## ACALANES UNION HIGH SCHOOL DISTRICT COURSE OF STUDY: CURRICULAR AREA – Mathematics

COURSE TITLE:	Advanced Placement Precalculus
<u>GRADE LEVEL(S)</u> :	11-12
COURSE LENGTH:	Year
PREFERRED PREVIOUS COURSE OF STUDY:	Algebra 2 or Algebra 2 Advanced
CREDITS PER SEMESTER:	5
STANDARDS & BENCHMARKS:	California Common Core State Standards — Mathematics
GRADUATION REQUIREMENT:	Fulfills 10 credits of the 30-credit Mathematics graduation requirement
UC/CSU A-G DESIGNATION:	Meets UC/CSU A-G requirements for Mathematics (C) / Precalculus
<u>ADOPTED BY</u> <u>AUHSD GOVERNING BOARD</u> :	June 4, 2025

#### **INSTRUCTIONAL RESOURCES**

College Board. "AP Classroom." *AP Central*, College Board, 2025, <u>https://apcentral.collegeboard.org/instructional-resources/ap-classroom</u>.

College Board. *AP Precalculus Course and Exam Description*. Fall 2023, College Board, 2023, <u>https://apcentral.collegeboard.org/media/pdf/ap-precalculus-course-and-exam-description.pdf</u>.

Demana, Franklin D., et al. *Precalculus: Graphical, Numerical, Algebraic.* 11th ed., AP® ed., Pearson College & Career Readiness, 2024.

## **COURSE DESCRIPTION**

AP Precalculus is a course focused on functions as models for dynamic phenomena, designed to enhance students' preparedness for college-level calculus and other mathematics and science courses. Students will engage in a research-based exploration of a broad spectrum of function types foundational to various academic disciplines and careers. The course aims to develop a deep conceptual understanding of functions, including their graphical, numerical, analytical, and verbal representations, and how they embody the dynamic covariation of quantities. Students will learn to develop and validate function models using bivariate data sets, characteristics of covarying quantities, and specific function characteristics. They will use these models for interpretation, interpolation, and extrapolation while understanding their assumptions and limitations. Key mathematical practices such as procedural and symbolic fluency, multiple representations, and communication and reasoning will be developed throughout the course.

Reference: College Board. AP Precalculus Course and Exam Description. Fall 2023, College Board, 2023.

### **GRADING GUIDELINES**

Summative Assessment: 95% Formative Coursework: 5%

### **COURSE CONTENT — SCOPE and SEQUENCE**

Units and Standards	Core Objectives
Unit 1: Polynomial and Rational Functions	In Unit 1, students develop an understanding of two key function concepts while exploring polynomial and rational functions. The first concept is covariation, or how output values change in tandem with changing input
California Common Core State Standards — Mathematics	values. The second concept is rates of change, including average rate of change, rate of change at a point, and changing rates of change. The central idea of a function as a rule for relating two simultaneously changing sets of
<ul> <li>Algebra: Arithmetic with Polynomials and Rational Expressions (A-APR); Creating Equations (A-CED); and Seeing Structure in Expressions</li> </ul>	values provides students with a vital tool that has many applications, in nature, human society, and business and industry. For example, the idea of crop yield increasing, but at a decreasing rate, or the efficacy of a medicine decreasing, but at an increasing rate, are important understandings that inform critical decisions.

(A-SSE)	
	<u>Topics</u>
• Functions: Interpreting	1.1 Change in Tandem
Functions (F-IF) and Building	1.2 Rates of Change
Functions (F-BF)	1.3 Rates of Change in Linear and Quadratic Functions
Number and Quantity: Complex	1.4 Polynomial Functions and Complex Zeros
Number System (N-CN)	1.6 Polynomial Functions and End Behavior
Number Oystein (N ON)	1.7 Rational Functions and End Behavior
<ul> <li>Modeling (M)</li> </ul>	1.8 Rational Functions and Zeros
	1.9 Rational Functions and Vertical Asymptotes
	1.10 Rational Functions and Holes
	1.11 Equivalent Representations of Polynomial and Rational Expressions
	1.12 Transformations of Functions
	1.13 Function Model Selection and Assumption Articulation
	1.14 Function Model Construction and Application
	Reference: College Board. AP Precalculus Course and Exam Description. Fall
	2023, College Board, 2023.

<ul> <li>Unit 2: Exponential and Logarithmic Functions</li> <li>California Common Core State Standards — Mathematics</li> <li><i>Algebra:</i> Reasoning with Equations and Inequalities (A-REI)</li> <li><i>Functions:</i> Interpreting Functions (F-IF); Building Functions (F-BF); and Linear</li> </ul>	In Unit 2, students build an understanding of exponential and logarithmic functions. Exponential and logarithmic function models are widespread in the natural and social sciences. When an aspect of a phenomenon changes proportionally to the existing amount, exponential and logarithmic models are employed to harness the information. Exponential functions are key to modeling population growth, radioactive decay, interest rates, and the amount of medication in a patient. Logarithmic functions are useful in modeling sound intensity and frequency, the magnitude of earthquakes, the pH scale in chemistry, and the working memory in humans. The study of these two function types touches careers in business, medicine, chemistry, physics, education, and human geography.
Quadratic and Exponential	Topics
Models (F-LE)	2.1 Change in Arithmetic and Geometric Sequences
	2.2 Change in Linear and Exponential Functions
<ul> <li>Modeling (M)</li> </ul>	2.3 Exponential Functions
	2.4 Exponential Function Manipulation
	2.5 Exponential Function Context and Data Modeling
	2.6 Competing Function Model Validation
	2.7 Composition of Functions
	2.8 Inverse Functions
	2.9 Logarithmic Expressions
	2.10 Inverses of Exponential Functions
	2.11 Logarithmic Function Manipulation
	2.12 Eogantimic Function Manipulation
	2.14 Logarithmic Function Context and Data Modeling
	2.15 Semi-log Plots
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	Reference: College Board. <i>AP Precalculus Course and Exam Description</i> . Fall 2023, College Board, 2023.

# Unit 3: Trigonometric and Polar Functions

California Common Core State Standards — Mathematics

- Algebra: Creating Equations (A-CED) and Reasoning with Equations and Inequalities (A-REI)
- Functions: Interpreting Functions (F-IF); Building Functions (F-BF); and Trigonometric Functions (F-TF)
- *Geometry:* Similarity, Right Triangles, and Trigonometry (G-SRT)
- Modeling (M)

In Unit 3, students explore trigonometric functions and their relation to the angles and arcs of a circle. Since their output values repeat with every full revolution around the circle, trigonometric functions are ideal for modeling periodic, or repeated pattern phenomena, such as: the highs and lows of a wave, the blood pressure produced by a heart, and the angle from the North Pole to the Sun year to year. Furthermore, periodicity is found in human inventions and social phenomena. For example, moving parts of an analog clock are modeled by a trigonometric function with respect to each other or with respect to time; traffic flow at an intersection over the course of a week demonstrates daily periodicity; and demand for a particular product over the course of a year falls into an annually repeating pattern. Polar functions, which are also explored in this unit, have deep ties to trigonometric functions as they are both based on the circle. Polar functions are defined on the polar coordinate system that uses the circular concepts of radii and angles to describe location instead of rectangular concepts of left-right and up-down, which students have worked with previously. Trigonometry is the bridge between the two systems.

### <u>Topics</u>

3.1 Periodic Phenomena
3.2 Sine, Cosine, and Tangent
3.3 Sine and Cosine Function Values
3.4 Sine and Cosine Function Graphs
3.5 Sinusoidal Functions
3.6 Sinusoidal Function Transformations
3.7 Sinusoidal Function Context and Data Modeling
3.8 The Tangent Function
3.9 Inverse Trigonometric Functions
3.10 Trigonometric Equations and Inequalities
3.11 The Secant, Cosecant, and Cotangent Functions
3.12 Equivalent Representations of Trigonometric Functions
3.13 Trigonometry and Polar Coordinates

	<ul> <li>3.14 Polar Function Graphs</li> <li>3.15 Rates of Change in Polar Functions</li> <li>Reference: College Board. <i>AP Precalculus Course and Exam Description</i>. Fall 2023, College Board, 2023.</li> </ul>
Unit 4: Functions Involving Parameters, Vectors, and Matrices	In Unit 4, students explore function types that expand their understanding of the function concept. Parametric functions have multiple dependent variables' values paired with a single input variable or parameter. Modeling scenarios
California Common Core State Standards — Mathematics	with parametric functions allows students to explore change in terms of components. This component-based understanding is important not only in
<ul> <li>Algebra: Creating Equations (A-CED) and Reasoning with Equations and Inequalities (A-REI)</li> </ul>	understand one aspect of a phenomenon independent of other confounding aspects. Another major function type in this unit involves matrices mapping a set of input vectors to output vectors. The capacity to map large quantities of vectors instantaneously is the basis for vector-based computer graphics. While students may see their favorite video game character trip and fall or seemingly
<ul> <li>Functions: Interpreting Functions (F-IF) and Building Functions (F-BF)</li> </ul>	move closer or farther, matrices implement a rotation on a set of vectors or a dilation on a set of vectors. The power of matrices to map vectors is not limited to graphics, but to any system that can be expressed in terms of components of vectors such as electrical systems, network connections, and regional
<ul> <li>Number and Quantity: Vector and Matrix Quantities (N-VM)</li> </ul>	population distribution changes over time. Vectors and matrices are also powerful tools of data science as they can be used to model aspects of complex scientific and social science phenomena.
• Modeling (M)	
	<b>Topics</b> 4.1 Parametric Functions4.2 Parametric Functions Modeling Planar Motion4.3 Parametric Functions and Rates of Change4.4 Parametric Functions and Accumulation4.5 Implicitly Defined Functions

<ul> <li>4.6 Conic Sections</li> <li>4.7 Parametrization of Implicitly Defined Functions</li> <li>4.8 Vectors</li> <li>4.9 Vector Operations</li> <li>4.10 Matrices</li> <li>4.11 The Inverse and Determinant of a Matrix</li> <li>4.12 Linear Transformations and Matrices</li> <li>4.13 Matrices as Functions</li> <li>4.14 Matrices Modeling Contexts</li> </ul>
Reference: College Board. AP Precalculus Course and Exam Description. Fall 2023, College Board, 2023.