**COURSE DESCRIPTION**

**Course Title:** Calculus Honors

**Course Number:** 00291

**Course Prerequisites:** Completion of Pre-Calculus Honors or Pre-Calculus CP with an average of 80% or above.

**Course Description:** Calculus Honors is intended for all mathematics, engineering, and science students who want to further their fundamental knowledge of mathematics. This course is designed for students to study: Limits, Derivatives, Trigonometric Functions, the Integral, and applications of these ideas in various mathematics, science, and physics real-world problems. District mid-term assessment and final exam are required.

**Suggested Grade Level**: Grades 11-12

**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:** Honors & Dual Enrollment (1) GPA +5%

**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**: 02121

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,
 pdesas.org, TI-89 Titanium Graphing Calculator

**Curriculum Document**

**WCSD Board Approval:**

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

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

**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 Their Properties, and Differentiation**

* Summer Preparation of Calculus (Review/Assessment)
	+ Graphs and Models
	+ Linear Models and Rates of Change
	+ Functions and Their Graphs
	+ Trigonometric Functions Review
* Limits Graphically and Numerically
* Analytical Evaluation of Limits
* Continuity and One-Sided Limits
* Infinite Limits
* Limits at Infinity
* The Derivative and the Tangent Line Problem
* Basic Differentiation Rules and Rates of Change
* Marking Period 1

**Marking Period 2: Differentiation, and Applications of Differentiation**

* The Product and Quotient Rules and Higher-Order Derivatives
* The Chain Rule
* Implicit Differentiation
* Related Rates
* 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
* Mid-Term Review and Assessment

**Marking Period 3: Applications of Differentiation, and Integration**

* A Summary of Curve Sketching
* Optimization Problems
* Antiderivatives and Indefinite Integration
* Area
* Riemann Sums and Definite Integrals
* The Fundamental Theorem of Calculus
* Integration by Substitution
* Numerical Integration
* Marking Period 3

**Marking Period 4: Logarithmic, Exponential, and Other Transcendental Functions**

* The Natural Logarithmic Function and Differentiation
* The Natural Logarithmic Function and Integration
* Inverse Functions
* Exponential Functions: Differentiation and Integration
* Bases Other Than e and Applications
* Inverse Trigonometric Functions and Differentiation
* Inverse Trigonometric Functions: Integration and Completing the Square
* Final Exam Review and Assessment
* ***Optional, if time permits: Performance Indicators: Applications of Integration***
	+ *Area of a Region Between Two Curves*
	+ *Volume: The Disc Method*
	+ *Volume: The Shell Method*
	+ *Arc Length*

**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-world data | CC.2.2.HS.C.6CC.2.2.HS.D.10 | 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: Slope-Intercept Form, Point-Slope Form, Standard Form, General Form | A-CED.2 | SP/MP1 |
| Interpret slope as a ratio or as a rate in a real-world and mathematical application | A-SSE.1 F-IF | 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 and complete 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 |
| Determine if a function is even, odd, or neither |  |  |
| Describe angles and use degree measure | G-CO.1 | SP/MP1 |
| Use radian measure | F-TF.1 | SP/MP1 |
| Find co-terminal angles of trigonometric functions |  |  |
| Understand the definitions of the six trigonometric functions | F-TF G-SRT | SP/MP1 |
| Evaluate trigonometric functions | F-TF | SP/MP1 |
| Solve trigonometric equations | F-TF | SP/MP1 |
| Identify and graph trigonometric functions | CC.2.2.HS.C.8F-IF.7 F-TF | SP/MP1 |
| Estimate a limit using a numerical or graphical approach | CC.2.2.HS.C.6A-REI.11F-IF.4 | MP1 |
| Learn different ways that a line can fail to exist | A-SSE.1 | MP1 |
| Use a formal definition of a limit | A-SSE.1 | MP1 |
| Evaluate a limit using properties of limits | CC.2.2.HS.C.1F-IF | MP1 |
| Develop and use a strategy for finding limits | CC.2.2.HS.C.1 | MP1 |
| Evaluate a limit: Dividing Out Technique, Rationalizing Technique, Squeeze Theorem | CC.2.2.HS.C.1F-IF | MP1 |
| Determine continuity at a point and continuity on an open interval | CC.2.2.HS.D.7 | MP1 |
| Determine one-sided limits and continuity on a closed interval | CC.2.2.HS.D.7 | MP1 |
| Use properties of continuity | CC.2.2.HS.D.7 | MP1 |
| Understand and use the Intermediate Value Theorem | CC.2.2.HS.C.1 | MP1 |
| Determine infinite limits from the left and from the right | CC.2.2.HS.D.7F-IF.4 | MP1 |
| Find and sketch the vertical asymptotes of the graph of a function | CC.2.2.HS.D.7F-IF.4 | MP1 |
| Determine (finite) limits at infinity | CC.2.2.HS.D.7F-IF.4 | MP1 |
| Determine the horizontal asymptotes, if any, of the graph of a function | CC.2.2.HS.D.7F-IF.4 | MP1 |
| Determine infinite limits at infinity | CC.2.2.HS.D.7F-IF.4 | MP1 |
| Use a TI-89 Titanium graphing calculator to estimate limits, then find them analytically | CC.2.2.HS.C.1F-IF | MP1 |
| Find the slope of the tangent line to a curve at a point | CC.2.2.HS.C.1 | MP1 |
| Use the limit definition to find the derivative of a function | CC.2.2.HS.C.1F-IF | MP1 |
| Understand the relationship between differentiability and continuity | CC.2.2.HS.C.1 | MP1 |
| Find the derivative of a function rule: Constant Rule, Power Rule, Constant Multiple Rule, Sum and Difference Rules | CC.2.2.HS.C.1 | MP1 |
| Find the derivatives of the sine function and of the cosine function | F-TF | MP1 |
| Use derivatives to find rates of change | CC.2.2.HS.C.1F-IF | MP1 |
| **Marking Period 1** |  | MP1 |
| Find the derivative of a function: Product Rule, Quotient Rule  | CC.2.2.HS.C.1 | MP2 |
| Find the derivative of a trigonometric function | F-TF | MP2 |
| Find a higher-order derivative of a function | F-TF | MP2 |
| Find the derivative of a composite function using the Chain Rule | CC.2.2.HS.C.1F-BF.1C | MP2 |
| Find the derivative of a function using the General Power Rule | CC.2.2.HS.C.1F-BF.1C | MP2 |
| Simplify the derivative of a function using algebra | CC.2.2.HS.C.1F-BF.1C | MP2 |
| Find the derivative of a trigonometric function using the Chain Rule | CC.2.2.HS.C.1F-BF.1C | MP2 |
| Distinguish between functions written in implicit form and explicit form | CC.2.2.HS.C.1F-BF.1C | MP2 |
| Use implicit differentiation to find the derivative of a function | CC.2.2.HS.C.1F-BF.1C | MP2 |
| Find a related rate | F-IF.6 | MP2 |
| Use related rates to solve real-life problems | F-IF.6 | MP2 |
| Understand the definition of extrema of a function on an interval | F-IF.4 | MP2 |
| Understand the definition of relative extrema of a function on an open interval | F-IF.4 | MP2 |
| Find extrema on a closed interval | F-IF.4 | MP2 |
| Understand and use Rolle’s Theorem | CC.2.2.HS.C.1 | MP2 |
| Understand and use the Mean Value Theorem | CC.2.2.HS.C.1 | MP2 |
| Determine intervals on which a function is increasing or decreasing | F-IF.4 | MP2 |
| Apply the First Derivative Test to find relative extrema of a function | CC.2.2.HS.C.1F-IF.4 | MP2 |
| Determine intervals on which a function is concave upward or concave downward | F-IF.4 | MP2 |
| Find any points of inflection of the graph of a function | F-IF.4 | MP2 |
| Apply the Second Derivative Test to find relative extrema of a function | CC.2.2.HS.C.1 | MP2 |
| **Mid-Term Review and Assessment** |  | MP2 |
| * Review and extend knowledge of Limits and Their Properties
 |  | MP2 |
| * Review and extend knowledge of Differentiation
 |  | MP2 |
| * Review and extend knowledge of Applications of Differentiation: Extrema on an Interval, Rolle’s Theorem, Mean Value Theorem, Increasing/Decreasing Functions, First Derivative Test, Concavity and the Second Derivative Test
 |  | MP2 |
| Analyze and sketch the graph of a function on the TI-89 Titanium graphing calculator | CC.2.2.HS.C.2F-IF.4 F-IF.7 | MP3 |
| Solve applied minimum and maximum problems | CC.2.2.HS.C.1F-IF | MP3 |
| Write the general solution of a differential equation and use indefinite integral notation for antiderivatives | CC.2.2.HS.C.6 | MP3 |
| Use basic integration rules to find antiderivatives | CC.2.2.HS.C.6 | MP3 |
| Find a particular solution of a differential equation | CC.2.2.HS.C.6 | MP3 |
| Use sigma notation to write and evaluate a sum | CC.2.2.HS.C.6 | MP3 |
| Understand the concept of area | CC.2.2.HS.C.2CC.2.3.HS.A.14 | MP3 |
| Approximate the area of a plane region | CC.2.3.HS.A.14A-REI.11 | MP3 |
| Find the area of a plane region using limits | CC.2.3.HS.A.14F-IF | MP3 |
| Understand the definition of a Riemann Sum | CC.2.2.HS.C.1 | MP3 |
| Evaluate a definite integral using limits and geometric formulas | CC.2.2.HS.C.2CC.2.2.HS.C.4CC.2.3.HS.A.14 | MP3 |
| Evaluate a definite integral using properties of definite integrals | CC.2.2.HS.C.2CC.2.2.HS.C.4 | MP3 |
| Evaluate a definite integral using the Fundamental Theorem of Calculus | CC.2.2.HS.C.1CC.2.2.HS.C.2CC.2.2.HS.C.4 | MP3 |
| Understand and use the Mean Value Theorem of Integrals | CC.2.2.HS.C.1 | MP3 |
| Find the average value of a function over a closed interval | CC.2.2.HS.C.1 | MP3 |
| Understand and use the Second Fundamental Theorem of Calculus | CC.2.2.HS.C.1CC.2.2.HS.C.2CC.2.2.HS.C.4 | MP3 |
| Understand and use the Net Change Theorem | CC.2.2.HS.C.1 | MP3 |
| Use pattern recognition to find an indefinite integral | F-IF | MP3 |
| Use a change of variables to find an indefinite integral | F-IF | MP3 |
| Use the General Power Rule for Integration to find an indefinite integral | CC.2.2.HS.C.1 | MP3 |
| Use a change of variables to evaluate a definite integral | F-IF.2 | MP3 |
| Evaluate a definite integral involving an even or odd function | F-IF.2 | MP3 |
| Approximate a definite integral using the Trapezoidal Rule | CC.2.2.HS.C.1A-REI.11 | MP3 |
| Approximate a definite integral using Simpson’s Rule | CC.2.2.HS.C.1A-REI.11 | MP3 |
| Analyze the approximate errors: Trapezoidal Rule, Simpson’s Rule | CC.2.2.HS.C.1A-REI.11 | MP3 |
| **Marking Period 3** |  | MP3 |
| Develop and use properties of the natural logarithmic function | CC.2.2.HS.C.1A-SSE.3C | MP4 |
| Understand the definition of the number e | F-BFA-SSE.3C | MP4 |
| Find derivatives of functions involving the natural logarithmic function | F-BFA-SSE.3C | MP4 |
| Use the Log Rule for Integration to integrate a rational function | CC.2.2.HS.C.1F-BFA-SSE.3C | MP4 |
| Integrate trigonometric functions | F-BF F-TF | MP4 |
| Verify that one function is the inverse function of another function | F-BF.4B | MP4 |
| Determine whether a function has an inverse function  | F-BF | MP4 |
| Find the derivative of an inverse function | F-BF | MP4 |
| Develop properties of the natural exponential function | F-BF.5A-SSE.3C | MP4 |
| Differentiate natural exponential functions | F-BF.5A-SSE.3C | MP4 |
| Integrate natural exponential functions | F-BF.5A-SSE.3C | MP4 |
| Define exponential functions that have bases other than e | F-LE.4A-SSE.3C | MP4 |
| Differentiate and integrate exponential functions that have bases other than e | F-LE.4A-SSE.3C | MP4 |
| Use exponential functions to model compound interest and exponential growth | F-IF.8B | MP4 |
| Develop properties of the six inverse trigonometric functions | F-TF.2 F-TF.3F-TF.4 | MP4 |
| Differentiate an inverse trigonometric function | F.BF.4F-TF | MP4 |
| Review the basic differentiation rules for elementary functions | CC.2.2.HS.C.1 | MP4 |
| Integrate functions whose antiderivatives involve inverse trigonometric functions | F-TF.7 F-BF.4 | MP4 |
| Use the method of completing the square to integrate a function | F-IF.8A | MP4 |
| Review the basic integration rules involving elementary functions | CC.2.2.HS.C.1 | MP4 |
| **Final Exam Review and Assessment** |  | MP4 |
| * Review and extend knowledge of Applications of Differentiation: Summary of Curve Sketching, Optimization Problems
 |  | MP4 |
| * Review and extend knowledge of Integration
 |  | MP4 |
| * Review and extend knowledge of Logarithmic, Exponential, and Other Transcendental Functions
 |  | MP4 |
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|  |  |  |
| ***Optional, if time permits: Performance Indicators: Applications of Integration*** |  |  |
| *Find the area of a region between two curves using integration* | *CC.2.3.HS.A.14* | *MP4* |
| *Find the area of a region between intersecting curves using integration* | *CC.2.3.HS.A.14* | *MP4* |
| *Describe integration as an accumulation process* | *CC.2.2.HS.C.1* | *MP4* |
| *Find the volume of a solid revolution: Disk Method, Washer Method* | *CC.2.3.HS.A.13**CC.2.3.HS.A.14* | *MP4* |
| *Find the volume of a solid with known cross sections* | *CC.2.3.HS.A.13**CC.2.3.HS.A.14* | *MP4* |
| *Find the volume of a solid revolution using the Shell Method* | *CC.2.3.HS.A.13**CC.2.3.HS.A.14* | *MP4* |
| *Compare the uses of the Disk Method and the Shell Method*  | *F-IF.9* | *MP4* |
| *Find the arc length of a smooth curve* | *G-MG* | *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
* Mid-Term exam
* Final exam
* Projects
* Student presentations