Glendale Unified School District

High School

April 16, 2019

Department:	Mathematics
Course Title:	Precalculus (*Formerly Math Analysis)*
Course Code:	*(Educational Services will assign course number **after** Board Approval)*
School(s) Course Offered:	Clark Magnet High School, Crescenta Valley High School, Hoover High School, Verdugo Academy
UC/CSU Approved (Y/N, Subject):	Y, "c" Mathematics
Course Credits:	Full Year (10)
Recommended Prerequisite:	Integrated III
Recommended Textbook:	*Precalculus: Mathematics for Calculus* James Stewart, Lothar Redlin, Saleem Watson Cengage Learning Seventh Edition
Course Overview:	Precalculus is a 4th year high school mathematics course to solidify and explore deeper concepts and content that students have seen before as well as introducing some new concepts to help prepare them for more advanced mathematics. This course meets all the Common Core state standards for a fourth-year of high school mathematics and is well balanced among procedural fluency (algorithms and basic skills), deep conceptual understanding, strategic competence (problem solving), and adaptive reasoning (application and extension). The course embeds the CCSS Standards for Mathematical Practice as an integral part of each lesson and chapter.

Course Content:

Semester A

Chapter 1: **Fundamentals** *(approximately 20 days)*

STANDARDS
N.Q.1, N.Q.2, N.Q.3, N.CN.7, A.SSE.3a, A.CED.1, A.CED.2, A.CED.3, A.CED.4, A.REI.2, A.REI.3, A.REI.4, A.RED.4a, A.REI.4b, F.IF.1, F.IF.2, F.IF.4, F.IF.5, F.IF.7, F.IF.7b, F.IF.8, G.GPE.1, G.GPE.5, G.GPE.6, G.GPE.7

A. In the first chapter, students will review the real numbers, equations and the coordinate plane. Students will get a fresh look at these review concepts by applying them to real world problems.

Major Topics:
Real numbers
Exponential, radical and rational expressions
Complex numbers
Inequalities
Lines, circles

B. Unit Assignment:
After completing section 1.12, students will use their understanding of proportionality to determine how a frog's size relates to its sensitivity to pollutants in the environment. They will explore how animals, of the same body type, will have a skin area and volume that are proportional to the length of their body. The students will be able to calculate proportionality according to body length, weight, surface skin area, and volume.

Mathematical Practices Used in Ch. 1:

- MP.1: Students will explain to themselves the meaning of a problem and look for entry points to its solution. They analyze givens, constraints, relationships and goals for modeling questions regarding inequalities and proportions. They make conjectures about the form and meaning of the solution and plan a solution pathway rather than simply jumping into a solution attempt.
- MP.2: Students make sense of quantities and their relationships in problem situations. They are able to abstract a given situation and represent the relationship between two variables symbolically, as in direct and indirect variation.
- MP.3: Students learn how to use stated assumptions, definitions and previously established results in constructing arguments and equations to represent real world situations. They will utilize the distance*rate=time equation and proportional relationships to analyze situations that take into account the context of each question.

Chapter 2: **Functions** *(approximately 14 days)*

STANDARDS
N.Q.1, N.Q.2, N.Q.3, A.SSE.3b, A.CED.2, F.IF.2, F.IF.4, F.IF.5, F.IF.6, F.IF.7, F.IF.7a, F.IF.7b, F.IF.8, F.IF.8a, F.BF.1, F.BF.1a, F.BF.1b, F.BF.3, F.BF.4, F.BF.4a, F.BF.4b, F.BF.4c, F.BF.4d, F.LE.2, S.ID.6a, S.ID.6b, S.ID.7

A. In this chapter students will study functions and their graphs, as well as many real-world applications of the functions.

Major Topics:
Graphs of Functions
Average Rate of Change of a Function
Transformations of Functions
Combining Functions
One-to-one Functions and their Inverses

B. Unit Assignment:
After completing Section 2.3, students will give a verbal summary of a situation described by a graph. In this assignment students describe, or tell the story that corresponds to a, given graph as well as make graphs that corresponds to a real-world "story".

Mathematical Practices Used in Ch. 2:

- MP.4: Students will model linear relationships in real world situations and use average rate of change to interpret and quantify the relationship between two variables.
- MP.6. Students will label axes and specify key points to clearly and accurately represent the different type of basic functions such as the linear function, reciprocal function and greatest integer function. Students will also attend to precision for piece-wise functions, ensuring that endpoints are clearly marked and representative of the corresponding domains.
- MP.7: Students will be able to interpret average rate of change within the context of a question and express the significance of the value to the problem. The students will be able to step back and overview transformations of functions as they apply to all types of parent functions and can interpret the structure of functions as a simple transformation on the parent function.

Chapter 3: **Polynomials and Rational Functions** *(approximately 13 days)*

STANDARDS
N.Q.1, N.Q.2, N.Q.3, A.SSE.3b, A.SSE.3c, F.IF.2, F.IF.4, F.IF.5, F.IF.6, F.IF.7, F.IF.7c, F.IF.7d, F.IF.8b, F.BF.1a

A. In this chapter students will study polynomial and rational functions and their graphs, as well as many real-world applications of the functions.

Major Topics:
Quadratic Functions and Models
Polynomial Functions and Their Graphs
Real Zeros of Polynomials
Complex Zeros and the Fundamental Theorem of Algebra
Rational Functions
Polynomial and Rational Inequalities

B. Unit Assignment:
After completing Section 3.2, students will experience the process of collecting data and then analyzing the data using linear regression. In this assignment students will construct bridges out of paper and use pennies as weights to determine how strong each bridge is. Students will model the data with linear and power functions to determine which model best fits the data. The model will allow students to predict the strength of a large bridge before it is built.

Mathematical Practices used in Ch. 3:

- MP.2: Students will be able to reason abstractly by understanding the general importance of a power function to the graph of a polynomial. The students will also be able to contextualize the significance of the end behavior and zeros of the function.
- MP.4: Students can model real world situations with fluctuations by using polynomial functions. They can use the properties of polynomial functions to help contextualize the problem.
- MP.7: Students will be able to discern a pattern in the factored form of a polynomial and its relationship to the x-intercepts of a graph. They will also be able to recognize the significance of the power function of the expanded form of a polynomial and the end behavior of the graph.

Chapter 4: **Exponential and Logarithmic Functions** *(approximately 13 days)*

N.Q.1, N.Q.3, A.SSE.3c, F.IF.2, F.IF.4, F.IF.5, F.IF.6, F.IF.7, F.IF.7e, F.IF.8b, F.BF.5, F.LE.4

A. In this chapter students will study exponential functions where the independent variable is in the exponent. Exponential functions are used in modeling many real-world situations. The inverse function of exponential functions are called logarithmic functions. Once an exponential model has been obtained, students will use the model to predict things such as the size of a population or the growth of an investment.

Major Topics:
Exponential Functions
The Natural Exponential Function
Logarithmic Functions
Laws of Logarithms
Exponential and Logarithmic Equations
Modeling with Exponential Functions
Logarithmic Scales

B. Unit Assignment:
After completing Section 4.3, students will use logarithms or orders of magnitude to compare sizes of objects. It is often difficult to compare objects that vary enormously in size. In this assignment students learn how logarithms can be used to define the concept of "order of magnitude" which provides a simple way of comparison of these objects.

Mathematical Practices Used in Ch. 4:

- MP.2: Students will be able to quantitatively understand the structure of a logarithmic and exponential function separately as well as the inverse relationship of the functions. They will also be able to understand how the key features of a graph are represented in the algebraic expressions.
- MP.4: Students will be able to model a data set by using a linear, quadratic, exponential or logarithmic expression. Students will be able to determine which function best fits the data by identifying key points as well as end behavior.
- MP.5: Students will be able to determine when it is appropriate to use a graphing utility to fit an exponential or logarithmic curve to model a data set.

Chapter 5: **Trigonometric Functions: Unit Circle Approach** *(approximately 12 days)*

STANDARDS
N.Q.2, N.Q.3, F.IF.8, F.LE.2, F.TF.1, F.TF.2, F.TF.3, F.TF.8, G.SRT.6, G.SRT.7, S.ID.6a

A. In this chapter students will study one way of viewing trigonometric functions, as functions of real numbers. Students will see in this chapter how the trigonometric functions are used to model periodic motion.

Major Topics:
The Unit Circle
Trigonometric Functions of Real Numbers
Trigonometric Graphs
Inverse Trigonometric Functions and Their Graphs
Modeling Harmonic Motion

B. Unit Assignment:
After completing Section 5.3 students will consider an application to biology. In this assignment students will use sine functions to model the population of a predator and its prey. An isolated island is inhabited by two species of mammals: lynx and hares. The lynx are predators who feed on the hares, their prey. Students will find functions of the form y=asink(t-b)=c that model the lynx and hare populations from a given graph.

Mathematical Practices Used in Ch. 5:

- MP.2: Students will be able to reason abstractly by understanding how the even-odd properties of a trigonometric function is related to the direction of rotation of the angle measure and the quadrant in which the terminal side is drawn.
- MP.5: Students will be able to determine when it is appropriate to use a graphing utility to model periodic phenomena with a sinusoidal function. Students will be able to fit a trigonometric function by identifying the key features of the graph.
- MP.6: Students will be able to clearly define the meaning of the variables in a trigonometric equation by identifying which is an angle and what specific ratio is defined. Students will also be able to accurately label axes according to the expression being graphed, whether the unit circle or a trigonometric function.

Semester B

Chapter 6: **Trigonometric Functions: Right Triangle Approach** *(approximately 16 days)*

STANDARDS
F.TF.3, F.TF.4, G.SRT.6, G.C.5

A. In this chapter students will study another way of viewing trigonometric functions, as functions of angles. Students will see in this chapter the relationships between angles and distances.

Major Topics:
Angle Measures
Trigonometry of Right Triangles
Trigonometric Functions of Angles
Inverse of Trigonometric Functions and Right Triangles
The Law of Sines
The Law of Cosines

B. Unit Assignment:
After completing Section 6.2 students will investigate how areas and volumes of similar figures change as the size of the figure increases (or decreases). In this assignment students will find power functions that relate these quantities and use

those functions to explore the possibility of the existence of a real-life giant ape. Students will begin by finding some properties of similar figures.

Mathematical Practices Used in Ch. 6:

- MP.1: Students will be able to analyze the given information for an oblique triangle and will persevere in determining the best law (either law of cosines or sines) to solve the triangle. Students will also be able to determine when the ambiguous case for the law of sines applies and will solve for both possible triangles, when necessary.
- MP.3: Students will be able to determine when, for an ambiguous triangle, the second case does or does not work and can create a viable argument as to why.
- MP.4: Students will be able to model real world situations with right and oblique triangles and will be able to use the laws of cosine and sine and the properties of right triangles to determine distances and angles.

Chapter 7: **Analytic Trigonometry** *(approximately 13 days)*

STANDARDS
N.Q.1, N.Q.2, F.IF.7, F.IF.7e, F.TF.4, F.TF.5, F.TF.7, F.TF.8

A. In this chapter students will study algebraic properties of trigonometric functions. Students will simplify and factor expressions and solve equations that involve trigonometric functions.

Major Topics:
Trigonometric Identities
Addition and Subtraction Formulas
Double-Angle, Half-Angle and Product-Sum Formulas
Basic Trigonometric Equations

B. Unit Assignment:
After completing Section 7.3 students will use trigonometry to find the best location from which to view a painting or a movie. In this assignment, students will use graphing devices and the Law of Cosines to find the best viewing angle possible.

Mathematical Practices Used in Ch. 7:

- MP.1: Students will look for entry points to a trigonometric identity proof and will persevere in looking for relationships to equate the two expressions. Students will analyze the given expressions to determine a solution pathway instead of jumping into a solution attempt.
- MP.2: Students will be able to reason through a trigonometric equation by being able to reason abstractly and seeing a quadratic form that requires factorization. Students will also be able to reason quantitatively by identifying the relationships between the ratios of sides with the corresponding angle measures.

- MP.3: Students will be able to build a logical progression of statements to provide a proof for a trigonometric identity by utilizing the quotient identities, Pythagorean identities, as well as the sum, difference, double- and half-angle formulas.

Chapter 8: **Polar Coordinates and Parametric Equations** *(approximately 11 days)*

STANDARDS
F.IF.7, F.IF.7e, F.TF.4, F.TF.5, F.TF.8

A. In this chapter students will study a different way of locating points in the plane. Instead of using rectangular coordinates to specify a location, students will give distance and direction from a fixed reference point.

Major Topics:
Polar Coordinates
Graphs of Polar Equations
Polar Form of Complex Numbers: De Moivre's Theorem
Plane Curves and Parametric Equations

B. Unit Assignment:
After completing the chapter, students will use parametric equations and trigonometry to model the path of a projectile in motion. Students will be able to utilize coordinate geometry to realize how changing the angle of projection affects the domain and range of motion.

Mathematical Practices Used in Ch. 8:
- MP.1: Students will be able to visualize the graphing of a complex number as it relates to right triangle trigonometry and how this relationship allows for the conversion between rectangular and polar systems.
- MP.2: Students will be able to relate the roots of a complex number as points equally spaced about a circle and will be able to relate the periodicity of a sinusoidal function to help identify the polar form of the roots.
- MP.3: Students will be able to analyze the relationship between rectangular coordinates and the path of a point moving on a plane to eliminate a parameter and convert between rectangular and parametric equations.

Chapter 9: **Vectors in Two and Three Dimensions** *(approximately 16 days)*

STANDARDS
N.Q.1, N.Q.2, N.Q.3, F.TF.6, F.TF.7, G.SRT.8, G.SRT.9

A. In this chapter students will be able to represent quantities, such as force, with vectors that are defined by magnitude and direction. Students will also study how several forces acting on an object will affect the movement of that object.

Major Topics:
Vectors in Two Dimensions
The Dot Product
Three-Dimensional Coordinate Geometry
Vectors in Three Dimensions
The Cross Product
Equations of Lines and Planes

B. Unit Assignment:
After completing the chapter, students will use vector fields to model real-world scenarios, like the gravitational force on the earth or wind on the surface of the earth. Students will be able to then analyze the vector fields to identify the center and direction of motion.

Mathematical Practices Used in Ch. 9:

- MP.4: Students will be able to graph vectors in the cartesian system and use the dot product to find the angle between two vectors as well as the direction angles of a vector.
- MP.5: Students will use proper graphing utilities to help them visualize and analyze three-dimensional vectors and cross product vectors.
- MP.6: Students will attend to precision by properly drawing and labeling axes to graph in three dimensions.

Chapter 10: **Systems of Equations and Inequalities** *(approximately 20 days)*

STANDARDS
N.Q.1-3, N.CN.4, N.CN.5, N.VM.1-5, A.REI.5, N.REI.6, G.SRT.10, G.SRT.11

A. In this chapter, students will use more than two variables to create and solve a system of equations and inequalities. Students will be able to adapt the elimination and substitution methods of solving systems with two variables to now solve systems with three or more variables as well as learning new methods of solving, such as utilizing matrices and Cramer's Rule.

Major Topics:
Systems of Linear Equations in Two Variables
Systems of Linear Equations in Several Variables
Matrices and Systems of Linear Equations
The Algebra of Matrices

Inverses of Matrices and Matrix Equations
Systems of Nonlinear Equations
Systems of Inequalities

B. Unit Assignment:
After section 10.4, students will use matrix multiplication to project the population proportions of the young, juvenile and adult proportions of a population of animals. Students will use these predictions to analyze the health and growth of the population for the coming seasons in order to understand the long-term prospects of the population.

Mathematical Practices used in Ch. 10:

- MP.2: Students will analyze a linear system of equations and inequalities and understand that there are multiple methods of solving a system – i.e. substitution, elimination, augmented matrices, Cramer's rule, etc.
- MP.4: Students will understand how to create a matrix to represent data and how matrix operations can be used to analyze the data.
- MP.5: Students will understand how a matrix can be used to represent equations and data and how to algebraically manipulate matrices to solve linear systems.

Chapter 11: **Conic Sections** *(approximately 13 days)*

STANDARDS
N.VM.7-12, A.REI.7-9, A.REI.12

A. In this chapter, students will understand how conic sections are different cross-sections of a cone. Students will be able to identify the equations of different conics as well as their geometric properties and their graphs.

Major Topics:
Parabolas
Ellipses
Hyperbolas
Shifted Conics

B. Unit Assignment:
At the end of the chapter, students will study the use of conics in architecture and how the geometric properties of each conic can create architectural features, such as a whispering gallery. Students will also learn practical methods by which conics could be constructed with by using practical construction tools.

Mathematical Practices Used in Ch. 11:

- MP.1: Students will be able to transform the general form of a conic into the standard form of the respective conic to determine key features.
- MP.2: Students will be able to identify the type of conic from the general form.
- MP.4: Students will be able to model real world situations with the appropriate conic type and use the key features to solve problems.