Curriculum: AP Calculus AB-I

Curricular Unit: Limits, Derivatives, and Integrals

Instructional Unit: A. Approximate limits, derivatives, and definite integrals using numeric methods

Description Section in Schoolnet:

I: a,b,c

a. Analysis of graphs. With the aid of technology, graphs of functions are often easy to produce. The emphasis is on the interplay between the geometric and analytic information and on the use calculus both to predict and to explain the observed local and global behavior of a function.
b. Limits of functions (including one-sided limits). An intuitive understanding of the limiting process. Calculating limits using algebra. Estimating limits from graphs or tables of data.
c. Asymptotic and unbounded behavior. Understanding asymptotes in terms of graphical behavior. Describing asymptotic behavior in terms of limits involving infinity. Comparing relative magnitudes of functions and their rates of change (For example contrasting exponential growth, polynomial growth, and logarithmic growth)

II: a,b

a. Concept of the derivative. Derivative presented graphically, numerically, and analytically. Derivative interpreted as an instantaneous rate of change. Derivative defined as the limit of the difference quotient. Relationship between differentiability and continuity
b. Derivative at a point. Slope of a curve at a point. Examples are emphasized, including points at which there are vertical tangents and points at which there are not tangents. Tangent line to a curve at a point and local linear approximation. Instantaneous rate of change as the limit of average rate of change. Approximate rate of change from graphs and tables of values

III: a,b

a. Interpretations and Properties of Definite Integrals. Definite integral as a limit of Riemann sums. Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval: $\int_a^b f'(x)dx = f(b) - f(a)$. Basic properties of integrals. (Examples include additivity and linearity)
b. Applications of Integrals. Appropriate integrals are used in a variety of applications to model physical, social, or economic situations. Although only a sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve

other similar application problems. Whatever applications are chosen, the emphasis is on using the method of setting up an approximating Riemann sum and representing its limit as a definite integral. To provide a common foundation, specific applications should include finding the area of a region (including a region bounded by polar curves), the volume of a solid with known cross section, the average value of a function, and the distance traveled by a particle along a line, and accumulated change from a rate of change

Standard Alignments (Section 2)

GLE/CLE: N/A
Knowledge: (MA) 4
CCSS: N/A
APCALC: AB.Ia,b,d; AB.IIa,b; AB.IIIa,f
NETS: 1a; 6a
Performance: 1.6

Unit (Section 3)

Learning Targets:

- **Estimate the instantaneous rate of change of the dependent variable with respect to the independent variable at a point given the equation of function**
- Tell whether the y value is increasing, decreasing, or neither as x increases through that interval
- Estimate how fast y is changing given a function specified by a graph, a table of values, or an equation
- **State the meaning of derivative**
- Estimate the definite integral of a function between x = a and x = b by counting squares, given the equation or the graph of the function
- State the meaning of definite integral
- **Estimate the value of a definite integral by dividing the region under the graph into trapezoids**
- Determine points of discontinuity from a graph
- Tell whether or not the function has a limit as x approaches a given value, give the graph of the function, and tell how your answer relates to the definition of a limit
- State the verbal definition of limit
- Explore Absolute Values

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Instructional Strategies:

- Lecture enhanced with:
  - SMART Notebook
  - PowerPoint
  - the Internet
- Drill and guided practice
- Demonstrations
- Problem solving
- Reflective discussion
- Class discussion
- Computer assisted instruction
- Games

Assessments/Evaluations:

- Direct teacher observations
- Project w/ scoring guides: Unit A take home quiz
- Formative assessments
- Homework assignments
- Formal common assessment

Mastery: 80%

Sample Assessment Questions:

- Find the definite integral from x=1 to x=3 using 5 trapezoids if $f(x) = x^2$.

Instructional Resources/Tools:

- Textbook(s): Calculus: *Concepts and Applications* (Second Edition), Paul Foerster, Chapter 1
- Website(s): www.apcentral.collegeboard.com
- Graphing calculator

Cross Curricular Connections:

- N/A

Depth of Knowledge (Section 5)

DOK: 3

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Curriculum: AP Calculus AB-I

Curricular Unit: Properties of Limits

Instructional Unit: B. Approximate limits, derivatives, and definite integrals using numeric methods

Description Section in Schoolnet:
I: b,c,d

b. Limits of functions (including one-sided limits). An intuitive understanding of the limiting process. Calculating limits using algebra. Estimating limits from graphs or tables of data
c. Asymptotic and unbounded behavior. Understanding asymptotes in terms of graphical behavior. Describing asymptotic behavior in terms of limits involving infinity. Comparing relative magnitudes of functions and their rates of change (For example contrasting exponential growth, polynomial growth, and logarithmic growth)
d. Continuity as a Property of Functions. An intuitive understanding of continuity. (The function values can be made as close as desired by taking sufficiently close values of the domain.) Understanding continuity in terms of limits. Geometric understanding of graphs of continuous functions (Intermediate Value Theorem and Extreme Value Theorem

Standard Alignments (Section 2)

GLE/CLE: N/A
Knowledge: (MA) 4
CCSS: N/A
APCALC: AB.Ib-d
NETS: 1a; 6
Performance: 1.6

Unit (Section 3)

Learning Targets:

- **Find limits using the properties of limits and explain why they are true. Evaluate limits numerically, algebraically, and graphically**
- Determine if a function is continuous using the definition
- **Determine one-sided limits. Find limits involving infinity**
- Understand the Intermediate Value Theorem

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Instructional Strategies:

- Lecture enhanced with:
  - SMART Notebook
  - PowerPoint
  - the Internet
- Drill and guided practice
- Demonstrations
- Problem solving
- Reflective discussion
- Class discussion
- Computer assisted instruction
- Games

Assessments/Evaluations:

- The students will be assessed on the concepts taught using a variety of modalities:
  - Direct teacher observations
  - Project w/ scoring guides: Unit B take home quiz
  - Formative assessment
  - Homework assignments
  - Formal common assessment

Mastery: 80%

Sample Assessment Questions:

Find each limit:

a) $\lim_{x \to \infty} \frac{2x+1}{\sqrt{x^2+1}}$

b) $\lim_{x \to 2} \frac{4x}{x-2}$

Instructional Resources/Tools:

- Textbook(s): Calculus: *Concepts and Applications* (Second Edition), Paul Foerster, Chapter 2
- Website(s): www.apcentral.collegeboard.com
- Graphing calculator

Cross Curricular Connections:

- N/A

Depth of Knowledge (Section 5)

DOK: 3

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Curriculum: AP Calculus AB-I

Curricular Unit: Derivatives, Antiderivatives, and Indefinite Integrals

Instructional Unit: C. Approximate limits, derivatives, and definite integrals using numeric methods

Description Section in Schoolnet:
II: a,e,f

a. Concept of the Derivative. Derivative presented graphically, numerically, and analytically. Derivative interpreted as an instantaneous rate of change. Derivative defined as the limit of the difference quotient. Relationship between differentiability and continuity
e. Applications of Derivatives. Analysis of curves, including the notions of monotonicity and concavity. Optimization, both absolute (global) and relative (local) extrema. Modeling rates of change, including related rates problems. Use of implicit differentiation to find the derivative of an inverse function. Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration. Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations
f. Computation of Derivatives. Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions. Basic rules for the derivative of sums, products, and quotients of functions. Chain rule and implicit differentiation

Standard Alignments (Section 2)

GLE/CLE: N/A
Knowledge: (MA) 4
CCSS: N/A
APCALC: AB.IIa,e,f
NETS: 1a; 6
Performance: 1.6

Unit (Section 3)

Learning Targets:

- **Know the definition of derivative. Use the definition of derivative to calculate the value of the derivative at a point. Know the relationship between the derivative and the slope of the tangent line**

- State and use the forward, backward, and symmetric difference quotient

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- Find the derivative of a function using the definition
- **State and us the constant, power of a variable, sum, and homogeneous rules for finding derivatives. Know and use various derivative notations**
- **Given an equation for the displacement of a moving object, find an equation for its velocity and acceleration, and analyze its motion**
- State and use the derivatives of the sin and cos functions
- **Find the derivative of a composite function using the chain rule**
- Given the information about a sinusoidal function, find its equation. Know the limit of sin(x)/x as x approaches 0
- Find the derivative of functions containing ln and e

Instructional Strategies:

- Lecture enhanced with:
  - SMART Notebook
  - PowerPoint
  - the Internet
- Drill and guided practice
- Demonstrations
- Problem solving
- Reflective discussion
- Class discussion
- Computer assisted instruction
- Games

Assessments/Evaluations:

- The students will be assessed on the concepts taught using a variety of modalities:
  - Direct teacher observations
  - Project w/ scoring guides: Unit C take home quiz
  - Formative assessment
  - Homework assignments
  - Formal common assessment
- Mastery: 80%

Sample Assessment Questions:

Find $f'(x)$:

a) $f(x) = 3 - x^{\frac{3}{5}} + x^{\frac{1}{2}} - 3x^4 + 7x^{-3}$

b) $f(x) = \sqrt{\sin x^4}$

c) What is $\lim_{h \to 0} \frac{\cos(x+h) - \cos x}{h}$

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Instructional Resources/Tools:
• Textbook(s): Calculus: *Concepts and Applications* (Second Edition), Paul Foerster, Chapter 3 • Website(s): www.apcentral.collegeboard.com • Graphing calculator
Cross Curricular Connections:
• N/A

Depth of Knowledge (Section 5)

DOK: 3

Curriculum: AP Calculus AB-I

Curricular Unit: Products, Quotients, and Parametric Functions

Instructional Unit: D. Approximate limits, derivatives, and definite integrals using numeric methods

Description Section in Schoolnet:
II: a,f

a. Concept of Derivative. Derivative presented graphically, numerically, and analytically. Derivative interpreted as an instantaneous rate of change. Derivative defined as the limit of the difference quotient. Relationship between differentiability and continuity

f. Computation of Derivatives. Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions. Basic rules for the derivative of sums, products, and quotients of functions. Chain rule and implicit differentiation

Standard Alignments (Section 2)

GLE/CLE: N/A
Knowledge: (MA) 4
CCSS: N/A
APCALC: AB.IIa,f
NETS: 1a; 6a
Performance: 1.6

Unit (Section 3)

Learning Targets:

- **Find the derivative of a function that is a product of two or more functions**
- **Find the derivative of a function that is the quotient of two functions**
- Find the derivative of a function containing any of the six trigonometric functions
- Find the inverse of a function
- Use the unit circle to evaluate inverse trig functions
- **Find the derivative of the six inverse trigonometric functions**
- Determine if a function is continuous, differentiable, or both
- Find the derivative of a function using Implicit Differentiation

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Instructional Strategies:

- Lecture enhanced with:
  - SMART Notebook
  - PowerPoint
  - the Internet
- Drill and guided practice
- Demonstrations
- Problem solving
- Reflective discussion
- Class discussion
- Computer assisted instruction
- Games

Assessments/Evaluations:

- The students will be assessed on the concepts taught using a variety of modalities:
  - Direct teacher observations
  - Project w/ scoring guides: Unit D take home quiz
  - Formative assessment
  - Homework assignments
  - Formal common assessment

- Mastery: 80%

Sample Assessment Questions:

- Find the first derivative:

  $f(x) = x^3 \cot(2x)$

Instructional Resources/Tools:

- Textbook(s): Calculus: *Concepts and Applications* (Second Edition), Paul Foerster, Chapter 4
- Website(s): www.apcentral.collegeboard.com
- Graphing calculator

Cross Curricular Connections:

- N/A

Depth of Knowledge (Section 5)

DOK: 3

Curriculum: AP Calculus AB-I

Curricular Unit: Definite and Indefinite Integrals

Instructional Unit: E. Approximate limits, derivatives, and definite integrals using numeric methods

Description Section in Schoolnet:

II: c

c. Derivative as a Function. Corresponding characteristics of graphs of f and f'. Relationship between the increasing and decreasing behavior of f and the sign of f'. The Mean Value Theorem and its geometric interpretation. Equations involving derivatives. Verbal descriptions are translated into equations involving derivatives and vice versa

III: a-d,f

a. Interpretations and Properties of Definite Integrals. Definite integral as a limit of Riemann sums. Definite integral of the rate of change of a quantity over an interval interpreted as the change of the quantity over the interval: $\int_a^b f'(x)dx = f(b) - f(a)$. Basic properties of integrals (Examples include additivity and linearity
b. Applications of Integrals. Appropriate integrals are used in a variety of applications to model physical, biological, or economic situations. Although only a sampling of applications can be included in any specific course, students should be able to adapt their knowledge and techniques to solve other similar application problems. Whatever applications are chosen , the emphasis is on using the method of setting up an approximating Riemann sum and representing its limit as a definite integral. To provide a common foundation, specific applications should include finding the area of a region, the volume of a solid with known cross sections, the average value of a function, the distance traveled by a particle along a line, and accumulated change from a rate of change
c. Fundamental Theorem of Calculus. Use the Fundamental Theorem to evaluate definite integrals. Use the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined
d. Techniques of Antidifferentiation. Antiderivatives following directly from derivatives of basic functions. Antiderivatives by substitution of variables (including change of limits for definite integrals).
f. Numerical Approximations to Definite Integrals. Use of Riemann sums (using left, right, and midpoint evaluations points) and the trapezoidal sums to approximate definite integrals of functions represented algebraically, graphically, and by tables of values

Standard Alignments (Section 2)

GLE/CLE: N/A
Knowledge: (MA) 4
CCSS: N/A
APCALC: AB.IIc; AB.IIIa-d,f
NETS: 1a; 6a
Performance: 1.6

Unit (Section 3)

Learning Targets:

- Find a linear equation to approximate a function close to a given point using differentials. Find values for the differential expressions dy and dx
- **Evaluate indefinite integrals using the antiderivative rules and the change of variable method**
- Use Riemann Sums to find approximate values for definite integrals
- Know and apply the Mean Value Theorem. Know and apply Rolle's Theorem
- **Know and apply the Fundamental Theorem of Calculus, Part II**
- **Evaluate definite integrals**
- Us properties of definite integrals
- Given a problem in which a quantity "y" varies with "x", write a definite integral and evaluate it to solve the problem
- Use Simpson's Rule to approximate definite integrals

Instructional Strategies:

- Lecture enhanced with:
  - SMART Notebook
  - PowerPoint
  - the Internet
- Drill and guided practice
- Demonstrations
- Problem solving
- Reflective discussion
- Class discussion
- Computer assisted instruction
- Games

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Assessments/Evaluations:

- The students will be assessed on the concepts taught using a variety of modalities:
  - Direct teacher observations
  - Project w/ scoring guides: Unit E take home quiz
  - Formative assessment
  - Homework assignments
  - Formal common assessment

Mastery: 80%

Sample Assessment Questions:

- Find the antiderivative: $\int \sin^4 5x \cos 5x dx$

Instructional Resources/Tools:

- Textbook(s): Calculus: *Concepts and Applications* (Second Edition), Paul Foerster, Chapter 5
- Website(s): www.apcentral.collegeboard.com
- Graphing calculator

Cross Curricular Connections:

- N/A

Depth of Knowledge (Section 5)

DOK: 3

Board Approved 8-3-15

Curriculum: AP Calculus AB-I

Curricular Unit: Calculus of Exponential and Logarithmic Functions

Instructional Unit: F. Approximate limits, derivatives, and definite integrals using numeric methods

Description Section in Schoolnet:
II: d,e,f

d. Second Derivatives. Corresponding characteristics of the graphs of f, f' and f''. Relationship between the concavity of f and the sign of f''. Points of inflection as places where concavity changes
e. Applications of Derivatives. Analysis of curves, including the notions of monotonicity and concavity. Optimization, both absolute (global) and relative (local) extrema. Modeling rates of change, including related rates problems. Use of implicit differentiation to find the derivative of an inverse function. Interpretation of the derivative as a rate of change in varied applied contexts, including velocity, speed, and acceleration. Geometric interpretation of differential equations via slope fields and the relationship between slope fields and solution curves for differential equations
f. Computation of Derivatives. Knowledge of derivatives of basic functions, including power, exponential, logarithmic, trigonometric, and inverse trigonometric functions. Derivative rules for sums, products, and quotients of functions. Chain rule and implicit differentiation

III: c,d

c. Fundamental Theorem of Calculus. Use the Fundamental Theorem to evaluate definite integrals. Use of the Fundamental Theorem to represent a particular antiderivative, and the analytical and graphical analysis of functions so defined
d. Techniques of Antidifferentiation. Antiderivatives following directly from derivatives of basic functions. Antiderivatives by substitution of variables (including change of limits for definite integrals)

Standard Alignments (Section 2)

GLE/CLE: N/A
Knowledge: (MA) 4
CCSS: N/A
APCALC: AB.IId,e,f; AB.IIIc,d
NETS: 1a; 6a
Performance: 1.6

Unit (Section 3)

Learning Targets:

- Find derivatives involving the natural logarithm function
- **Know and use the Fundamental Theorem of Calculus, Part I**
- Find the antiderivatives that involve the natural logarithm function
- Know and use the properties of logarithms. Know and use the properties of exponents
- Find the derivatives of logarithmic functions other than the natural logarithm
- **Perform logarithmic differentiation**
- Find antiderivatives of e functions
- Find the derivative of various functions

Instructional Strategies:

- Lecture enhanced with:
  - SMART Notebook
  - PowerPoint
  - the Internet
- Drill and guided practice
- Demonstrations
- Problem solving
- Reflective discussion
- Class discussion
- Computer assisted instruction
- Games

Assessments/Evaluations:

- The students will be assessed on the concepts taught using a variety of modalities:
  - Direct teacher observations
  - Project w/ scoring guides: Unit F take home quiz
  - Formative assessment
  - Homework assignments
  - Formal common assessment
- Mastery: 80%

Sample Assessment Questions:

- Find the derivative: $y = x^{\tan x}$

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Instructional Resources/Tools:
• Textbook(s): Calculus: *Concepts and Applications* (Second Edition), Paul Foerster, Chapter 6 • Website(s): www.apcentral.collegeboard.com • Graphing calculator
Cross Curricular Connections:
• N/A

Depth of Knowledge (Section 5)

DOK: 3