

Precalculus Essential Curriculum

UNIT 1: Trigonometry

Goal. The students will demonstrate the ability to define trigonometric ratios and apply trigonometry to solve real-world problems.

Objectives – The student will be able to:

- Define and evaluate the six trigonometric ratios.
- Solve triangles using trigonometric ratios.
- Define radian measure and convert angle measures between degrees and radians.
- Define the trigonometric functions in terms of the unit circle.
- Develop basic trigonometric identities.
- Use trigonometric functions to model and solve real-world problems, including right triangle relations, arc length, and speed.

UNIT 2: Trigonometric Graphs

Goal. The students will demonstrate the ability to sketch and analyze trigonometric graphs and apply trigonometry to solve real-world problems.

Objectives – The student will be able to:

- Graph the sine, cosine, and tangent functions.
- Identify the domain and range of a basic trigonometric function.
- Graph transformations of the sine, cosine, and tangent graphs.
- Graph the cosecant, secant, and cotangent functions and their transformations.
- Identify and sketch the period, amplitude (if any), and phase shift of the cosine, sine, and tangent functions.
- Use trigonometric graphs to model and solve real-world problems.

UNIT 3: Trigonometric Equations and Identities

Goal. The students will demonstrate the ability to solve trigonometric equations, investigate inverse trigonometric functions, and use trigonometric identities.

Objectives – The student will be able to:

- Solve trigonometric equations graphically and algebraically.
- Define the domain and range of the inverse trigonometric functions.
- Write a trigonometric function to model and solve real-world problems.
- Apply strategies to prove identities.
- Use the addition and subtraction identities for sine, cosine, and tangent functions.
- Use the double-angle and half-angle identities.
- Use identities to solve trigonometric equations.
- Solve triangles using the Law of Cosines.
- Solve triangles using the Law of Sines.

UNIT 4: Analytic Geometry

Goal. The students will demonstrate the ability to explore conic sections algebraically and graphically.

Objectives – The student will be able to:

- a. Define a circle and write its equation.
- b. Analyze and sketch the graph of a circle.
- c. Define an ellipse and write its equation.
- d. Analyze and sketch the graph of an ellipse.
- e. Define a hyperbola and write its equation.
- f. Analyze and sketch the graph of a hyperbola.
- g. Define a parabola and write its equation.
- h. Analyze and sketch the graph of a parabola.
- i. Write the equation of and graph a translated conic section.
- j. Use conic sections to model and solve real-world problems.

UNIT 5: Sequences and Series

Goal. The students will demonstrate the ability to identify and evaluate arithmetic and geometric sequences and series.

Objectives – The student will be able to:

- a. Identify and graph an arithmetic sequence.
- b. Write an arithmetic sequence recursively and explicitly.
- c. Use summation notation.
- d. Find the n^{th} term and the n^{th} partial sum of an arithmetic sequence.
- e. Recognize a geometric sequence.
- f. Write a geometric sequence recursively and explicitly.
- g. Find partial sums of a geometric sequence.
- h. Find the sum of an infinite geometric series.

UNIT 6: Functions and Graphs

Goal. The students will demonstrate the ability to solve equations and use function notation. The students will develop skills in constructing and interpreting graphs of functions.

Objectives – The student will be able to:

- a. Solve absolute-value, radical, and fractional equations.
- b. Determine whether a relation is a function.
- c. Determine the domain of a function.
- d. Evaluate piecewise-defined and greatest integer functions.
- e. Analyze graphs to determine domain and range, local maxima and minima, and intervals where they are increasing and decreasing.
- f. Find the vertex and intercepts of a quadratic function and sketch its graph.
- g. Transform graphs of parent functions.
- h. Determine whether a graph is symmetric with respect to the x-axis, y-axis, and/or origin.
- i. Perform addition, subtraction, multiplication, division, and composition of functions.
- j. Define inverse relations and functions and determine whether an inverse relation is a function.
- k. Verify inverses using composition.

UNIT 7: Polynomial and Rational Functions

Goal. The students will demonstrate the ability to solve polynomial equations and sketch and analyze graphs of polynomial and rational functions.

Objectives – The student will be able to:

- a. Divide polynomials.
- b. Apply the Remainder and Factor Theorems.
- c. Determine the maximum number of zeros of a polynomial.
- d. Find all rational zeros of a polynomial.
- e. Simplify and perform operations on complex numbers.
- f. Solve for the complex zeros of a polynomial.
- g. Analyze and sketch polynomial functions using continuity, end behavior, intercepts, local extrema, and points of inflections.
- h. Use polynomial functions to model and solve real-world problems.
- i. Find the domain of a rational function.
- j. Identify intercepts, holes, vertical, horizontal, and slant asymptotes in order to sketch graphs of rational functions.

UNIT 8: Exponential and Logarithmic Functions

Goal. The students will demonstrate the ability to use the laws of exponents and logarithms and apply them to real-world situations.

Objectives – The student will be able to:

- a. Simplify expressions containing radicals or rational exponents.
- b. Graph and identify transformations of exponential functions, including the number e .
- c. Use exponential functions to model and solve real-world problems.
- d. Graph and identify transformations of logarithmic functions.
- e. Evaluate logarithms to any base with and without a calculator.
- f. Apply properties and laws of logarithms to simplify and evaluate expressions.
- g. Solve exponential and logarithmic equations.
- h. Use exponential, logarithmic, and logistic models to solve real-world problems.

UNIT 9: Limits

Goal. The students will demonstrate the ability to calculate limits algebraically and estimate limits from graphs and tables of values.

Objectives – The student will be able to:

- a. Use the informal definition of limit.
- b. Use and apply the properties of limits to find the limit of various functions.
- c. Find one-sided limits.
- d. Determine if a function is continuous at a point or an interval.
- e. Find the limit as x approaches infinity.