PRECALCULUS 41

Description

Precalculus 41 provides an accelerated in-depth treatment of trigonometric functions and their applications. This course includes polynomial, rational, logarithmic and exponential functions. Precalculus 41 includes an introduction to regression analysis, polar coordinates, vectors and parametric equations. In addition, the course also includes units on partial fraction decomposition, mathematical induction, and the binomial theorem. Precalculus 41 prepares students for AP Calculus.

Course Overview

Course Goals

Students should:

Essential Questions

- How do patterns and functions help us describe data and physical phenomena and solve a variety of problems?
- How are quantitative relationships represented by numbers?
- How do geometric relationships and measurements help us to solve problems and make sense of our world?
- How can collecting, organizing and displaying data help us analyze information and make reasonable predictions and informed decisions?

Assessments

Common Assessments

Skill Assessments

Content Outline

I. Unit 1 - Defining and Analyzing Functions and Relations
II. Unit 2 - Trigonometric Functions
III. Unit 3 - Polar Coordinates
IV. Unit 4 - Polynomial, Rational, Exponential and Logarithmic Functions and Equations
V. Unit 5 - Statistics
VI. Unit 6 - Advanced Topics

Standards

State of Connecticut Mathematics Curriculum Frameworks

Connecticut State Standards are met in the following areas:

- ***Algebraic Reasoning: Patterns And Functions***
- ***Numerical and Proportional Reasoning***
- ***Geometry and Measurement***
- ***Working with Data: Probability and Statistics***

Grade Level Skills

Students will:

- Skills Matrix

Pacing Guide										
1st Marking Period			2nd Marking Period			3rd Marking Period			4th Marking Period	
September	October	November	December	January	February	March	April	May	June	
Unit 1 **Defining and Analyzing Functions and Relations** 3 ½ weeks	Unit 2 **Trigonometric Functions** 15 weeks				Unit 3 **Polar Coordinates** 2 ½ weeks	Unit 4 **Polynomial, Rational, Exponential and Logarithmic Functions and Equations** 8 weeks		Unit 5 **Statistics** 2 weeks	Unit 6 **Advanced Topics** 4 weeks	

Unit 1 - Defining and Analyzing Functions and Relations, 3 ½ weeks top

Standards

Algebraic Reasoning: Patterns And Functions – Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

1.1 Students should understand and describe patterns and functional relationships.

Core 1.1a Students will describe relationships and make generalizations about patterns and functions.

Extended 1.1a Students will model real world situations and make generalizations about mathematical relationships using a variety of patterns and functions.

1.2 Students should represent and analyze quantitative relationships in a variety of ways.

Core 1.2a Students should represent and analyze linear and non-linear functions and relations symbolically and with tables and graphs.

Extended 1.2a Students will relate the behavior of functions and relations to specific parameters and determine functions to model real world situations.

1.3 Students should use operations, properties, and algebraic symbols to determine equivalence and solve problems.

Core 1.3a Students will manipulate equations, inequalities, and functions to solve problems.

Extended 1.3a Students will use and extend algebraic concepts to include real and complex numbers, vectors, and matrices.

Unit Objectives

Students will be able to:

- recognize, analyze, graph, and solve everyday problems that can be modeled using functions.
- determine the domain and range of functions and perform operations on functions.

Essential Question

- How do patterns and functions help us describe data and physical phenomena and solve a variety of problems?

Focus Questions

- What are the major attributes to analyze a function?
- When is a relation a function?
- How do you determine the average rate of change of a function?
- How do you determine if a function is even or odd graphically or algebraically?
- How do you determine the composition of two functions?
- What is the domain of a composite function?

Assessment

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Skill Objectives

Students will:

- determine whether a relation is a function.
- determine the value of a function.
- determine domain and range of a function.
- identify the graph of a function.
- determine the average rate of change of a function.
- determine where a function is increasing, decreasing, or constant
- locate extrema.
- identify even and odd functions graphically and algebraically.
- graph functions using transformations.
- form the composite function and determine its domain.
- construct and analyze a function.
- determine x and y intercepts of graphs.

		• test for x axis, y axis and origin symmetry. • determine, use and interpret the slope of a line as a rate of change. • determine the equation of a line from its graph or its given attributes. • solve linear, quadratic and absolute value equations and inequalities algebraically and graphically. • determine whether a graph represents a function. • identify the domain and range of a function. • identify an appropriate symbolic representation for a function or a relation displayed graphically or verbally. • use functions to model problems. • determine the average rate of change of a function. • determine increasing intervals, decreasing intervals, constant intervals, local maxima and local minima for a function. • identify even or odd functions from graphs or equations. • sketch the graphs of linear, quadratic, cubic, square root, reciprocal, absolute value and greatest integer functions and their transformations. • represent translations, reflections, and dilations of plane figures using sketches, coordinates, vectors, and function notation to examine the effects of transformations and their composites and to solve related geometric problems. • graph piecewise-defined functions. • perform the operations of addition, subtraction, multiplication, division and composition with functions. • find the inverse of a relation from graphs or equations and determine if the inverse is a function. • solve everyday problems that can be modeled using linear and quadratic equations.

Unit 2 – Trigonometric Functions, 15 weeks top

Standards

Algebraic Reasoning: Patterns And Functions – Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

1.1 Students should understand and describe patterns and functional relationships.

Core 1.1a Students will describe relationships and make generalizations about patterns and functions.

Extended 1.1a Students will model real world situations and make generalizations about mathematical relationships using a variety of patterns and functions.

1.2 Students should represent and analyze quantitative relationships in a variety of ways.

Core 1.2a Students should represent and analyze linear and non-linear functions and relations symbolically and with tables and graphs.

Extended 1.2a Students will relate the behavior of functions and relations to specific parameters and determine functions to model real world situations.

1.3 Students should use operations, properties, and algebraic symbols to determine equivalence and solve problems.

Core 1.3a Students will manipulate equations, inequalities, and functions to solve problems.

Geometry and Measurement – Shapes and structures can be analyzed, visualized, measured and transformed using a variety of strategies, tools and technologies.

3.3 Students should develop and apply units, systems, formulas and appropriate tools to estimate and measure.

Core 3.3a Students will solve a variety of problems involving one- two- and three-dimensional measurements using geometric relationships and trigonometric ratios.

Extended 3.3a Students will approximate measurements that can not be directly determined with some degree of precision using appropriate tools, techniques and strategies.

3.2 Students should use spatial reasoning, location and geometric relationships to solve problems.

Extended 3.2a Students will use a variety of coordinate systems and transformations to solve geometric problems in two- and three-dimensions using appropriate tools and technology.

Unit Objective

Students will be able to:

- demonstrate an understanding of trigonometric functions, their basic values and their formulas.

Essential Questions

- How do patterns and functions help us describe data and physical phenomena and solve a variety of problems?
- How do geometric relationships and measurements help us to solve problems and make sense of our world?

Focus Questions

- What are the major attributes of each

Assessment

- Cul de Sac 41

Skill Objectives

Students will:

- determine the arc length of a circle in radian measure.
- convert from degrees to radians.
- convert from radians to degrees.
- determine the area of a sector of a circle in radian measure.
- determine the linear speed of an object traveling in circular motion.

	trigonometric function? • How do you determine a sinusoidal function from given data? • How do you determine the exact values of trigonometric functions? • How do you determine the approximate values of trigonometric functions? • How do you convert degree measure to radian measure? • How do you convert radian measure to degree measure? • How are trigonometric identities established? • How are trigonometric identities used to solve trigonometric equations? • How is right triangle trigonometry used to solve right triangles? • How are Law of Sines and Law of Cosines used to solve triangles? • How are Sines and Heron's formulas used to determine area of triangle?	• determine the exact values of the trigonometric functions. • use a calculator to approximate the values of trigonometric functions. • determine the domain and range of trigonometric functions. • determine the amplitude, period and phase shift of trigonometric functions. • use even and odd properties to determine the exact values of trigonometric functions. • graph transformations of the trigonometric functions. • determine an equation for a sinusoidal graph. • determine a sinusoidal function from data. • determine the exact value of the inverse trigonometric functions. • determine the approximate value of the inverse trigonometric functions • establish identities. • use sum and difference formulas to determine exact values and establish identities. • use double angle formulas to determine exact values and establish identities. • solve trigonometric equations. • solve right triangles and applied problems using right triangle trigonometry. • solve triangles and applied problems using Law of Sines and Law of Cosines. • determine the area of a triangle and applied problems using Sines and Heron's formula. • determine an equation for an object in simple harmonic motion. • solve right triangles using trigonometric ratios and the Pythagorean Theorem. • convert measures of angles between degrees and radians. • use the relationship between radius, arc length and measure of the central angle of a circle to solve for missing values. • determine the linear speed of an object traveling along a circular path.

		• find the exact value of trigonometric functions of special angles. • graph the six basic trigonometric functions and identify their domain and range. • use the inverse trigonometric functions to solve problems. • use quotient, reciprocal and Pythagorean identities to simplify expressions and prove new identities. • use Double angle formulas for Sine, Cosine and Tangent. • solve trigonometric equations using identities. • use Sum and Difference formulas. • determine amplitude, period and phase shift of a sinusoidal function. • graph sinusoidal functions. • use sinusoidal functions to model data from real life situations.

Unit 3 - Polar Coordinates, 2 ½ weeks top

Standards

Algebraic Reasoning: Patterns And Functions – Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

1.1 Students should understand and describe patterns and functional relationships.

Core 1.1a Students will describe relationships and make generalizations about patterns and functions.

Extended 1.1a Students will model real world situations and make generalizations about mathematical relationships using a variety of patterns and functions.

1.2 Students should represent and analyze quantitative relationships in a variety of ways.

Core 1.2a Students should represent and analyze linear and non-linear functions and relations symbolically and with tables and graphs.

Extended 1.2a Students will relate the behavior of functions and relations to specific parameters and determine functions to model real world situations.

1.3 Students should use operations, properties, and algebraic symbols to determine equivalence and solve problems.

Core 1.3a Students will manipulate equations, inequalities, and functions to solve problems.

Extended 1.3a Students will use and extend algebraic concepts to include real and complex numbers, vectors, and matrices.

Numerical and Proportional Reasoning – Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technologies.

2.1 Students should understand that a variety of numerical representations can be used to describe quantitative relationships.

Extended 2.1a Students will extend the understanding of number to include the set of complex numbers.

Geometry and Measurement – Shapes and structures can be analyzed, visualized, measured and transformed using a variety of strategies, tools and technologies.

3.3 Students should develop and apply units, systems, formulas and appropriate tools to estimate and measure.

Core 3.3a Students will solve a variety of problems involving one- two- and three-dimensional measurements using geometric relationships and trigonometric ratios.

3.2 Students should use spatial reasoning, location and geometric relationships to solve problems.

Extended 3.2a Students will use a variety of coordinate systems and transformations to solve geometric problems in two- and three-dimensions using appropriate tools and technology.

Unit Objectives

Students will be able to:

- compute all operations and solve problems using polar coordinates and polar equations.
- find complex roots and use Demoivre's theorem.
- convert a complex number from

Essential Questions

- How do patterns and functions help us describe data and physical phenomena and solve a variety of problems?
- How are quantitative relationships represented by numbers?
- How do geometric relationships and measurements help us to solve problems

Assessment

- Air traffic controller – To be created

Skill Objectives

Students will:

- plot points using polar coordinates.
- convert polar coordinates to rectangular coordinates.
- convert rectangular coordinates to polar coordinates.

rectangular to polar form.	and make sense of our world? **Focus Questions** • What are the major attributes of polar graphs? • How do you convert polar coordinates to rectangular coordinates? • How do you convert rectangular coordinates to polar coordinates? • How do you convert polar equations to rectangular equations? • How do you convert rectangular equations to polar equations? • How do you determine the product and quotient of complex numbers in polar form? • How do you determine the roots of complex numbers?	• graph and identify polar equations by converting to rectangular equations. • graph polar equations by plotting points and using a graphing utility. • test polar equations for symmetry graphically and algebraically. • plot points in the complex plane. • determine products and quotients of complex numbers in polar form. • use DeMoivre's Theorem to determine powers and roots of complex numbers in polar form. • determine roots of complex numbers. • use Cartesian, navigational, and polar systems to represent, analyze, and solve geometric and measurement problems. • graph simple polar equations by hand. • graph polar equations using a graphing utility. • perform operations on complex numbers in polar and rectangular form. • determine complex roots.

Unit 4 - Polynomial, Rational, Exponential and Logarithmic Functions and Equations, 8 weeks top

Standards

Algebraic Reasoning: Patterns And Functions – Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

1.1 Students should understand and describe patterns and functional relationships.

Core 1.1a Students will describe relationships and make generalizations about patterns and functions.

Extended 1.1a Students will model real world situations and make generalizations about mathematical relationships using a variety of patterns and functions.

1.2 Students should represent and analyze quantitative relationships in a variety of ways.

Core 1.2a Students should represent and analyze linear and non-linear functions and relations symbolically and with tables and graphs.

Extended 1.2a Students will relate the behavior of functions and relations to specific parameters and determine functions to model real world situations.

1.3 Students should use operations, properties, and algebraic symbols to determine equivalence and solve problems.

Core 1.3a Students will manipulate equations, inequalities, and functions to solve problems.

Extended 1.3a Students will use and extend algebraic concepts to include real and complex numbers, vectors, and matrices.

Numerical and Proportional Reasoning – Quantitative relationships can be expressed numerically in multiple ways in order to make connections and simplify calculations using a variety of strategies, tools and technologies.

2.1 Students should understand that a variety of numerical representations can be used to describe quantitative relationships.

Extended 2.1a Students will extend the understanding of number to include the set of complex numbers.

2.2 Use numbers and their properties to compute flexibly and fluently, and to reasonably estimate measures and quantities.

Extended 2.2a Investigate mathematical properties and operations related to objects that are not numbers.

Unit Objective

Students will be able to:

- solve polynomial, exponential, logarithmic, and rational equations.

Essential Questions

- How do patterns and functions help us describe data and physical phenomena and solve a variety of problems?
- How do geometric relationships and measurements help us to solve problems and make sense of our world?

Focus Questions

- How can a graph be used to solve an equation or inequality?
- How can a polynomial, rational, exponential or logarithmic equation be solved algebraically?
- How can a polynomial or rational

Assessment

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Skill Objectives

Students will:

- determine the zeros and the multiplicity (real and complex) of a polynomial function both algebraically and graphically.
- solve polynomial and rational inequalities algebraically and graphically.
- solve exponential and logarithmic equations algebraically and graphically.
- compare and contrast the properties of numbers and number systems including rational, real, and complex numbers.

	inequality be solved algebraically? • How can you determine the features of a graph given the equation? • How can you determine equivalent forms of rational, exponential and logarithmic expressions? • How do you apply the principles of polynomial, rational, exponential and logarithmic functions to real world situations?	• determine the complex zeros of polynomial functions by using a graphing utility, factoring, quadratic formula, and synthetic division. • determine the vertical, horizontal and oblique asymptotes of rational functions both algebraically and graphically • identify polynomial functions and their degree, domain, and range • analyze the graph of a polynomial and rational functions including maximum and minimum values • determine a polynomial function given specified zeros • analyze the graph of a rational function • graph polynomial and rational functions by hand and by using a graphing utility. • determine the x and y intercepts of rational functions. • determine any removable discontinuities of rational functions. • solve polynomial and rational inequalities algebraically and graphically • decompose a rational function into partial fractions • graph and analyze exponential and logarithmic functions including domain and range • convert between exponential and logarithmic expressions • solve exponential and logarithmic equations algebraically and graphically • apply the properties of logarithms • define and apply the number *e* as it relates to exponential and logarithmic functions • solve problems using any bases • solve real world problems involving compound or continuous interest, growth and decay problems.

Unit 5 - Statistics, 2 weeks top

Standards

Working with Data: Probability and Statistics – Data can be analyzed to make informed decisions using a variety of strategies, tools and technologies.

4.1 Collect, organize and display data using appropriate statistical and graphical methods.

Extended 4.1a Students will model real data graphically using appropriate tools, technology and strategies.

4.3 Students should understand and apply basic concepts of probability.

Extended 4.3a Students will solve problems using the methods of discrete mathematics

Unit Objectives

Students will be able to:

- draw and interpret graphs of relations and scatter plots by hand using transformations and by using a graphing utility.
- determine the polynomial, exponential, logarithmic and trigonometric functions of best fit to data (regression analysis).
- apply the binomial theorem.

Essential Question

- How can collecting, organizing and displaying data help us analyze information and make reasonable predictions and informed decisions?

Focus Questions

- How can a graphing utility be used to determine a regression equation of best fit?
- How can you use the binomial theorem to expand a binomial?

Assessment

- Scream Machine 41

Skill Objectives

Students will:

- draw and interpret graphs of relations and scatter plots by hand and by using a graphing utility.
- investigate, organize, display, and analyze data in tabular, graphical, and symbolic forms.
- make and justify predictions based on patterns and regression models.
- determine the polynomial, exponential, logarithmic and trigonometric functions of best fit to data.
- expand a binomial.
- apply the binomial principles to probability.
- evaluate a binomial coefficient using Pascal's Triangle and using combination formulas.
- apply the binomial theorem.

Unit 6 – Advanced Topics, 4 weeks top

Standards

Algebraic Reasoning: Patterns And Functions – Patterns and functional relationships can be represented and analyzed using a variety of strategies, tools and technologies.

1.1 Students should understand and describe patterns and functional relationships.

Core 1.1a Students will describe relationships and make generalizations about patterns and functions.

Extended 1.1a Students will model real world situations and make generalizations about mathematical relationships using a variety of patterns and functions.

1.2 Students should represent and analyze quantitative relationships in a variety of ways.

Core 1.2a Students should represent and analyze linear and non-linear functions and relations symbolically and with tables and graphs.

Extended 1.2a Students will relate the behavior of functions and relations to specific parameters and determine functions to model real world situations.

1.3 Students should use operations, properties, and algebraic symbols to determine equivalence and solve problems.

Core 1.3a Students will manipulate equations, inequalities, and functions to solve problems.

Extended 1.3a Students will use and extend algebraic concepts to include real and complex numbers, vectors, and matrices.

Unit Objectives

Students will be able to:

- apply operations of vector algebra to two and three-dimensional vectors.
- convert and graph parametric equations and their rectangular equivalents.
- prove statements using mathematical induction.

Essential Question

- How do patterns and functions help us describe data and physical phenomena and solve a variety of problems?

Focus Questions

- How do you perform operations on vectors?
- How can you determine the angle between two vectors?
- How can you use parametric equations and vectors to solve real world problems?
- How can mathematical induction be used to prove statements true for all n?

Assessment

- It's Going, Going…

Skill Objectives

Students will:

- graph vectors.
- solve real world problems involving vectors and parametric equations.
- graph parametric equations by hand and with a graphing utility.
- convert from parametric to rectangular equations.
- prove statements using mathematical induction.
- apply operations of addition, subtraction and scalar multiplication to two and three-dimensional vectors.
- determine position and unit vectors of two and three-dimensional vectors.
- determine the magnitude of two and three-dimensional vectors.

		• determine the dot product of two and three-dimensional vectors. • determine whether two vectors are parallel or orthogonal. • determine the angle between two vectors in two and three-dimensions using the vector formula. • decompose a fraction when the denominator has only non-repeated linear factors. • decompose a fraction when the denominator has repeated linear factors. • decompose a fraction when the denominator has only non-repeated irreducible quadratic factors. • decompose a fraction when the denominator has repeated irreducible quadratic factors.