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## ALGEBRA II Grades 9-12

**Units:** 10 high school credits

**UC Requirement Category:** c

### **General Description:**

Algebra II is a course which further develops the concepts learned in Algebra I. It will introduce topics in quadratics, polynomial, rational, exponential and logarithmic functions. Curve sketching and equation solving involving these families of functions is emphasized. It also explores the real number system in more detail, absolute value in equations and inequalities, complex numbers, simultaneous solution of sets of equations, determinants, matrices, equations and inequalities of first and second degree.

The expected outcomes are to understand Algebra II as a system and use logical reasoning to explain and solve problems. Understanding the relationship between algebra and other branches of mathematics and observing how algebra assists in developing solutions to problems is a goal as well as preparing for the PSAT and SAT exams in mathematics.

### *Algebra II Course Syllabus*

#### **Course Outcomes**

Upon completion of the Algebra II course, students will be able to:

1. Generate two-dimensional graphs
2. Recognize patterns and make reasonable conclusions
3. Solve various inequalities and equations
4. Use mathematical structures to solve application problems
5. Interpret data
6. Simplify algebraic expressions
7. Simplify numerical expressions
8. Apply the information to college entrance problems
9. Use current technology to assist in problem solving

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10. Work with matrices in order to solve various problems
11. Solve and simplify higher ordered radicals that also involve imaginary numbers
12. Use technology extensively to discover new ideas and create solutions
13. Work with exponential and logarithmic functions.

### **Unit 1: Real numbers, equations and inequalities**

#### **Subject Matter**

1. Real numbers
2. Variables and expressions
3. Properties
4. Solving equations in one variable
5. Translating word sentences into equations

#### **Outcomes**

1. Students will be able to perform operations on real numbers.
2. Students will be able to evaluate numerical and algebraic expressions.
3. Students will be able to solve equations containing one variable.
4. Students will be able to translate word sentences into equations.
5. Students will be able to solve literal equations for one of the variables.
6. Students will be able to solve and graph linear inequalities in one variable.
7. Students will be able to solve and graph the solution set of a conjunction or disjunction.
8. Students will be able to solve and graph compound sentences involving inequalities.
9. Students will be able to solve and graph equations and inequalities involving absolute value.

### **Unit 2: Equations and Inequalities**

#### **Subject Matter**

1. Literal equations and formulas
2. Solving inequalities
3. Conjunctions and disjunctions
4. Solving compound sentences with inequalities
5. Absolute value equations and inequalities
6. Problem solving using equations and inequalities

#### **Outcomes**

1. Students will be able to solve literal and formulas for one of the variables.
2. Students will be able to solve linear inequalities in one variable and graph the solution.
3. Students will be able to determine the truth or falsity of conjunctions and disjunctions.
4. Students will be able to graph the solution sets of conjunctions and disjunctions.

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5. Students will be able to solve compound sentences involving inequalities and graph the solution sets
6. Students will be able to solve equations and inequalities involving absolute value and graph the solution sets.
7. Students will be able to solve problems using equations and inequalities.

### **Unit 3: Functions and Graphs**

#### **Subject Matter**

1. Coordinate plan
2. Relations and functions
3. Graphing equations
4. Composition of functions
5. Inverse functions
6. Slope of a line
7. Parallel and perpendicular lines
8. Equations of a line

#### **Outcomes**

1. Students will be able to graph ordered pairs on a coordinate plane.
2. Students will be able to determine the coordinates of a point given its graph.
3. Students will be able to determine the domain and range of relations and functions and if a relation is a function.
4. Students will be able to graph equations in two variables.
5. Students will be able to find the composition of two functions and to evaluate composite functions.
6. Students will be able to find the inverse of a relation or functions and determine if the inverse of a function is a function.
7. Students will be able to find the slope of a line and to use the slope and y-intercept to write the equations of a line.
8. Students will be able to determine if two lines are parallel or perpendicular and to write an equation of a line parallel or perpendicular to a given line when the y-intercept is known.
9. Students will be able to write an equation of a line given the slope and a point on the line or given two points.

### **Unit 4: Systems of Equations and Inequalities**

#### **Subject Matter**

1. Direct variation
2. Solving linear systems using graphs
3. Solving linear systems using the addition method
4. Solving linear systems using the substitution method
5. Problem solving using linear systems of equations
6. Solving linear systems of inequalities

**Outcomes**

1. Students will be able to determine when a function is a direct variation and solve problems with direct variation.
2. Students will be able to find the solution of a linear system of equations in two variables by graphing, addition/subtraction method or substitution.
3. Students will be able to determine whether the system is consistent or inconsistent and dependent or independent.
4. Students will be able to solve word problems using systems of equations.
5. Students will be able to solve linear inequalities in two variables and linear systems of inequalities in two variables graphically.

**Unit 5: Matrices and Determinants**

**Subject Matter**

1. Matrix addition
2. Matrix multiplication
3. Solving linear systems in three variables using the addition method
4. Solving linear systems using augmented matrices
5. Solving linear systems using inverse matrices
6. Solving linear systems using determinants and Cramer's Rule.

**Outcomes**

1. Students will be able to find the sum and difference of two matrices and the product of a matrix and a scalar.
2. Students will be able to find the product of two matrices.
3. Students will be able to solve a system of linear equations in three variables using the addition method.
4. Students will be able to find the inverse of a matrix and use it to solve a system of equations.
5. Students will be able to evaluate determinants of a matrix and use it to solve a system of linear equations along with Cramer's Rule.

**Unit 6: Polynomials**

**Subject Matter**

1. Exponents and Monomials
2. Classification, addition and subtraction of polynomials
3. Multiplication of polynomials
4. Factoring polynomials—special cases
5. Factoring quadratic trinomials
6. Solving polynomial equations
7. Problem solving using polynomial equations

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### **Outcomes**

1. Students will be able to review the properties of exponents and define monomials.
2. Students will be able to classify, add and subtract polynomials.
3. Students will be able to multiply polynomials, including special products.
4. Students will be able to factor a polynomial completely
5. Students will be able to solve polynomial equations by factoring.
6. Students will be able to solve word problems using polynomial equations.

## **Unit 7: Rational Expressions**

### **Subject Matter**

1. Negative exponents and scientific notation
2. Simplifying rational expressions
3. Multiplying and dividing rational expressions
4. Adding and subtracting rational expressions
5. Simplifying complex rational expressions
6. Solving rational equations
7. Problem solving using rational expressions

### **Outcomes**

1. Students will be able to define zero and negative exponents.
2. Students will be able to write numbers in scientific notation.
3. Students will be able to simplify rational expressions.
4. Students will be able to multiply and divide rational expressions.
5. Students will be able to add and subtract rational expressions.
6. Students will be able to simplify complex rational expressions.
7. Students will be able to solve rational equations.
8. Students will be able to solve word problems using polynomial equations.

## **Unit 8: Irrational and Complex Numbers**

### **Subject Matter**

1. Roots and radicals
2. Multiplying and dividing radicals
3. Adding and subtracting radicals
4. Solving equations with radicals
5. Distance and midpoint formulas
6. Imaginary numbers
7. Adding and subtracting complex numbers
8. Multiplying and dividing complex numbers

### **Outcomes**

1. Students will be able to simplify to the nth root.
2. Students will be able to solve equations of the form  $x^n = k$

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3. Students will be able to add, subtract, multiply and divide radical expressions.
4. Students will be able to write radical expressions in simplest form.
5. Students will be able to solve radical equations.
6. Students will be able to find the distance between two points in a plane.
7. Students will be able to find the coordinates of the midpoint of a line segment.
8. Students will be able to simplify square roots of negative numbers and powers of  $i$ .
9. Students will be able to add, subtract, multiply and divide complex numbers.
10. Students will be able to find the absolute value of a complex number.

## **Unit 9: Quadratic Functions**

### **Subject Matter**

1. Graphing quadratic functions
2. The function  $y=ax^2+bx+c$
3. Completing the square
4. The quadratic formula
5. The discriminant
6. Sum and product of solution
7. Solving equations in quadratic form
8. Quadratic inequalities

### **Outcomes**

1. Students will be able to graph quadratic functions of the form  $y=ax^2+bx+c$ .
2. Students will be able to find the axis of symmetry and the vertex of a parabola and tell whether the vertex is a minimum or maximum.
3. Students will be able to sketch the graph of a quadratic function using the axis of symmetry, the vertex and the intercepts.
4. Students will be able to solve quadratic equations by completing the square and by using the quadratic formula.
5. Students will be able to use the discriminant to determine the nature of the solutions and the graph of a quadratic equation.
6. Students will be able to determine the relationship between the nature of the solutions and the graph of a quadratic function.
7. Students will be able to find the sum and the product of the solutions of a quadratic equation without solving the equations.
8. Students will be able to write a quadratic equation that has given solutions.
9. Students will be able to solve equations in quadratic form and to solve and graph quadratic inequalities in one variable.
10. Students will be able to solve problems by using a quadratic equation.

## **Unit 10: Polynomial Functions**

### **Subject Matter**

1. Dividing polynomials

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2. Synthetic division
3. Remainder and factor theorem
4. Solving polynomial equations
5. Polynomials functions
6. Problem solving using polynomial equations
7. Graphing rational algebraic expressions

### **Outcomes**

1. Students will be able to divide one polynomial by another polynomial.
2. Students will be able to use synthetic division to divide a polynomial by a first degree binomial.
3. Students will be able to evaluate a polynomial for a given value of the variable, using synthetic division.
4. Students will be able to show that given a binomial is a factor of a given polynomial.
5. Students will be able to solve polynomial equations of degree three or greater.
6. Students will be able to graph a polynomial function and approximate its real zeroes.
7. Students will be able to solve problems using polynomials equations.
8. Students will be able sketch the graphs of rational algebraic functions.

## **Unit 11: Conic Sections**

### **Subject Matter**

1. Circles
2. Parabolas
3. Ellipses
4. Hyperbolas
5. Graphing quadratic systems
6. Solving quadratic systems
7. Inverse and joint variations

### **Outcomes**

1. Students will be able to determine the relationships among the center, radius and the equation of a circle.
2. Students will be able to determine the relationships among the focus, directrix, vertex, axis of symmetry and the equation of a parabola.
3. Students will be able to determine the relationships among the foci, intercepts, and the equation of an ellipse.
4. Students will be able to determine the relationships among the foci, intercepts, asymptotes and the equations of a hyperbola.
5. Students will be able to determine graphically the number of real solutions of a quadratic system and to approximate solutions graphically.
6. Students will be able to solve a quadratic system algebraically.
7. Students will be able to solve problems involving inverse and joint variation.

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## **Unit 12: Exponential and Logarithmic Functions**

### **Subject Matter**

1. Rational exponents
2. Real exponents and exponential functions
3. Logarithmic functions
4. Properties of logarithms
5. Evaluating logarithms
6. Exponential logarithms

### **Outcomes**

1. Students will be able to simplify and evaluate expressions with rational exponents.
2. Students will be able to graph exponential functions and solve exponential equations.
3. Students will be able to define and graph logarithmic functions and evaluate logarithms.
4. Students will be able to express logarithms in expanded form and solve equations involving logarithms.
5. Students will be able to evaluate common logarithms and natural logarithms.
6. Students will be able to use logarithms to solve exponential equations.
7. Students will be able to express the logarithm of a number to one base as the logarithm of that number to another base.