specific anti-derivatives given initial conditions.

7) The course provides students with the opportunity to work with functions represented verbally.

Students will be given related rate, optimization, velocity, acceleration, and free fall problems as written story problems to discuss verbally among group members as well as in whole class discussion. Growth and decay problems will be incorporated as well as volume problems with rotation with integral solutions.

8) The course teaches students how to communicate mathematics and explain solutions to problems orally.

The classroom is set up in tables of four and cooperative group work and student presentations are an essential part of the class. Students will present their thinking a variety of ways including: group presentations, partner presentations, individual problems at the board, and net book projects on the Promethean Board.

9) The course teaches students how to communicate mathematics and explain solutions to problems in written sentences.

The course will include a variety previously released free response AP Calculus questions to be assigned and turned in with thorough written justification of answers. Being able to communicate in writing clearly and completely will a point of emphasis in this class whether it is individual work, group work, AP test practice, or projects.

10) The course teaches students how to use graphing calculators to help solve problems.

Students will use the TI 84 to estimate limits, roots, and the coordinates of intersecting functions. Students will use the NDeriv function fnInt function to perform numerical differentiation and integration to solve problems. Students will use the calculator to examine asymptotic behavior of functions as well.

11) The course teaches students how to use graphing calculators to experiment.

Students use the graphing calculator to numerically evaluate the limit of a function, determine the function's asymptotic behavior, and explore it's continuity. Students will use the zoom feature to predict and find the linearization of a function. Students will use the calculator to solve problems involving slope fields. Students will examine exponential growth and decay problems using the calculator to rates of change (the slope or derivative at a given point).

12) The course teaches students how to use graphing calculators to interpret results and support conclusions.

Students will use the calculator to approximate the value of an answer and decide whther or not the answer seems reasonable.

Textbook and Course Outline:

Finney, Demana, Waits and Kennedy. Calculus—Graphical, Numerical, Algebraic. Third edition. Pearson, Prentice Hall, 2007.

This course teaches all topics associated with Functions, Graphs, and Limits; Derivatives;
and Integrals as delineated in the Calculus AB Topic Outline. [C2]

Unit 1: Limits and Continuity (2 weeks) [C2]

A. Rates of Change
   - Average Speed
   - Instantaneous Speed

B. Limits at a Point
   -1-sided Limits

- 2-sided Limits
- Sandwich Theorem

C. Limits involving infinity
- Asymptotic behavior (horizontal and vertical)
- End behavior models
- Properties of limits (algebraic analysis)
- Visualizing limits (graphic analysis)

D. Continuity
- Continuity at a point
- Continuous functions
- Discontinuous functions
- Removable discontinuity (0/0 form)
- Jump discontinuity (We look at y = int(x).)
- Infinite discontinuity

E. Rates of Change and Tangent Lines
- Average rate of change
- Tangent line to a curve
- Slope of a curve (algebraically and graphically)
- Normal line to a curve (algebraically and graphically)
- Instantaneous rate of change

Unit 2: The Derivative (3 weeks) [C2]

A. Derivative of a Function
- Definition of the derivative (difference quotient)
- Derivative at a Point
- Relationships between the graphs of f and f'
- Graphing a derivative from data
- One-sided derivatives

B. Differentiability
- Cases where f'(x) might fail to exist
- Local linearity
- Derivatives on the calculator (Numerical derivatives using Nderiv)
- Symmetric difference quotient
- Relationship between differentiability and continuity
- Intermediate Value Theorem for Derivatives

C. Rules for Differentiation
- Constant, Power, Sum, Difference, Product, Quotient Rules
- Higher order derivatives

D. Applications of the Derivative
- Position, velocity, acceleration, and jerk
- Particle motion
- L'HÔpital's Rule

E. Derivatives of trigonometric functions

F. Chain Rule

G. Implicit Differentiation
- Differential method

- y’ method

H. Derivatives of inverse trigonometric functions

I. Derivatives of Exponential and Logarithmic Functions

Unit 3: Applications of the Derivative (3 weeks) [C2]

A. Extreme Values
- Relative Extrema
- Absolute Extrema
- Extreme Value Theorem
- Definition of a critical point

B. Implications of the Derivative
- Rolle’s Theorem
- Mean Value Theorem
- Increasing and decreasing functions

C. Connecting f’ and f’’ with the graph of f(x)
- First derivative test for relative max/min
- Second derivative
- Concavity
- Inflection points
- Second derivative test for relative max/min

D. Optimization problems

E. Linearization models and Newton’s Method
- Local linearization
- Tangent line approximation
- Differentials

F. Related Rates

Unit 4: The Definite Integral (2 weeks) [C2]

A. Approximating areas
- Riemann sums
- Left sums
- Right sums
- Midpoint sums
- Trapezoidal sums
- Definite integrals

B. Properties of Definite Integrals
- Power rule
- Mean value theorem for definite integrals

C. The Fundamental Theorem of Calculus
- Part 1
- Part 2

Unit 5: Differential Equations and Mathematical Modeling (2 weeks) [C2]

A. Slope Fields

B. Antiderivatives
- Indefinite integrals

- Power formulas
- Trigonometric formulas
- Exponential and Logarithmic formulas

C. Separable Differential Equations
- -Growth and decay
- Slope fields
- General differential equations
- Newton's law of cooling

D. Logistic Growth

Unit 6: Applications of Definite Integrals (2 weeks) [C2]

A. Integral as net change
- Calculating distance traveled (particle motion)
- Consumption over time
- Net change from data

B. Area between curves
- Area between a curve and an axis
- Integrating with respect to x
- Integrating with respect to y
- Area between intersecting curves
- Integrating with respect to x
- Integrating with respect to y

C. Calculating volume
- Cross sections
- Disc method
- Shell method

Technology requirement:

This course teaches students how to use graphing calculators to help solve problems, experiment, interpret results, and support conclusions. [C5]

We will be using the TI-84 in class, for projects, homework, group work and AP Exam practice.

Conceptual Connections:

This course provides students with the opportunity to work with functions represented in a variety of ways -- graphically, numerically, analytically, and verbally -- and emphasizes the connections among these representations. [C3]

We will be solving problems graphically on the TI-84. We will be using our technology to solve problems numerically. We will look at the analytical side of our concepts and have to be able to verbally and especially in writing explain our reasoning on free

response style questions. There will be times when we will put our calculators aside and think about the reasonableness of our ideas and solutions.

Communication:

This course teaches students how to communicate mathematics and explain solutions to problems both verbally and in written sentences. [C4]

In the real world, and on the AP Calculus Test, communication of our ideas and solutions to problems is important. We should be able to communicate both verbally and in writing our numerical analysis (data points with no equation), graphical analysis (graph with no equations), and analytical analysis (equation and variable manipulation).

Supplemental Curriculum:

Curriculum from "AP by the Sea" teacher training will include: cooperative function, derivative, written description matching card activity. Here students try to find others in the class with matching calculus cards in sets of four. Cooperative group activities will be used to re-enforce free response style AP Exam questions. Students will also use our new Promethean Board technology and student net books to do projects and research online with the many resources available.

Fitting into our Expected School-Wide Learning Results

Communicate Effectively [C4]
Solve Problems [C2, C5]
Use Technology [C5]
Pursue your Future [C3]
Work with others collaboratively [C2, C3, C4, C5]