Ganado Unified School District #20
Pre-Calculus/ 11-12

PACING Guide SY 2022-2023

Time Line & Resources (Identify textbook, page number or website link & etc.)	**Arizona Mathematics Standards**	**Essential Question (HESS Matrix)**	**Learning Goal**	**Vocabulary (Content/Academic)**
First Quarter				
Chapter 0: Preparing for Pre-Calculus	**RFR.AF.1:** Interpret parameters of a function defined by an expression in the context of the situation. **RFR.AF.2:** Sketch the graph of a function that models a relationship between two quantities, identifying key features. **RFR.AF.3:** Interpret key features of graphs and tables for a function that models a relationship between two quantities in terms of the quantities. **RFR.AF.4:** Use limits to describe long-range behavior, asymptotic behavior, and points of discontinuity. **RFR.BF.1:** Model relationships between quantities that require adding, subtracting, multiplying, and/or dividing functions	What are the different methods in solving quadratic equations? What is a conjugate?	I will be able to: • Use set notation to denote elements, subsets, and complements. • Find the intersections and unions of sets • Perform operations with pure imaginary numbers and complex numbers • Use complex conjugates to write quotients of complex numbers in standard form • Graph quadratic functions • Solve quadratic equations	- Set - Element - Subset - Universal Set - Complement - Union - Intersection - Empty Set - Imaginary Unit - Complex Number - Standard Form - Real Part - Imaginary Part - Imaginary Number - Pure Imaginary Number - Complex Conjugates

	RFR.BF.2: Model relationships through composition and attend to the restrictions of the domain **RFR.BF.3:** Rewrite a function as a composition of functions **RFR.BF.4:** Determine if a function has an inverse. If so, find the inverse. If not, define a restriction on the domain that meets the requirement for invertibility and find the inverse on the restricted domain **RFR.BF.5:** Interpret the meanings of quantities involving functions and their inverses **RFR.BF.6:** Verify by analytical methods that one function is the inverse of another			
Chapter 1: Function from a Calculus Perspective	**RFR.AF.1:** Interpret parameters of a function defined by an expression in the context of the situation. **RFR.AF.2:** Sketch the graph of a function that models a relationship between two quantities, identifying key features. **RFR.AF.3:** Interpret key features of graphs and tables for a function that models a relationship between two quantities in terms of the quantities.	How will you use data to determine functional relationships between quantities?	I will be able to: • Describe subsets of real numbers • Identify and evaluate functions and state their domains • Use graphs of functions to estimate function values • Identify even and odd functions	- Set-builder Notation - Interval Notation - Implied Domain - Piecewise-Defined Function - Relevant Domain - Zeros - Roots - Line Symmetry - Point Symmetry - Even Function - Odd Function

	RFR.AF.4: Use limits to describe long-range behavior, asymptotic behavior, and points of discontinuity. **RFR.BF.1:** Model relationships between quantities that require adding, subtracting, multiplying, and/or dividing functions **RFR.BF.2:** Model relationships through composition and attend to the restrictions of the domain **RFR.BF.3:** Rewrite a function as a composition of functions **RFR.BF.4:** Determine if a function has an inverse. If so, find the inverse. If not, define a restriction on the domain that meets the requirement for invertibility and find the inverse on the restricted domain **RFR.BF.5:** Interpret the meanings of quantities involving functions and their inverses **RFR.BF.6:** Verify by analytical methods that one function is the inverse of another		• Use limits to determine the continuity of a function • Use limits to describe the end behavior of functions • Find intervals on which functions are increasing, constant, or decreasing • Determine the average rate of change of a function • Identify, graph, and describe parent functions • Identify and graph transformations of functions • Perform operations with functions • Find composite of functions • Use the horizontal line test to determine whether a function has an inverse function. • Find inverse function algebraically and graphically	- Continuous - Limit - Discontinuous - Infinite - Jump - Point - Removable and Nonremovable Discountinuities - End Behavior - Increasing - Decreasing - Constant - Maximum - Minimum - Extrema - Average Rate of Change - Secant Line - Transformations - Translation - Reflection - Dilation - Parent Square Root - Constant Identity - Quadratic - Cubic - Reciprocal - Absolute Value - Step - Greatest Integer Functions - Composition - Inverse Relation - Inverse Function - One-to-one

Second Quarter				
Chapter 2: Power, Polynomials and Rational Functions	**RFR.AF.1:** Interpret parameters of a function defined by an expression in the context of the situation. **RFR.AF.2:** Sketch the graph of a function that models a relationship between two quantities, identifying key features. **RFR.AF.3:** Interpret key features of graphs and tables for a function that models a relationship between two quantities in terms of the quantities. **RFR.AF.4:** Use limits to describe long-range behavior, asymptotic behavior, and points of discontinuity. **RFR.BF.1:** Model relationships between quantities that require adding, subtracting, multiplying, and/or dividing functions **RFR.BF.2:** Model relationships through composition and attend to the restrictions of the domain **RFR.BF.3:** Rewrite a function as a composition of functions **RFR.BF.4:** Determine if a function has an inverse. If so, find the inverse. If not, define a restriction on the	What are the key characteristics of the graph of a power function? What are the key characteristics of the graph of a radical function? What are the key characteristics of the graph of a polynomial function? What are the key characteristics of the graph of a rational function? How do you divide polynomials using long division? How do you divide polynomials using synthetic division? How are long division and synthetic division the same?	I will be able to: • Graph and Analyze power functions • Graph and Analyze radical functions and solve radical equations • Graph polynomial functions • Model real-world data with polynomial functions • Divide polynomials using long division • Use the Remainder and Factor Theorems • Find real zeros of polynomial functions • Find complex zeros of polynomial functions • Analyze and graph rational functions • Solve rational equations • Solve polynomial inequalities • Solve rational inequalities	- Power Function - Monomial Function - Radical Function - Extraneous solutions - Polynomial Function - Leading coefficient - Leading-Term test - Turning point - Quadratic Form - Repeated Zero - Multiplicity - Synthetic Division - Depressed Polynomial - Synthetic Substitution - Rational Zero Theorem - Descartes' Rule of Signs - Fundamental Theorem of Algebra - Linear Factorization Theorem - Complex Conjugates - Rational Function - Asymptote - Vertical Asymptote

	domain that meets the requirement for invertibility and find the inverse on the restricted domain **RFR.BF.5:** Interpret the meanings of quantities involving functions and their inverses **RFR.BF.6:** Verify by analytical methods that one function is the inverse of another			- Horizontal Asymptote Oblique Asymptote - Holes - Polynomial Inequality - Sign Chart - Rational Inequality
Chapter 3: Exponential and Logarithmic Functions	**RFR.AF.1:** Interpret parameters of a function defined by an expression in the context of the situation. **RFR.AF.2:** Sketch the graph of a function that models a relationship between two quantities, identifying key features. **RFR.AF.3:** Interpret key features of graphs and tables for a function that models a relationship between two quantities in terms of the quantities. **RFR.AF.4:** Use limits to describe long-range behavior, asymptotic behavior, and points of discontinuity. **RFR.BF.1:** Model relationships between quantities that require adding, subtracting, multiplying, and/or dividing functions	How will you identify the domains, ranges, and end behaviors of exponential functions? How will you identify the domains, ranges, and end behaviors of logarithm functions? How will you use the properties of exponents and logarithms to solve exponential and logarithmic equations? What are some means of collecting and organizing data? How do you make and interpret a scatter plot? What is the best line of fit for a scatter plot?	I will be able to: • Evaluate, analyze, and graph exponential functions • Solve problems involving exponential growth and decay. • Evaluate expressions involving logarithms • Sketch and analyze graphs of logarithmic functions • Apply properties of logarithms. • Apply the Change of Base Formula. • Apply the One-to-One Property of Exponential Functions to solve equations. • Apply the One-to-One Property of Logarithmic Functions to solve equations.	-Algebraic function -Transcendental function -Exponential function -Natural base -Continuous compound interest -Logarithmic function with base b -Logarithm -Common logarithm -Natural logarithm -Logistic growth function -Linearize

	RFR.BF.2: Model relationships through composition and attend to the restrictions of the domain **RFR.BF.3:** Rewrite a function as a composition of functions **RFR.BF.4:** Determine if a function has an inverse. If so, find the inverse. If not, define a restriction on the domain that meets the requirement for invertibility and find the inverse on the restricted domain **RFR.BF.5:** Interpret the meanings of quantities involving functions and their inverses **RFR.BF.6:** Verify by analytical methods that one function is the inverse of another	How will you use models to predict and make decisions and critical judgements? What is nonlinear regression? **PREPARATION FOR CALCULUS**: Describe parent functions symbolically and graphically? Determine the domain and range of functions using graphs, tables, and symbols. Use regression to determine the appropriateness of an exponential, logarithmic, logistic, cubic, quartic, or quadratic model.	• Model data, using exponential, logarithmic, and logistic functions.	
Third Quarter				
Chapter 4: Trigonometric Functions	**RFR.ETT.1:** Model real-world situations involving trigonometry. **RFR.ETT.2:** Apply the Law of Sines and Law of Cosines to solve problems.	How would you solve triangles? What are the key characteristics of the graphs of trigonometric functions?	I will be able to: • Find the values of trigonometric functions for acute angles of right triangles. • Solve right triangles	-Trigonometric functions -Reciprocal function -Inverse trigonometric function -Angles of elevation and depression

	RFR.ETT.3: Use trigonometry to find the area of triangles. **RFR.ETT.4:** Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$, and use the unit circle to express the values of sine, cosine, and tangent for π-x, π+x, and 2π-x in terms of their values for x, where x is any real number. **RFR.ETT.5:** Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions. **RFR.ETT.6:** Use inverse functions to solve trigonometric equations utilizing real world context; evaluate the solution and interpret them in terms of context. **RFR.AF.5:** Sketch the graph of all six trigonometric functions, identifying key features.	What are the six trigonometry ratios and their relationships to each other? What is the difference between degree measurement and radian measurements? How are the six trigonometric ratios of any angle found by using the unit circle? **PREPARATION FOR CALCULUS**: How would you analyze related rates? How would you integrate trigonometric functions between a range of values?	• Convert degree measures of angles to radian measures and vice versa. • Use angle measures to solve real-world problems • Find values of trigonometric functions for any angle. • Find values of trigonometric functions using the unit circle. • Graph transformations of the since and cosine functions • Use sinusoidal functions to solve problems. • Graph tangent and reciprocal trigonometric functions. • Graph damped trigonometric functions • Evaluate and graph inverse trigonometric functions • Find composition of trigonometric functions • Solve oblique triangles by using the Law of Sines or the Law of Cosines • Find areas of oblique triangles	-Vertex -Initial side -Terminal side -Standard position -Radian -Coterminal angles -Linear speed -Angular speed -Sector -Quadrantal angles -Reference angle -Unit circle -Circular function -Periodic function -Period -Sinusoid -Amplitude -Frequency -Phase shift -Vertical shift -Midline -Damped trigonometric -Damping factor -Damped oscillation -Damped wave -Damped harmonic motion -Arcsine function -Arccosine function -Arctangent function -Oblique triangles -Law of Sines -Law of Cosines -Heron's Formula

Chapter 5: Trigonometric Identities and Equations	**RT.RTS.1:** Use the structure of a trigonometric expression to identify ways to rewrite it. **RT.RTS.2:** Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. **RT.RTS.3:** Solve trigonometric equations	Why would you use trigonometric identities to find trigonometric values? What trigonometric identities would you use to simplify/rewrite trigonometric expressions? What trigonometric identities would you use to verify trigonometric identities? What trigonometric identities would you use to solve trigonometric equations? **<u>PREPARATION FOR CALCULUS</u>**: How would use trigonometric identities to transform expressions into forms that are more suitable for integration and differentiation? How would you use trigonometric substitution for integration?	I will be able to: • Identify and use basic trigonometric identities to find trigonometric values • Use basic trigonometric identities to simplify and rewrite trigonometric expressions • Verify trigonometric identities • Determine whether equations are identities • Solve trigonometric equations using algebraic techniques • Solve trigonometric equations using basic identities • Use sum and difference identities to evaluate trigonometric functions • Use sum and difference identities to solve trigonometric equations • Use double-angle, power-reducing, half-angle and product-to-sum identities to evaluate trigonometric expressions and solve trigonometric equations.	-Identity -Trigonometric identity -Cofunction -Odd-Even identities -Verify an Identity -Reduction Identity
Fourth Quarter				

Chapter 6: Systems of Equations and Matrices Lesson 6-1 through 6-3	**RM.UM.1** Use matrices to represent and manipulate data. **RM.UM.2** Use matrix operations to solve problems. Add, subtract, and multiply matrices of appropriate dimensions. Multiply matrices by scalars to produce new matrices **RM.UM.3** Find the inverse and determinant of a matrix **RM.UM.4** Use matrices to solve systems of linear equations.	How you represent and manipulate date using matrices? What does the solution to a system represent? How do I recognize when there are multiple or no solutions and what does that represent? What strategies can I use to solve systems of equations?	I will be able to: • Solve systems of linear equations using matrices and Gaussian elimination • Solve systems of linear equations using matrices and Gauss-Jordan elimination • Multiply matrices • Find determinants and inverses of 2X2 and 3X3 matrices • Solve systems of linear equations using inverse matrices • Solve systems of linear equation using Cramer's Rule	- Multivariable linear system - Row-echelon form - Gaussian elimination - Augmented matrix - Coefficient matrix - Reduced row-echelon form - Gauss-Jordan elimination - Identity matrix - Inverse matrix - Inverse - Invertible - Singular matrix - Determinant - Square system - Cramer's Rule
Chapter 7: Conic Sections and Parametric Equations Lesson 7-5 Parametric Equations	**RV.MP.1** Model real-world contexts with parametric equations **RV.MP.2** Use parametric equations to solve problems **RV.MP.3** Graph parametric equations and identify orientation **RV.MP.4** Analyze and interpret the graphs of parametric equations	How do I use parametric equations to model real-world situations? How do I solve problems using parametric equations? How do I graph parametric equations?	I will be able to: • Graph parametric equations • Solve problems related to the motion of projectiles	- Parametric equation - Parameter - Orientation - Parametric curve
Chapter 8: Vectors	**RV.EV.1** Recognize vector quantities as having both magnitude and direction **RV.EV.2** Represent vector quantities by directed line segments,	How can you represent physical quantities that you cannot see? How do I convert points and equations from	I will be able to: • Represent and operate with vectors geometrically • Solve vector problems and resolve vectors into	- Vector - Initial point - Terminal point - Standard position - Direction - Magnitude

	and use appropriate symbols for vectors and their magnitudes **RV.EV.3** Find the components of a vector by subtracting the coordinates of an initial point from the coordinates of a terminal point **RV.EV.4** Solve problems involving velocity and other quantities that can be represented by vectors **RV.EV.5** Add and subtract vectors, and multiply a vector by a scalar	rectangular to polar form and vice versa? How do I graph a vector? How do I perform operations with vectors?	their rectangular components • Represent and operate with vectors in the coordinate plane • Write a vector as a linear combination of unit vectors • Find the dot product of two vectors and use the dot product to find the angel between them • Find the projection of one vector onto another • Plot points and vectors in the three-dimensional coordinate system • Express algebraically and operate with vectors in space • Find dot products of and angles between vectors in space • Find cross products of vectors in space, and use cross products to find area and volume	- Quadrant bearing - True bearing - Parallel vectors - Equivalent vectors - Opposite vectors - Resultant - Triangle method - Parallelogram method - Zero vector - Components - Rectangular components - Component form - Unit vector - Linear combination - Dot product - Orthogonal - Vector projection - Work - Three-dimensional coordinate system - Z-axis - Octant - Ordered triple - Cross product - Torque - Parallelepiped - Triple scalar product
Chapter 9: Polar Coordinates and Complex Numbers Lesson 9-1 thru 9-3	**RT.EPE.1** Graph polar equations **RT.EPE.2** Analyze and interpret the graphs of polar equations	Why is it helpful to have more than one coordinate system?	I will be able to: • Graph points with polar coordinates • Graph simple polar equations • Graph polar equations	- Polar coordinate system - Pole - Polar axis - Polar coordinates - Polar equation

	RT.EPE.3 Use polar equations to solve problems		• Identify and graph classical curves • Convert between polar and rectangular coordinates • Convert between polar and rectangular equations •	- Polar graph - Limcon - Cardoid - Rose - Leminscate - Spiral of Archimedes