# Algebra 2 Course Syllabus

**Course Description:**

In Algebra 2, students will master equations and inequalities, including writing equations, and solving absolute equations and inequalities. Students will learn to identify and graph linear functions and inequalities, with a focus on domain and range, as well as slopes of lines, including parallel and perpendicular lines. Students will also solve systems of linear equations and inequalities, and will become proficient in using matrices and determinants to solve systems. Students will learn to solve quadratic equations, learning the implication of the imaginary number, and will graph quadratics. Student will master polynomials, both the factoring of them, and operations with polynomials. Students will go on to learn to work with rational expressions, exponent, roots, and radicals, and will learn to solve and interchange exponential and logarithmic functions.  Students will move on to conic sections, including parabolas, circles, ellipses, and hyperbolas, and will learn the basics of trigonometry and special triangles. Students will learn to solve permutations and combinations, as well as know which is used when, and will become proficient in working with sequence and series.  Finally, students will learn to perform operations with complex numbers.

Part 1: 5 credit hours

Part 2: 5 credit hours

## Course Outline

## Common Core Standards (CA)

## *Algebra 2, Part 1*

### Unit 1: Equations and Inequalities
1.1 Writing Equations
1.2 Solving One-Step Equations
1.3 Solving Multi-Step Equations
1.4 Solving Inequalities
1.5 Graphing on Number Lines
1.6 Solving Absolute Value Equations
1.7 Solving Absolute Value Inequalities

**In Unit 1 students will learn:**
How to write equations from basic mathematical statements.
How to solve one step and multi-step equations.
To understand and analyze the differences between equations and inequalities, and how to gain a mastery in solving inequalities as well as graphing them on a number line.
How to solve absolute value equations and inequalities, understanding that there will be more than one solution in both cases.
How to graph the absolute value inequalities.
[ A-SSE, A-CED, A-REI, F-IF ]

## Unit 2: Linear Functions & Inequalities

2.1 Relations, Functions, Domain & Range
2.2 Graphs of Linear Functions
2.3 The Slope of a Line
2.4 Parallel and Perpendicular Lines
2.5 y=mx+b
2.6 Writing Equations of Lines
2.7 Graphing Inequalities

**In Unit 2 students will learn:**
To understand and show a comprehension of what relations are and what makes a relation a function, with techniques for identifying functions both graphically as well as algebraically.
How to identify the domain and range for several relations, as well as how to apply domain and range restrictions to real life problems.
How to graph linear functions and will describe slope behaviors, including how to identify two linear functions that are either parallel or perpendicular.
How to, given two points, or other key characteristics of a line, be able to work backwards and determine the equation of that line.
How to solve and graph linear inequalities, showing the understanding that there will be infinite solutions to a linear inequality.
[A-SSE, A-CED, A-REI, F-IF, F-BF ]

## Unit 3: Systems of Linear Equations and Inequalities

3.1 The Graphing Method – Two Varaibles
3.2 The Substitution Method -Two Variables
3.3 The Addition Method -Two Variables
3.4 Graphing Linear Equations - 3 Variables
3.5 Solving Systems of Linear Equations - 3 Variables

**In Unit 3 students will learn:**
How to solve systems of both linear equations and inequalities using a range of potential methods, including the graphing method, the substitution method, and the addition method.
To understand that each method is favorable under different sets of circumstances, and that all methods should ultimately lead to the exact same solution.
How to find systems of equations that yield "no solution," in the case of parallel lines and how to determine if systems are consistent, inconsistent, dependent, or independent.
How to solve systems of equations with three variables and to understand that in order to solve systems, one must have as many equations as there are variables.
[A-SSE, F-IF, F-BF ]

## Unit 4: Matrices and Determinants

4.1 Matrix Operations
4.2 Multiplication of Matrices
4.3 Determinants
4.4 Cramer's Rule
4.5 Inverses of 2x2 Matrices
4.6 Solving Systems Using Matrices

**In Unit 4 students will learn:**
How to solve systems of equations using the graphing, addition, and substitution methods, and how to use matrices, as another way to readily solve systems of equations with two and three variables.
How to perform matrix operations, including addition, subtraction, and in the case of Cramer's rule, division of matrices.

To understand the limitations upon whether or not certain matrix operations can be performed, based upon the dimensions of the matrices.

How to find the determinants of both two variable and three variable matrices, and how to use the determinants to find solutions to sets of equations.

Cramer's rule will be gone into in depth, and students will learn to solve systems using this technique.

How to find inverses of matrices and how to use the inverses of matrices to solve systems.

[F-IF, F-BF ]

## Unit 5: Quadratic Equations

5.1 Quadratic Functions: $ax^2+bx+c$
5.2 Solutions to Quadratic Functions; Factoring
5.3 Completing the Square
5.4 The Quadratic Formula
5.5 Complex Roots: i

**In Unit 5 students will learn:**

To recognize quadratic equations and to be able to understand and analyze the basic anatomy of a quadratic function, including x and y vertices, axis of symmetry, the vertex, and the direction and relative steepness of the curve of the quadratic.

To understand that the solution to quadratic equations represent the x intercepts and to be able to understand that there can be either one, two, or zero solutions for any given quadratic, which can be shown graphically as well as solved for algebraically.

How to solve quadratic equations using the factoring method, completing the square, and the quadratic formula and will begin to identify which methods work better for which equations.

To understand that all three methods should yield the same results.

To understand the concept of complex roots "i" will be introduced and that in the case of a negative square root, i is used to represent the imaginary solution.

How to perform basic operations involved i.

[ N-CN, A-SSE, F-IF, F-BF ]

## Unit 6: Graphing Quadratic Functions

6.1 Graphing Basic Parabolas (Positive & Negative)
6.2 Graphing Quadratics (Table Method)
6.3 Graphing Quadratics Using Vertex & Intercepts

**In Unit 6 students will learn:**

To perfect the graphing of parabolas, starting with the basic concepts of how the "a" value in the standard form will lead to an upward or downward parabola.

That different methods of graphing quadratics, the table method, the vertex form, and the intercepts, can be used to demonstrate the different ways to arrive at the same graph.

How to identify and utilize key points, like the x and y intercepts and the vertex, to be able to quickly sketch any parabola, regardless of what form it is given in.
[F-IF ]

## Unit 7: Polynomials

7.1 Addition and Subtraction of Polynomials
7.2 Products of Polynomials
7.3 Factoring Special Polynomials
7.4 Division of Polynomials; Long Division
7.5 Divison of Polynomials: Synthetic Division
7.6 Complex Fractions

**In Unit 7 students will learn:**
The basic vocabulary associated with and the key aspects of polynomials, including the degree of a polynomial and its coefficients.
How to perform basic operations with polynomials, like the addition, subtraction, multiplication, and division of them.
With regards to dividing polynomials, how to factor (when possible) both the top and bottom expressions, and to cancel like factors.
The two methods of dividing polynomials; long division and synthetic division.
How to make wise decisions regarding which method would be most convenient and when.
How to simplify the numerator and denominator of complex fractions, so the final multiplication of the inverse of the denominator can be done.
[N-CN, A-SSE, A-APR, A-REI, F-BF ]

## Unit 8: Rational Expressions

8.1 Simplifying Rational Expressions
8.2 Adding & Subtracting Rational Expressions
8.3 Multiplying & Dividing Rational Expressions

**In Unit 8 students will learn:**
How to work with rational expressions and how to perform operations with rational expressions.
To use the basic notion that fractions must have a common denominator to be added or subtracted to go on to add rational expressions.
How to factor both denominators prior to finding a common denominator, in order to simplify the process.
That dividing a fraction by a fraction is the same as multiplying the fraction by the reciprocal of the second fraction.
That after factoring each expression, students will understand that one can cancel identical factors in order to simplify the expression.
How to always factor both the numerator and denominator for any rational expression to check for the opportunity to cancel out factors.
How to check for erroneous solutions by plugging answers back into the original rational expression.
[A-SSE, A-APR, A-REI ]

| **Course Outline** | **Common Core Standards (CA)** |
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## *Algebra 2, Part 2*

### Unit 1: Exponents, Roots, Radicals

1.1 Positive and Negative Powers
1.2 Roots and Exponents
1.3 Radical Equations and Operations
1.4 Radicals in Fractions
1.5 Fractions in the Exponent
1.6 Writing Repeating Decimals as Fractions

**In Unit 1 students will learn:**
How to work with exponents, including both positive and negative power exponents.
To understand that a positive exponent leads to an increasing graph while a negative exponent leads to a decreasing graph.
To develop an understanding of the relationship between roots and exponents, and their reciprocal relationship, and how to solve equations with roots and equations with exponents.
How to manipulate and work with radical equations and to perform operations with radical expressions, including how to add and subtract like radicals.
How to simplify radicals in fractions, understanding how to rationalize a denominator by multiplying top and bottom by the root in the denominator or by multiplying the top and bottom by the conjugate of the denominator.
How to convert repeating decimals to a fraction.
[ A-APR, A-REI, F-IF ]

### Unit 2: Exponential and Logarithmic Functions

2.1 Exponential Functions
2.2 Exponential Equations
2.3 Exponents with Base 10
2.4 Base e
2.5 Scientific Notation
2.6 Inverse Functions
2.7 Properties of Log Functions
2.8 Logarithmic Equations
2.9 Translation of Exponential and Logarithmic Graphs

**In Unit 2 students will learn:**
How to identify and analyze exponential functions, paying special attentions to the end behavior of graphs based on the key characteristics of the function.
How to use this understanding of exponential functions to solve exponential equations and how to be aware of domain and range restrictions for exponential equations.
How to manipulate exponential equations and expressions with the base 10.
To grasp an understanding of base e expressions and equations, and that base e and the natural log are inverses of one another.
[A-SSE, A-CED, A-REI, F-IF, F-BF, F-LE ]

## Unit 3: Conic Sections- Solving, Graphing

3.1 Circles: Equations & Graphs of
3.2  Ellipses: Equations & Graphs of
3.3 Hyperbolas: Equations & Graphs of
3.4 Parabolas: Equations & Graphs of

**In Unit 3 students will learn:**

The equations for and graphs of conic sections, including those for circle, ellipses, hyperbolas, and parabolas.

How to decipher the center and radius of a circle, given its equations, as well as match graphs of circles to their equations.

How to put equations for circles into standard form, so they can be analyzed more easily.

To master ellipses and how to sketch an ellipse from its equations by identifying its center, major and minor axis, and focal points.

The parts and characteristics of hyperbolas and how to sketch their graphs, given an equation.

To become proficient in graphing parabolas using key components of their equations, such as their vertex, axis of symmetry, and focus.

How to distinguish between circles, ellipses, hyperbolas, and parabolas, using only their equations.
[A-SSE, A-CED, F-IF, G-GPE ]

## Unit 4: Trigonometry

4.1 Sin, Cos, Tan, Cosec, Sec, Cot
4.2  Converting Between Radians & Degrees
4.3  Trig Ratios of Special Angles
4.4  The Unit Circle
4.5 The Law of Sines
4.6 The Law of Sines

**In Unit 4 students will learn:**

How to solve for the six trigonometric functions and to determine the sine, Cosine, Tangent, Cosecant, Secant, and Cotangent of given the sketch of a right triangle.

How to find the remaining trigonometric functions given one of the six trig functions.

How to convert between radians and degrees and how to solve problems in which a certain angle is expressed in either and is to be converted to the other.

To gain a mastery of recognizing and working with special triangles, knowing the ratios of the sides of 30-60-90 triangles and 45-45-90 triangles. How to solve for missing sides of special triangles given one side length and two angles.
[F-BF, F-TF ]

## Unit 5: Permutation & Combinations

5.1 Permutations
5.2 Combinations
5.3 Basic Probability
5.4 Binomial Theorem

**In Unit 5 students will learn:**

How to solve real life problems involving permutations and combinations, with scenarios like how many ways a certain number of players can form a roster, or how many ways some friends can be arranged in a photo.

How to assess whether a combination or a permutation is required to solve a particular problem, and how to perform the appropriate calculation.  How to solve

random chance probability problems and to solve both "replacement" and "without replacement" problems. How to use the binomial theorem to raise polynomials to large powers.
[A-APR, A-REI, S-ID, S-IC, S-MD ]

## Unit 6: Sequence and Series
6.1 Arithmetic Sequence ( nth Term)
6.2 Arithmetic Series (Sum Of)
6.3 Geometric Sequence (nth Term)
6.4 Geometric Series (Sum Of)
6.5 Sum of Infinite Series

**In Unit 6 students will learn:**
How to identify and manipulate arithmetic sequence to solve for nth terms within that sequence, up to any value for n.
How to create a formula for solving for the nth term, given as few as two or three values within the arithmetic sequence.
How to work to find the sum of n terms of an arithmetic sequence, up to any value for n.
To master the identification of geometric sequences, how to find the common ratio, and to solve for an nth term.
How to find the sum of any geometric sequence for up to any value of n.
How to identify an infinite series and to understand when it is possible to find the sum of a converging infinite series, or how to identify a diverging infinite series, and realize that no sum exists.
In the case that a sum does exist for an infinite series, how to find that sum.  [F-BF ]

## Unit 7: Complex Numbers (i), Operations w/ Functions
7.1 Basic Operations with Complex Numbers
7.2 Multiplying and Dividing Complex Numbers
7.3 Adding & Subtracting Functions
7.4 Multiplying & Dividing Functions
7.5 Composition of Functions

**In Unit 7 students will learn:**
Complex numbers and the notion of imaginary numbers and solutions.  How to perform Basic operations with complex numbers and how to add, subtract, multiply, and divide complex numbers.
In the case of dividing complex numbers, how to multiply the numerator and denominator of complex fractions by the "conjugate" of the complex number in the denominator.
How to answer all complex number problems in the standard form, upon their simplification.
How to perform the composition of functions, in which one function is substituted in for the input variable of another.
[N-CN, A-SSE, F-BF ]