**COURSE DESCRIPTION**

**Course Title:** AP Calculus AB

**Course Number:** 00292

**Course Prerequisites:** Grade of 80% or higher in Honors Pre-Calculus or Pre-Calculus CP

**Course Description:** AP Calculus AB is an introductory college-level calculus course for the students who are interested in furthering their fundamental knowledge of calculus. Students cultivate their understanding of differential and integral calculus through engaging with real-world problems represented graphically, numerically, analytically, and verbally and using definitions and theorems to build arguments and justify conclusions as they explore concepts like change, limits, and the analysis of functions. Students taking this course are preparing for the option of taking the AP Calculus Exam. District final exam is required.

**Suggested Grade Level**: Grade 12

**Length of Course:** Two Semesters

**Units of Credit:** 1

**PDE Certification and Staffing Policies and Guidelines (CSPG) Required Teacher Certifications:**

CSPG #50 Mathematics (7-12)

To find the CSPG information, go to [CSPG](https://www.education.pa.gov/Educators/Certification/Staffing%20Guidelines/Pages/default.aspx)

**Certification verified by the WCSD Human Resources Department:** [x] Yes [ ] No

**WCSD STUDENT DATA SYSTEM INFORMATION**

**Course Level:** AP (1) GPA +10%

**Mark Types:** Check all that apply.

[x] F – Final Average [x] MP – Marking Period [x] EXM – Final Exam

**GPA Type**: [ ]  GPAEL-GPA Elementary [ ]  GPAML-GPA for Middle Level [x]  NHS-National Honor Society

[x]  UGPA-Non-Weighted Grade Point Average [x]  GPA-Weighted Grade Point Average

**State Course Code**: 02124

To find the State Course Code, go to [State Course Code](https://nces.ed.gov/forum/sced.asp), download the Excel file for *SCED*, click on SCED 6.0 tab, and choose the correct code that corresponds with the course.

**TEXTBOOKS AND SUPPLEMENTAL MATERIALS**

**Board Approved Textbooks, Software, and Materials:**

**Title:**  *Calculus AP Edition with CalcChat and CalcView, 11e*

**Publisher:** Cengage Learning

**ISBN #:**  978-1-337-28688-6

**Copyright Date:** 2018

**WCSD Board Approval Date:** 6/29/2020

**Supplemental Materials:** College Board: AP Classroom, Khan Academy, Kuta Software, Brainfuse,
 SAS pdesas.org, Graphing Calculator: TI-89 Titanium,
 Online Calculator: Desmos

**Curriculum Document**

**WCSD Board Approval:**

**Date Finalized:** 5/23/2022

**Date Approved:**  6/13/2022

**Date(s) Revised:**  6/12/2023 **Implementation Year:** 2022-2023

**SPECIAL EDUCATION, 504, and GIFTED REQUIREMENTS**

The teacher shall make appropriate modifications to instruction and assessment based on a student’s Individual Education Plan (IEP), Chapter 15 Section 504 Plan (504), and/or Gifted Individual Education Plan (GIEP).

**SCOPE AND SEQUENCE OF CONTENT, AND CONCEPTS**

**Marking Period 1: Summer Preparation for Calculus, Limits and Continuity, and
 Differentiation: Definition and Basic Derivative Rules**

* Summer Preparation for Calculus (Review/Assessment)
	+ Graphs and Models
	+ Linear Models and Rates of Change
	+ Functions and Their Graphs
	+ Trigonometric Functions Review
* Limits Graphically and Numerically
* Evaluation of Limits Analytically
* Continuity and One-Sided Limits
* Infinite Limits
* Limits of Infinity
* The Derivative and the Tangent Line Problem
* Basic Differentiation Rules and Rates of Change
* Product and Quotient Rules and Higher Order Derivatives
* The Natural Logarithmic Function: Differentiation
* Exponential Functions: Differentiation, Integration
* **End of Marking Period 1**

**Marking Period 2: Differentiation: Composite, Implicit, Inverse Functions,
 Contextual Application of Differentiation, and Analytical Applications of
 Differentiation**

* The Chain Rule
* Implicit Differentiation
* Inverse Functions
* Inverse Trigonometric Functions: Differentiation
* Basic Differentiation Rules and Rates of Change
* Related Rates
* Differentials
* Indeterminate Forms and L’Hopital’s Rule
* Extrema on an Interval
* Rolle’s Theorem and the Mean Value Theorem
* Increasing and Decreasing Functions and the First Derivative Test
* Concavity and the Second Derivative Test
* A Summary of Curve Sketching
* Optimization Problems
* **End of Marking Period 2**

 **Marking Period 3: Integration and Accumulation of Change, Differential Equations, and
 Applications of Integration: Average Value**

* Antiderivatives
* Area
* Riemann Sums and Definite Integrals
* The Fundamental Theorem of Calculus: Accumulation Functions
* Integration by Substitution
* The Natural Logarithmic Function: Integration
* Differentials
* Exponential Functions: Differentiation, Integration
* Bases Other Than e and Applications
* Slope Fields and Euler’s Method
* Separation of Variables and the Logistic Equation
* The Fundamental Theorem of Calculus: Average Value of Functions
* **End of Marking Period 3**

 **Marking Period 4: Applications of Integration: Area, Volume, and AP Calculus AB Preparation
 and Exam**

* Area of a Region Between Two Curves
* Volume: The Disc and Washer Methods
* **AP Calculus AB Preparation and Exam**
	+ Limits and Continuity
	+ Differentiation: Definition and Basic Derivative Rules
	+ Differentiation: Composite, Implicit, and Inverse Functions
	+ Contextual Application of Differentiation
	+ Analytical Applications of Differentiation
	+ Integration and Accumulation of Change
	+ Differential Equations
	+ Applications of Integration
* **Final Exam Review and Assessment**
	+ Limits and Continuity
	+ Differentiation: Definition and Basic Derivative Rules
	+ Differentiation: Composite, Implicit, and Inverse Functions
	+ Contextual Application of Differentiation
	+ Analytical Applications of Differentiation
	+ Integration and Accumulation of Change
	+ Differential Equations
	+ Applications of Integration

**Standards/Eligible Content and Skills**

| **Performance Indicator** | **PA Core Standard and/or Eligible Content** | **Marking Period Taught**  |
| --- | --- | --- |
| Sketch the graph of an equation | CC.2.2.HS.D.7F-IF.7 | SP/MP1 |
| Find the intercepts of a graph | CC.2.2.HS.C.2F-IF.7 | SP/MP1 |
| Test a graph for symmetry with respect to an axis or the origin | CC.2.2.HS.C.2F-IF.7 | SP/MP1 |
| Find the points of intersection of two graphs | CC.2.2.HS.C.2F-IF.7 | SP/MP1 |
| Interpret mathematical models for real-life data | CC.2.2.HS.C.6CC.2.2.HS.D.10A-CED.3 | SP/MP1 |
| Find the slope of a line passing through two points | CC.2.2.HS.C.1 | SP/MP1 |
| Write the equation of a line with a given point and slope | A-CED.2 | SP/MP1 |
| Interpret slope as a ratio or as a rate in a real-life application | CC.2.2.HS.C.6A-SSE.1 | SP/MP1 |
| Sketch the graph of a linear equation in slope-intercept form | CC.2.2.HS.C.2F-IF.7 | SP/MP1 |
| Write equations of lines that are parallel or perpendicular to a given line | A-CED.2 | SP/MP1 |
| Use function notation to represent and evaluate a function | F-IF.2 | SP/MP1 |
| Find the domain and range of a function | F-IF.1 | SP/MP1 |
| Sketch the graph of a function | CC.2.2.HS.C.2F-IF.7 | SP/MP1 |
| Identify different types of transformations of functions | CC.2.2.HS.C.4 | SP/MP1 |
| Classify functions and recognize combinations of functions | CC.2.2.HS.C.4 | SP/MP1 |
| Describe angles and use degree measure | G-CO.1 | SP/MP1 |
| Use radian measure | F-TF.1 | SP/MP1 |
| Understand the definitions of the six trigonometric functions | F-TF.2 G-SRT.6 | SP/MP1 |
| Evaluate trigonometric functions | CC.2.2.HS.C.7 | SP/MP1 |
| Solve trigonometric equations | CC.2.2.HS.D.10 | SP/MP1 |
| Graph trigonometric functions | CC.2.2.HS.C.8F-IF.7 | SP/MP1 |
| Define a limit | A-SSE.1 | MP1 |
| Use limit notation | A-SSE.1 | MP1 |
| Estimate limit values from graphs | CC.2.2.HS.C.6A-REI.11F-IF.4 | MP1 |
| Estimate limit values from tables | CC.2.2.HS.C.6A-REI.11F-IF.4 | MP1 |
| Determine limits using algebraic properties of limits | CC.2.2.HS.C.1CC.2.2.HS.C.6 | MP1 |
| Determine limits using algebraic manipulation | CC.2.2.HS.C.1CC.2.2.HS.C.6 | MP1 |
| Select procedures for determining limits | CC.2.2.HS.C.1 | MP1 |
| Determine limits using the Squeeze Theorem | CC.2.2.HS.C.1CC.2.2.HS.C.6 | MP1 |
| Connect multiple representations of limits | CC.2.2.HS.D.7 | MP1 |
| Explore different types of discontinuities | CC.2.2.HS.D.7 | MP1 |
| Define continuity at a point | CC.2.2.HS.D.7 | MP1 |
| Confirm continuity on an open interval | CC.2.2.HS.D.7 | MP1 |
| Remove discontinuities | CC.2.2.HS.D.7 | MP1 |
| Connect infinite limits and vertical asymptotes | CC.2.2.HS.D.7F-IF.4 | MP1 |
| Connect limits at infinity and horizontal asymptotes | CC.2.2.HS.D.7F-IF.4 | MP1 |
| Work with the Intermediate Value Theorem (IVT) | CC.2.2.HS.C.1 | MP1 |
| Define average and instantaneous rates of change at a point | CC.2.2.HS.C.1F-IF.6 | MP1 |
| Define the derivative of a function | CC.2.2.HS.C.1F-IF.2 | MP1 |
| Use the derivative function | CC.2.2.HS.C.1 | MP1 |
| Estimate derivatives of a function at a point | CC.2.2.HS.C.1A-REI.11 | MP1 |
| Connect differentiability and continuity – when derivatives do and do not exist | CC.2.2.HS.C.1 | MP1 |
| Apply the Power Rule | CC.2.2.HS.C.1 | MP1 |
| Use the derivative rules: Constant, Sum, Difference, Constant, Multiple | CC.2.2.HS.C.1 | MP1 |
| Find the derivatives of cos x, sin x, ex, and ln x | CC.2.2.HS.C.6 | MP1 |
| Use the Product Rule | CC.2.2.HS.C.1 | MP1 |
| Use the Quotient Rule | CC.2.2.HS.C.1 | MP1 |
| Find the derivative of tangent, cotangent, secant, and/or cosecant functions | CC.2.2.HS.C.6 | MP1 |
| **End of Marking Period 1**  |  | **MP1** |
| Use the Chain Rule | CC.2.2.HS.C.1F-BF.1C | MP2 |
| Use implicit differentiation | CC.2.2.HS.C.1F-BF.1C | MP2 |
| Differentiate inverse functions | F-BF.4 | MP2 |
| Differentiate inverse trigonometric functions | F-BF.4 F.TF.7 | MP2 |
| Select procedures for calculating derivatives | CC.2.2.HS.C.6 | MP2 |
| Calculate higher-order derivatives | CC.2.2.HS.C.1 | MP2 |
| Interpret the meaning of the derivative in context | CC.2.2.HS.C.1CC.2.2.HS.C.6 | MP2 |
| Connect position, velocity, and acceleration – straight-line motion | F-IF.6 | MP2 |
| Use rates of change in applied context other than motion | F-IF.6 | MP2 |
| Set up related rates problems | F-IF.6 | MP2 |
| Solve related rates problems | F-IF.6 | MP2 |
| Approximate values of a functions using local linearity and linearization | CC.2.2.HS.C.1A-REI.11 | MP2 |
| Use L’Hopital’s Rule for determining limits of indeterminate forms | CC.2.2.HS.C.1 | MP2 |
| Use the Mean Value Theorem | CC.2.2.HS.C.1 | MP2 |
| Use the Extreme Value Theorem | CC.2.2.HS.C.1 | MP2 |
| Find global extrema, local extrema, and critical points | F-IF.4 | MP2 |
| Determine intervals on which a function is increasing or decreasing | F-IF.4 | MP2 |
| Use the First Derivative Test to determine relative/local extrema | CC.2.2.HS.C.1F-IF.4 | MP2 |
| Use the Candidates Test to determine absolute/global extrema | CC.2.2.HS.C.1F-IF.4 | MP2 |
| Determine concavity of functions over their domains | CC.2.2.HS.C.1F-IF.4 | MP2 |
| Use the Second Derivative Test to determine extrema | CC.2.2.HS.C.1 | MP2 |
| Sketch graphs of functions and their derivatives | CC.2.2.HS.C.2F-IF.7 | MP2 |
| Connect a function, first derivative, and a second derivative | CC.2.2.HS.C.5 | MP2 |
| Set up optimization problems | CC.2.2.HS.C.1 | MP2 |
| Solve optimization problems | CC.2.2.HS.C.1 | MP2 |
| Explore behaviors of implicit relations | F-IF.4 | MP2 |
| **End of Marking Period 2**  |  | **MP2** |
| Explore accumulations of change | F-IF.6 | MP3 |
| Approximate Riemann Sums | CC.2.2.HS.C.1 | MP3 |
| Use Riemann Sums, summation notation, and definite integral notation | CC.2.2.HS.C.1CC.2.2.HS.C.6 | MP3 |
| Use the Fundamental Theorem of Calculus with accumulation functions involving area | CC.2.2.HS.C.2CC.2.3.HS.A.14 | MP3 |
| Interpret the behavior of accumulation functions involving area | CC.2.2.HS.C.2CC.2.3.HS.A.14 | MP3 |
| Apply properties of definite integrals | CC.2.2.HS.C.2 | MP3 |
| Use the Fundamental Theorem of Calculus with definite integrals | CC.2.2.HS.C.4 | MP3 |
| Find the antiderivatives and indefinite integrals using basic rules and notation | CC.2.2.HS.C.6 | MP3 |
| Integrate using substitution | A-SSE.3 | MP3 |
| Integrate functions using long division and completing the square | A.APR.6A-SSE.3F-IF.8A | MP3 |
| Select techniques for antidifferentiation | CC.2.2.HS.C.6 | MP3 |
| Model situations with differential equations | CC.2.2.HS.C.2 | MP3 |
| Verify solutions for differential equations | CC.2.2.HS.C.9 | MP3 |
| Sketch slope fields | CC.2.2.HS.C.5F-IF.7 | MP3 |
| Reason using slope fields | CC.2.2.HS.D.9 | MP3 |
| Find general solutions using separation of variables | CC.2.2.HS.D.10 | MP3 |
| Find particular solutions using initial conditions and separation of variables | CC.2.2.HS.D.10 | MP3 |
| Model exponentials with differential equations | CC.2.2.HS.D.6A-SSE.3C | MP3 |
| Find the average value of a function on an interval | CC.2.2.HS.C.1 | MP3 |
| Connect position, velocity, and acceleration of functions using integrals | CC.2.2.HS.C.1 | MP3 |
| Use accumulation functions and definite integrals in applied contexts | CC.2.2.HS.C.1 | MP3 |
| **End of Marking Period 3**  |  | **MP3** |
| Find the area between curves expressed as functions of x | CC.2.3.HS.A.14 | MP4 |
| Find the area between curves expressed as functions of y | CC.2.3.HS.A.14 | MP4 |
| Find the area between curves that intersect at more than two points | CC.2.3.HS.A.14 | MP4 |
| Find the volume with cross sections of squares and rectangles | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| Find the volume with cross sections of triangles and semicircles | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| Find the volume using the disc method revolving around x- or y-axis | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| Find the volume using the disc method revolving around other axes | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| Find the volume using the washer method revolving around the x- or y-axis | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| Find the volume using the washer method revolving around other axes | CC.2.3.HS.A.13CC.2.3.HS.A.14 | MP4 |
| **AP Calculus AB Preparation and Exam** |  | **MP4** |
| * Review and prepare knowledge of Limits and Continuity
 |  | MP4 |
| * Review and prepare knowledge of Differentiation: Definition and Basic Derivative Rules
 |  | MP4 |
| * Review and prepare knowledge of Differentiation: Composite, Implicit, Inverse Functions
 |  | MP4 |
| * Review and prepare knowledge of Contextual Application of Differentiation
 |  | MP4 |
| * Review and prepare knowledge of Analytical Applications of Differentiation
 |  | MP4 |
| * Review and prepare knowledge of Integration and Accumulation of Change
 |  | MP4 |
| * Review and prepare knowledge of Differential Equations
 |  | MP4 |
| * Review and prepare knowledge of Applications of Integration
 |  | MP4 |
| **Final Exam Review and Assessment** |  | **MP4** |
| * Review and demonstrate knowledge of Limits and Continuity
 |  | MP4 |
| * Review and demonstrate knowledge of Differentiation: Definition and Basic Derivative Rules
 |  | MP4 |
| * Review and demonstrate knowledge of Differentiation: Composite, Implicit, Inverse Functions
 |  | MP4 |
| * Review and demonstrate knowledge of Contextual Application of Differentiation
 |  | MP4 |
| * Review and demonstrate knowledge of Analytical Applications of Differentiation
 |  | MP4 |
| * Review and demonstrate knowledge of Limits and Continuity
 |  | MP4 |
| * Review and demonstrate knowledge of Integration and Accumulation of Change
 |  | MP4 |
| * Review and demonstrate knowledge of Differential Equations
 |  | MP4 |
| * Review and demonstrate knowledge of Applications of Integration
 |  | MP4 |

**ASSESSMENTS**

**PDE Academic Standards, Assessment Anchors, and Eligible Content:** The teacher must be knowledgeable of the PDE Academic Standards, Assessment Anchors, and Eligible Content and incorporate them regularly into planned instruction.

**Formative Assessments:** The teacher will utilize a variety of assessment methods to conduct in-process evaluations of student learning.

**Effective formative assessments for this course include:
Suggested but not limited to:**

* Pre-assessments of prior knowledge (e.g., Entrance cards or KWL chart)
* Bellringers/Problems of the Day (PODs)
* Discussions
* Exit ticket
* Teacher observations/Questioning
* Graphic organizers (e.g., Venn Diagrams, word mapping, webbing, KWL chart, etc.)
* Outlining
* Cooperative learning
* Written work
* Quizzes
* Oral response
* Self-evaluation
* Homework
* Summarizing
* Note-taking

**Summative Assessments:** The teacher will utilize a variety of assessment methods to evaluate student learning at the end of an instructional task, lesson, and/or unit.

**Effective summative assessments for this course include:
Suggested but not limited to:**

* Performance assessment
* Chapter/unit tests
* Quizzes
* Final exam
* Projects
* Student presentations