FOLSOM CORDOVA UNIFIED SCHOOL DISTRICT

Pre-Calculus

Board Approval Date: May 20, 2021	**Course Length: 2 Semesters**
Grading: A-F	**Credits: 5 Credits per Semester**
Proposed Grade Level(s): 9, 10, 11, 12	**Subject Area: Mathematics** **Elective Area (if applicable):** **N/A**
Prerequisite(s): **"C" or better in Mathematics III**	**Corequisite(s):** **N/A**
CTE Sector/Pathway: N/A	
Intent to Pursue 'A-G' College Prep Status: Yes	
A-G Course Identifier: (c) Mathematics	
Graduation Requirement: Yes	
Course Intent: District Course **Program (if applicable): N/A**	
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COURSE DESCRIPTION:

Precalculus is a course that combines reviews of algebra, geometry, and functions into a preparatory course for calculus. The course focuses on the mastery of critical skills and exposure to new skills necessary for success in subsequent math courses. The first semester includes linear, quadratic, exponential, logarithmic, radical, polynomial, and rational functions; systems of equations; and conic sections. The second semester covers trigonometric ratios and functions; inverse trigonometric functions; applications of trigonometry, including vectors and laws of cosine and sine; polar functions and notation; and arithmetic of complex numbers. Within each Precalculus lesson, students are supplied with a post-study Checkup activity that provides them the opportunity to hone their computational skills by

working through a low-stakes problem set before moving on to formal assessment. Unit-level Precalculus assessments include a computer-scored test and a scaffolded, teacher-scored test. The course is built to state standards and the National Council of Teachers of Mathematics (NCTM) standards.

DETAILED UNITS OF INSTRUCTION: (Online Course)

Unit Number/Title	Unit Essential Questions	Examples of Formative Assessments	Examples of Summative Assessment
1. Functions	Can all transformations of basic functions be represented in a predictable algebraic way? When is it more appropriate to analyze a function algebraically? Graphically? How could the sum of an infinite number of numbers possibly converge? What is the relationship between operations with matrices and operations with real numbers?	*Practice problems on Functions *Calculator Skills Review	*Unit Test
2. Quadratic Functions	How does understanding the notion of "rate of change" help us in our daily lives? How are quadratics solved and what do the solutions mean? How can real-world situations be modeled by quadratic functions? How do you solve and transform quadratics?	*Practice problems on Quadratics Functions *Calculator Skills Review	*Unit Test
3. Polynomial and Rational Functions	How are rational functions related to polynomial functions? What do real zeros of a function look like? Why are asymptotes significant in the study of rational functions? How do you solve	*Practice problems on Polynomial and Rational Functions *Calculator Skills Review	*Unit Test

	polynomial equations using synthetic division and roots? How can polynomial functions be used to model real-life situations?		
4. Exponential and Logarithmic Functions	What is a logarithmic function and what are its characteristics? How are exponential and logarithmic functions related? How do exponential and logarithmic functions model real-world problems and their solutions?	*Practice problems on Exponential and Logarithmic Functions *Calculator Skills Review	*Unit Test
5. Conic Sections	What are conic sections? How can they be identified from an equation? A graph?	*Practice problems on Conic Sections *Calculator Skills Review	*Unit Test
6. Introduction to Trigonometry	How does right triangle trigonometry relate to trigonometry in a unit circle? How are the circular functions related to the trigonometric functions? How do trigonometric and circular functions model real world problems and their solutions?	*Practice problems on Introduction to Trig *Calculator Skills Review	*Unit Test
7. Trigonometric Identities	How do you build graphs of the six trigonometric functions? How do you transform trigonometric graphs with reflections, shifts, and stretches?	*Practice problems on Trig Functions *Calculator Skills Review	*Unit Test
8. Working with Trigonometric Functions	How do you solve for angles using the inverse trigonometric ratios? Where can the graphs of trigonometric functions be	*Practice problems on Working with Trig Functions *Calculator Skills Review	*Unit Test

	found in our everyday lives?		
9. Trigonometric Identities	How do you prove trigonometric identities? Why is it important to understand how trigonometric identities were derived? How can trigonometric identities be used outside of the calculus classroom?	*Practice problems on Trig Identities *Calculator Skills Review	*Unit Test
10. Applications of Trigonometry	How do you use the laws of sine and cosines to solve triangles? Why are functions and relations represented by vectors? How can trigonometry be used to solve real-life problems?	*Practice problems on Applications of Trig *Calculator Skills Review	*Unit Test
11. Complex Numbers	How do you use polar coordinates to express locations of points? How can you produce a variety of graphs using polar functions? How do you express complex numbers in polar form? How do you express powers and roots of complex numbers?	*Practice problems on Complex Numbers *Calculator Skills Review	*Unit Test

ESSENTIAL STANDARDS:

NUMBER AND QUANTITY

N-CN 3.

Find the conjugate of a complex number; use conjugates to find moduli and quotients of complex numbers.

N-CN 4.

Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers) and explain why the rectangular and polar forms of a given complex number represent the same number.

N-CN 5.

Represent addition, subtraction, multiplication, and conjugation of complex numbers geometrically on the complex plane; use properties of this representation for computation. For example, $(-1 + \sqrt{3}\, i)3 = 8$ because (–1

+ √3 i) has modulus 2 and argument 120°.
N-CN 6.
Calculate the distance between numbers in the complex plane as the modulus of the difference, and the midpoint of a segment as the average of the numbers at its endpoints.
N-VM 1.
Recognize vector quantities as having both magnitude and direction. Represent vector quantities by directed line segments and use appropriate symbols for vectors and their magnitudes (e.g., v, |v|, ||v||, v).
N-VM 2.
Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point.
N-VM 3.
Solve problems involving velocity and other quantities that can be represented by vectors.
N-VM 4a.
Add and subtract vectors. Add vectors end-to-end, component-wise, and by the parallelogram rule. Understand that the magnitude of a sum of two vectors is typically not the sum of the magnitudes.
N-VM 4b.
Add and subtract vectors. Given two vectors in magnitude and direction form, determine the magnitude and direction of their sum.
N-VM 4c.
Add and subtract vectors. Understand vector subtraction v – w as v + (–w), where –w is the additive inverse of w, with the same magnitude as w and pointing in the opposite direction. Represent vector subtraction graphically by connecting the tips in the appropriate order and perform vector subtraction component-wise.
N-VM 5a.
Multiply a vector by a scalar. Represent scalar multiplication graphically by scaling vectors and possibly reversing their direction; perform scalar multiplication component-wise, e.g., as c(vx, vy) = (cvx, cvy).
N-VM 5b.
Multiply a vector by a scalar. Compute the magnitude of a scalar multiple cv using ||cv|| = |c|v. Compute the direction of cv knowing that when |c|v ≠ 0, the direction of cv is either along v (for c > 0) or against v (for c < 0).
N-VM 6.
Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
N-VM 7.
Multiply matrices by scalars to produce new matrices, e.g., as when all the payoffs in a game are doubled.N-VM 8.
Add, subtract, and multiply matrices of appropriate dimensions.
N-VM 9.
Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
N-VM 10.
Understand that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
N-VM 11.
Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.
N-VM 12.
Work with 2 × 2 matrices as transformations of the plane and interpret the absolute value of the determinant in terms of area.

ALGEBRA

A-SSE 1a.

Interpret expressions that represent a quantity in terms of its context. Interpret parts of an expression, such as terms, factors, and coefficients.

A-SEE 1b.

Interpret expressions that represent a quantity in terms of its context. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

A-SEE 2.

Use the structure of an expression to identify ways to rewrite it. For example, see x4 – y4 as (x2)2 – (y2)2, thus recognizing it as a difference of squares that can be factored as (x2 – y2)(x2 + y2).

A-APR 6.

Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.

A-APR 7.

Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.

A-CED 1.

Create equations and inequalities in one variable including ones with absolute value and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions. CA

A-CED 2.

Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.

A-CED 3.

Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context. For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.

A-CED 4.

Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm’s law V = IR to highlight resistance R.

A-REI 8.

Represent a system of linear equations as a single matrix equation in a vector variable.

A-REI 9.

Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension 3 × 3 or greater).

FUNCTIONS

F-IF 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 5.

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

For example, if the function h gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.
F-IF 7d.
Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior.
F-IF 7e.
Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude.
F-IF 10.
Demonstrate an understanding of functions and equations defined parametrically and graph them. CA
F-IF 11.
Demonstrate an understanding of functions and equations defined parametrically and graph them. CA
F-BF 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.
F-BF 4b.
Find inverse functions. Verify by composition that one function is the inverse of another.
F-BF 4c.
Find inverse functions. Read values of an inverse function from a graph or a table, given that the function has an inverse.
F-BF 4d.
Find inverse functions. Produce an invertible function from a non-invertible function by restricting the domain.
F-TF 4.
Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
F-TF 6.
Understand that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.
F-TF 7.
Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.
F-TF 9.
Prove the addition and subtraction formulas for sine, cosine, and tangent and use them to solve problems.
F-TF 10.
Prove the half angle and double angle identities for sine and cosine and use them to solve problems. CA

GEOMETRY
G-SRT 9.
Derive the formula A = 1/2 ab sin(C) for the area of a triangle by drawing an auxiliary line from a vertex perpendicular to the opposite side.
G-SRT 10.
Prove the Laws of Sines and Cosines and use them to solve problems.
G-SRT 11.
Understand and apply the Law of Sines and the Law of Cosines to find unknown measurements in right and non-right triangles (e.g., surveying problems, resultant forces).

G-GPE 3.
Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.
G-GPE 3.1
Given a quadratic equation of the form.
ax2 + by2 + cx + dy + e = 0, use the method for completing the square to put the equation into standard form; identify whether the graph of the equation is a circle, ellipse, parabola, or hyperbola and graph the equation. CA

RELEVANT STANDARDS AND FRAMEWORKS, CONTENT/PROGRAM SPECIFIC STANDARDS:

Link to Common Core Standards (if applicable):
Educational standards describe what students should know and be able to do in each subject in each grade. In California, the State Board of Education decides on the standards for all students, from kindergarten through high school.
https://www.cde.ca.gov/be/st/ss/documents/ccssmathstandardaug2013.pdf

Link to Framework (if applicable):
Curriculum frameworks provide guidance for implementing the content standards adopted by the State Board of Education (SBE). Frameworks are developed by the Instructional Quality Commission, formerly known as the Curriculum Development and Supplemental Materials Commission, which also reviews and recommends textbooks and other instructional materials to be adopted by the SBE.
https://www.cde.ca.gov/ci/ma/cf/documents/mathfwprecalculus.pdf

Link to Subject Area Content Standards (if applicable):
Content standards were designed to encourage the highest achievement of every student, by defining the knowledge, concepts, and skills that students should acquire at each grade level.

Link to Program Content Area Standards (if applicable):
Program Content Area Standards applies to programs such as International Baccalaureate, Advanced Placement, Career and Technical Education, etc.

TEXTBOOKS AND RESOURCE MATERIALS:

Textbooks

Board Approved	Pilot Completion Date (If applicable)	Textbook Title	Author(s)	Publisher	Edition	Date
Yes		*APEX: Precalculus*		APEX Online Courses		*2019*

Other Resource Materials

N/A

Supplemental Materials

Board approved supplemental materials (Including but not limited to: Film Clips, Digital Resources, Supplemental texts, DVDs, Programs (Pebble Creek, DBQ, etc.):
N/A