PCTVS PASSAIC COUNTY TECHNICAL-VOCATIONAL SCHOOLS

Course Title: AP Calculus AB

Course Number: 0059

Number of Credits: 5

June 2020

I. Course Description:

The overall goal of this course is to help students understand and apply the three big ideas of AB Calculus: limits, derivatives, and integrals and the Fundamental Theorem of Calculus. Imbedded throughout the big ideas are the mathematical practices for AP Calculus: reasoning with definitions and theorems, connecting concepts, implementing algebraic/computational processes, connecting multiple representations, building notational fluency, and communicating mathematics orally and in well-written sentences. All students are required to complete summer work reviewing precalculus and Algebra 2 concepts prior to entry in the course. Students will be provided with and expected to use a school issued TI-Nspire CAS graphing calculator.

II. Units:

Content Area:	**AP Calculus AB**	**Grade(s)**	**9 - 12**
Unit Plan Title:	Unit 1 - Limits REVIEW – 1 WEEK Summer Packet Review LIMITS – 5 WEEKS **Finding Limits Graphically and Numerically** **Evaluating Limits Analytically** **Continuity and One-Sided limits** **Infinite Limits** **Limits at Infinity**		
NJSLS Standard(s) Addressed in this unit			
F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. F.IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). F.IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes			

F.LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions
F.BF.B.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Essential Questions (3-5): Limits

Can change occur at an instant?
How does knowing the value of a limit, or that a limit does not exist, help you to make sense of interesting features of functions and their graphs?
How do we close loopholes so that a conclusion about a function is always true?
How do limits guarantee the continuity of a function?
When do limits fail to exist?
What is the difference between calculating a limit and evaluating a function at a point?

Anchor Text

Calculus for AP with CalcChat and CalcView, Ron Larson, Paul Battaglia, 2016, Cengage Learning, ISBN: 978-1-1-305-67491-2

Informational Texts (3-5)

Fast Track to a 5: Preparing for the AP Calculus AB and Calculus BC Examinations, Author, 2017, ISBN: 9781337090261

Short Texts (1-3)

N/A

Formative & Summative Assessments

Formative Assessment	*Summative Assessment*
Instructor's observations of notetaking, and assignments	Trimester Post Test
Class Participation	Final Exam
Cooperative learning activities	Project
Observing citizenship and appropriate social responses	Chapter Test
Instructor's observations of time management skills	
Trimester Pre-Test	

Quiz
Homework
Classwork

Resources (websites, Canvas, LMS, Google Classroom, documents, etc.)

- Canvas
- Desmos
- Geogebra
- TI Nspire CAS Graphing Calculator
- Wolfram Math World
- https://apcentral.collegeboard.org
- https://www.khanacademy.org/math/ap-calculus-ab
- https://tutorial.math.lamar.edu/
- Cengage.com
- Maa.org Mathematical Association of America
- Nms.org National Math and Science Initiative (NMSI)
- Mctm.org National Council of Teachers of Mathematics (NCTM)
- https://apcentral.collegeboard.org/pdf/ap-calculus-ab-bc-course-and-exam-description-0.pdf?course=ap-calculus-ab

Suggested Time Frame:	6 Weeks

Content Area:	**AP Calculus AB**	**Grade(s)**	**9 - 12**
Unit Plan Title:	**Unit 2 – Differentiation and Applications of Differentiation** **II. DIFFERENTIATION – 9 WEEKS** *1.* **The Derivative and the Tangent Line Problems** *2.* **Basic Differentiation Rules and Rates of Change** *3.* **Product and Quotient Rules and Higher-Order Derivatives** *4.* **The Chain Rule** *5.* **Implicit Differentiation**. *6.* **Derivatives of Inverse Functions**. *7.* **Indeterminate Forms and L'Hoptial's Rule**		

	8. **Related Rates**. **III. APPLICATIONS OF DIFFERENTIATION – 4 WEEKS** *1.* **Extrema on an Interval-** *2.* **Rolle's Theorem and the Mean Value Theorem-** *3.* **Increasing and Decreasing Functions and the First Derivative Test** *4.* **Concavity and the Second Derivative** *5.* **A Summary of Curve Sketching** **6. Optimization Problems**

NJSLS Standard(s) Addressed in this unit

F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Essential Questions (3-5)

Why do mathematical properties and rules for simplifying and evaluating limits apply to differentiation?
If you knew that the rate of change in high school graduates at a particular level of public investment in education (in graduates per dollar) was a positive number, what might that tell you about the number of graduates at that level of investment?
How are problems about position, velocity, and acceleration of a particle in motion over time structurally similar to problems about the volume of a rising balloon over an interval of heights, the population of London over the 14th century, or the metabolism of a dose of medicine over time?
Why is the derivative important?
How is the average rate of change related to the instantaneous rate of change?
How is the derivative related to the tangent line to a curve?
What is the connection between differentiability and continuity?

Anchor Text

Calculus for AP with CalcChat and CalcView, Ron Larson, Paul Battaglia, 2016, Cengage Learning, ISBN: 978-1-1-305-67491-2

Informational Texts (3-5)

Fast Track to a 5: Preparing for the AP Calculus AB and Calculus BC Examinations, Author, 2017, ISBN: 9781337090261

Short Texts (1-3)

N/A

Formative & Summative Assessments

Formative Assessment	*Summative Assessment*
Instructor's observations of notetaking, and assignments	Trimester Post Test
Class Participation	Final Exam
Cooperative learning activities	Project
Observing citizenship and appropriate social responses	Chapter Test
Instructor's observations of time management skills	
Trimester Pre-Test	
Quiz	
Homework	
Classwork	

Resources (websites, Canvas, LMS, Google Classroom, documents, etc.)

Canvas
Desmos
Geogebra
TI Nspire CAS Graphing Calculator
Wolfram Math World
https://apcentral.collegeboard.org
https://www.khanacademy.org/math/ap-calculus-ab
https://tutorial.math.lamar.edu/
Cengage.com
Maa.org Mathematical Association of America
Nms.org National Math and Science Initiative (NMSI)
Mctm.org National Council of Teachers of Mathematics (NCTM)
https://apcentral.collegeboard.org/pdf/ap-calculus-ab-bc-course-and-exam-description-0.pdf?course=ap-calculus-ab

Suggested Time Frame:	13 Weeks

Content Area:	**AP Calculus AB**	**Grade(s)**	**9 - 12**
Unit Plan Title:	Unit 3 – Integration, Differential Equations, and Applications of Integration **IV. INTEGRATION – 7 WEEKS** *1.* **Antiderivatives and Indefinite Integrals** *2.* **Area** *3.* **Riemann Sums and Definite Integrals** *4.* **The Fundamental Theorem of Calculus** *5.* **Integration by Substitution** *6.* **The Natural Log Functions: Integration** *7.* **Inverse Trigonometric Functions: Integration**. **V. DIFFERENTIAL EQUATIONS - 2 WEEKS** *1.* **Slope Fields** *2.* **Growth and Decay** *3.* **Separation of Variables-** **VI. APPLICATIONS OF INTEGRATION – 3 WEEKS** *1.* **Are of a Region Between Two Curves-** **2. Volume: The Disk and Washer Methods**		

NJSLS Standard(s) Addressed in this unit

F.IF.A.2 Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context.
F.IF.B.4 For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. *
F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.
F.IF.C.8. a Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.

G.MG.3 Apply geometric methods to solve design problems (e.g., designing an object or structure to satisfy physical constraints or minimize cost; working with typographic grid systems based on ratios).

Essential Questions (3-5): Integration, Differential Equations, and Applications of Integration

How is integrating to find areas related to differentiating to find slopes?
How are the rules for differentiation used to develop the basic rules of integration?
How can we use the measure of area under a curve to discuss net change of a function over time?
How is the anti-derivative related to the accumulation function?
How are area under the curve and the definite integral related?
How are the properties of definite integrals related to the Riemann sum definition?
How can one apply numerical techniques to compute an integral without knowing the associated antiderivative?
How can integrals be used to find areas or volumes?

Anchor Text

Calculus for AP with CalcChat and CalcView, Ron Larson, Paul Battaglia, 2016, Cengage Learning, ISBN: 978-1-1-305-67491-2

Informational Texts (3-5)

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Short Texts (1-3)

N/A

Formative & Summative Assessments

Formative Assessment	*Summative Assessment*
Instructor's observations of notetaking, and assignments	Trimester Post Test
Class Participation	Final Exam
Cooperative learning activities	Project
Observing citizenship and appropriate social responses	Chapter Test
Instructor's observations of time management skills	
Trimester Pre-Test	
Quiz	
Homework	

Classwork
Resources (websites, Canvas, LMS, Google Classroom, documents, etc.)
• Canvas • Desmos • Geogebra • TI Nspire CAS Graphing Calculator • Wolfram Math World • https://apcentral.collegeboard.org • https://www.khanacademy.org/math/ap-calculus-ab • https://tutorial.math.lamar.edu/ • Cengage.com • Maa.org Mathematical Association of America • Nms.org National Math and Science Initiative (NMSI) • Mctm.org National Council of Teachers of Mathematics (NCTM) • https://apcentral.collegeboard.org/pdf/ap-calculus-ab-bc-course-and-exam-description-0.pdf?course=ap-calculus-ab

Suggested Time Frame:	12 Weeks

Content Area:	**AP Calculus AB**	**Grade(s)**	**9 - 12**
Unit Plan Title:	**Unit 4 - Review & Project-Based Applications of Calculus** **R. REVIEW – 3 WEEKS** **S. MODELING & APPLICATIONS OF CALCULUS – 2 WEEKS**		

NJSLS Standard(s) Addressed in this unit
F.IF.C.9 Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). F.IF.C.8 Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. F.IF.B.6 Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. F.IF.C.7 Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases.

F.IF.B.5 Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes
F.LE.A.1 Distinguish between situations that can be modeled with linear functions and with exponential functions
F.BF.B.3 Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs. Experiment with cases and illustrate an explanation of the effects on the graph using technology. Include recognizing even and odd functions from their graphs and algebraic expressions for them.

Essential Questions (3-5): Limits

Can change occur at an instant?
How does knowing the value of a limit, or that a limit does not exist, help you to make sense of interesting features of functions and their graphs?
How do we close loopholes so that a conclusion about a function is always true?
How do limits guarantee the continuity of a function?
How are area under the curve and the definite integral related?
What is the difference between calculating a limit and evaluating a function at a point?
Why do mathematical properties and rules for simplifying and evaluating limits apply to differentiation?
What is the connection between differentiability and continuity?

Anchor Text

Calculus for AP with CalcChat and CalcView, Ron Larson, Paul Battaglia, 2016, Cengage Learning, ISBN: 978-1-1-305-67491-2

Informational Texts (3-5)

Fast Track to a 5: Preparing for the AP Calculus AB and Calculus BC Examinations, Author, 2017, ISBN: 9781337090261

Short Texts (1-3)

N/A

Formative & Summative Assessments

Formative Assessment	*Summative Assessment*
Instructor's observations of notetaking, and assignments	Trimester Post Test
Class Participation	Final Exam
Cooperative learning activities	Project

Observing citizenship and appropriate social responses Instructor's observations of time management skills Trimester Pre-Test Quiz Homework Classwork	Chapter Test

Resources (websites, Canvas, LMS, Google Classroom, documents, etc.)

- Canvas
- Desmos
- Geogebra
- TI Nspire CAS Graphing Calculator
- Wolfram Math World
- https://apcentral.collegeboard.org
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- https://tutorial.math.lamar.edu/
- Cengage.com
- Maa.org Mathematical Association of America
- Nms.org National Math and Science Initiative (NMSI)
- Mctm.org National Council of Teachers of Mathematics (NCTM)
- https://apcentral.collegeboard.org/pdf/ap-calculus-ab-bc-course-and-exam-description-0.pdf?course=ap-calculus-ab

Suggested Time Frame:	5 Weeks

III. Instructional Strategies:

Lecture
Graphs and other visuals
Student investigative activities
Engaging silently and aloud
Reading silently and aloud
Brainstorming
Listening

Participating in small and large groups
Collaborative projects
Answering questions (oral and written)
Summarizing
Debating
Peer teaching
Note takings
Playing games

Differentiated Instruction

Students will work individually, engage in cooperative learning, and utilize discovery learning on certain activities. Using lectures, the internet, and interactive whiteboards, students will be exposed to various teaching methods to appeal to visual, auditory, and kinesthetic learners.

IV. Scope and Sequence:

Key: I – Introduced, D – Developed in Depth, R – Reinforced

Skills/ Concepts to be Learned	11	12
Finding Limits Graphically and Numerically	DR	DR
Evaluating Limits Analytically	IDR	IDR
Continuity and One-Sided limits	IDR	IDR
Infinite Limits	IDR	IDR
Limits at Infinity	DR	DR
The Derivative and the Tangent Line Problems	DR	DR
Basic Differentiation Rules and Rates of Change	DR	DR
Product and Quotient Rules and Higher-Order Derivatives	IDR	IDR
The Chain Rule	IDR	IDR
Implicit Differentiation	IDR	IDR
Derivatives of Inverse Functions	IDR	IDR
Indeterminate Forms and L'Hoptial's Rules	IDR	IDR
Related Rates	IDR	IDR

Extrema on an Interval	DR	DR
Rolle's Theorem and the Mean Value Theorem	IDR	IDR
Increasing and Decreasing Functions and the First Derivative Test	IDR	IDR
Concavity and the Second Derivative	IDR	IDR
A Summary of Curve Sketching	IDR	IDR
Optimization Problems	IDR	IDR
Antiderivatives and Indefinite Integrals	IDR	IDR
Area	IDR	IDR
Riemann Sums and Definite Integrals	IDR	IDR
The Fundamental Theorem of Calculus	IDR	IDR
Integration by Substitution	IDR	IDR
The Natural Log Functions: Integration	IDR	IDR
Inverse Trigonometric Functions: Integration	IDR	IDR
Slope Fields	IDR	IDR
Growth and Decay	IDR	IDR
Separation of Variables	IDR	IDR
Area of a Region Between Two Curves	IDR	IDR
Volume: The Disk and Washer Methods	IDR	IDR
Modeling and Application of Calculus	IDR	IDR

V. Complete List Of course Textbooks, Instructional Resources & Software

Calculus for AP with CalcChat and CalcView, Ron Larson, Paul Battaglia, 2016, Cengage Learning, ISBN: 978-1-1-305-67491-2

Fast Track to a 5: Preparing for the AP Calculus AB and Calculus BC Examinations, Author, 2017, ISBN: 9781337090261

Canvas

Desmos

Geogebra

TI Nspire CAS Graphing Calculator

Wolfram Math World

https://apcentral.collegeboard.org

https://www.khanacademy.org/math/ap-calculus-ab

https://tutorial.math.lamar.edu/

Cengage.com

Maa.org Mathematical Association of America

Nms.org National Math and Science Initiative (NMSI)

Nctm.org National Council of Teachers of Mathematics (NCTM)

https://apcentral.collegeboard.org/pdf/ap-calculus-ab-bc-course-and-exam-description-0.pdf?course=ap-calculus-ab

VI. Student Handout:

AP Calculus AB Course Overview

The overall goal of this course is to help students understand and apply the three big ideas of AB Calculus: limits, derivatives, and integrals and the Fundamental Theorem of Calculus. Imbedded throughout the big ideas are the mathematical practices for AP Calculus: reasoning with definitions and theorems, connecting concepts, implementing algebraic/computational processes, connecting multiple representations, building notational fluency, and communicating mathematics orally and in well-written sentences. All students are required to complete summer work reviewing precalculus and Algebra 2 concepts prior to entry in the course. Students will be provided with and expected to use a school issued TI-Nspire CAS graphing calculator.

Proficiencies:

Define limits and use the limit notation.
Estimate limit vales from graphs.
Estimate limit values from tables.
Determine limits using algebraic manipulation.
Select procedures for determining limits.
Determine limits using the squeeze theorem.
Connect multiple representations of limits.
Explore types of discontinuity.
Define continuity at points.
Confirm continuity at a point.
Conform continuity over an interval.
Remove discontinuity.
Work with the Intermediate Value Theorem (IVT).
Connect infinite limits and vertical asymptotes.
Connect limits at infinity and horizontal asymptotes.
Define average and instantaneous rates of change at a point.
Define the derivative of a function and use derivative notation.
Estimate derivatives of a function at a point.
Connect differentiability and continuity, determining when derivatives do and do not exist.
Interpret the meaning of the derivative in context.

Approximate values as a function using local linearity and linearization.
Apply the power rule, Derivative rules of constant, sum, difference, and multiple constant and Derivatives of cos x, sin x, e^x, and ln x.
Find the derivative using product and quotient rule.
Find the derivatives of tangent, cotangent, secant, and cosecant functions.
Calculate higher-order derivatives.
Calculate Straight-line motion: connecting position, velocity, and acceleration.
Find the derivative using The Chain Rule, and Rates of change in applied context other than motion.
Find the derivative using implicit differentiation.
Find the Derivatives of inverse functions and inverse trigonometric functions.
Using L'Hopital's rule for determining limits of indeterminate forms (0/0 and ∞/∞).
Extreme Value Theorem, global versus local extrema, and critical points. Using the candidates test to determine absolute(global) extrema.
Use the Mean Value Theorem
Determine intervals on which a function is increasing or decreasing.
Using the First Derivative Test to determine relative(local) extrema.
Determine concavity of functions over their domains.
Use the Second Derivative Test to determine extrema.
Sketch graphs of functions and their derivatives.
Connecting a function, its first derivative, its second derivative.
Solve optimization problems.
Explore behaviors of implicit relations.
Find antiderivatives and indefinite integrals: basic rules and notation.
Select techniques for antidifferentiation.
Connect position, velocity, and acceleration of functions using integrals.
Explore accumulations of change.
Interpret the behavior of accumulation functions involving area.
Approximating areas with Riemann sums. Riemann sums, summation notation and definite integral notation.
Apply properties if definite integrals.
Use the Fundamental Theorem of Calculus and definite integrals.
Find the average value of a function on an interval.
Integrate using substitution.
Integrate natural log functions.
Integrate functions using long division.
Integrate trigonometric functions.
Integrate functions using completing the square.

Verifying solutions of differential equations.
Model situations with differential equations.
Sketch slope fields. Reasoning using slope fields.
Find exponential models with differential equations.
Finding general solitons using separation of variables.
Use accumulation functions and definite integrals in applied contexts.
Find the area between curves expressed as a function of x, y, and that intersect at more than two points.
Find volume with disk method and washer method: revolving around x- or y- axis and revolving around other axes.
Find volume with cross sections: squares, rectangles, triangles, and semicircles.
Model and Applications of Calculus; Limits, Derivatives, and Integration

Addendum

Pacing Chart

P. REVIEW – 1 WEEK	**Summer Assignment**
1. Summer Packet Review	Summer Assignment
I. LIMITS – 5 WEEKS	**Chapter 1**
1. Finding Limits Graphically and Numerically	Section 1.2
2. Evaluating Limits Analytically	Section 1.3
3. Continuity and One-Sided limits	Section 1.4
4. Infinite Limits	Section 1.5
5. Limits at Infinity	Section 1.6
II. DIFFERENTIATION – 9 WEEKS	**Chapter 2**
1. The Derivative and the Tangent Line Problems	Section 2.1
2. Basic Differentiation Rules and Rates of Change	Section 2.2
3. Product and Quotient Rules and Higher-Order Derivatives	Section 2.3
4. The Chain Rule	Section 2.4
5. Implicit Differentiation	Section 2.5
6. Derivatives of Inverse Functions	Section 2.6
7. Indeterminate Forms and L'Hoptial's Rule	Chapter 7 - Section 7
8. Related Rates	Section 2.7
III. APPLICATIONS OF DIFFERENTIATION – 4 WEEKS	**Chapter 3**
1. Extrema on an Interval	Section 3.1

2. Rolle's Theorem and the Mean Value Theorem	Section 3.2
3. Increasing and Decreasing Functions and the First Derivative Test	Section 3.3
4. Concavity and the Second Derivative	Section 3.4
5. A Summary of Curve Sketching	Section 3.5
6. Optimization Problems	Section 3.6
IV. INTEGRATION – 7 WEEKS	**Chapter 4**
1. Antiderivatives and Indefinite Integrals	Section 4.1
2. Area	Section 4.2
3. Riemann Sums and Definite Integrals	Section 4.3
4. The Fundamental Theorem of Calculus	Section 4.4
5. Integration by Substitution	Section 4.5
6. The Natural Log Functions: Integration	Section 4.6
7. Inverse Trigonometric Functions: Integration	Section 4.7
V. DIFFERENTIAL EQUATIONS - 2 WEEKS	**Chapter 5**
1. Slope Fields	Section 5.1
2. Growth and Decay	Section 5.2
3. Separation of Variables	Section 5.3
VI. APPLICATIONS OF INTEGRATION – 3 WEEKS	**Chapter 6**
1. Area of a Region Between Two Curves	Section 6.1
2. Volume: The Disk and Washer Methods	Section 6.2
R. REVIEW – 3 WEEKS	**AP Central**
1. Review for AP Exam	AP Central

S. MODELING & APPLICATIONS OF CALCULUS – 2 WEEKS	**External Material**
1. Modeling and Applications of Calculus	External Material