Algebra II

Mathematics Curriculum Framework

Revised 2004

Amended 2006

Course Title: Algebra II
Course/Unit Credit: 1
Course Number:
Teacher Licensure: Secondary Mathematics
Grades: 9-12

ALGEBRA II

Algebra II is designed for students who have successfully completed Algebra I (or its equivalent). Algebra II will build on the basic concepts presented in Algebra I to encourage higher order thinking. Algebra II students will represent and analyze mathematical situations. The students will analyze and apply a variety of methods to model and graph linear and nonlinear equations and inequalities. Students will also use algebraic, graphical, and numerical methods for analysis of quadratic equations and functions and polynomials and rational functions. Exponential functions, logarithmic functions, data analysis, and probability will be explored in Algebra II. Arkansas teachers are responsible for integrating appropriate technology in the course work for Algebra II.

Strand	Standard
Relations and Functions	
	1. Students will represent and analyze mathematical situations and properties using patterns, relations, functions and algebraic symbols.
Linear and Absolute Value Equations and Inequalities	
	2. Students will analyze and apply various methods to model, graph and solve linear and absolute value equations and inequalities.
Quadratic Equations and Functions	
	3. Students will use algebraic, graphical, and numerical methods to analyze, compare, translate, and solve quadratic equations.
Polynomial and Rational Functions, *Equations and Inequalities	
	4. Students will use algebraic, graphical, and numerical methods to analyze, compare, translate, and solve polynomial and rational equations.
Exponential and Logarithmic Functions	
	5. Students will graph exponential functions and relate them to logarithms. They will solve real world problems using exponential functions.
Data Analysis and Probability	
	6. Students will evaluate and interpret data, make predictions based on data, and apply basic understanding of probability to solve real world problems.

* denotes amended changes to the framework

CONTENT STANDARD 1. Students will represent and analyze mathematical situations and properties using patterns, relations, functions and algebraic symbols.

RF.1.AII.1	Determine, with or without technology, the *domain* and *range* of a *relation* defined by a graph, a table of values, or a symbolic equation including those with restricted domains and whether a relation is a *function*
RF.1.AII.2	Evaluate, add, subtract, multiply, and divide *functions* and give appropriate domain and range restrictions
RF.1.AII.3	Determine the *inverse of a function* (Graph, with and without appropriate technology, functions and their inverses)
RF.1.AII.4	Analyze and report, with and without appropriate technology, the effect of changing coefficients, exponents, and other parameters on functions and their graphs (*linear*, *quadratic*, and higher degree polynomial)
RF.1.AII.5	Graph, with and without appropriate technology, functions defined as *piece-wise* and *step*
RF.1.AII.6	*Recognize periodic phenomena (sine or cosine functions such as sound waves, length of daylight, circular motion)
RF.1.AII.7	*Investigate and identify key characteristics of period functions and their graphs (period, amplitude, maximum, and minimum)
RF.1.AII.8	*Use basic properties of frequency and amplitude to solve problems
RF.1.AII.9	Apply the concepts of functions to real world situations

Key: RF.1.AII.1 = Relations and Functions. Standard 1. Algebra II. 1st Student Learning Expectation

CONTENT STANDARD 2**.** Students will analyze and apply various methods to model, graph and solve linear and absolute value equations and inequalities.

LEI.2.AII.1	Solve, with and without appropriate technology, absolute value equations and inequalities written in one or two variables, and graph solutions.
LEI.2.AII.2	Solve, with and without appropriate technology, systems of linear equations with two variables and graph the solution set
LEI.2.AII.3	Develop and apply, with and without appropriate technology, the basic operations and properties of matrices (associative, commutative, identity, and inverse)
LEI.2.AII.4	Solve, with and without appropriate technology, systems of linear equations with *three variables using algebraic methods, including matrices
LEI.2.AII.5	Apply, with or without technology, the concepts of linear and absolute value equations and inequalities and systems of linear equations and inequalities to model real world situations including *linear programming*

Key: LEI.2.AII.1 = Linear and Absolute Value Equations and Inequalities. Standard 2. Algebra II. 1st Student Learning Expectation

CONTENT STANDARD 3: Students will use algebraic, graphical, and numerical methods to analyze, compare, translate, and solve quadratic equations.

QEF.3.AII.1	Perform computations with *radicals* • simplify radicals with different *indices* • add, subtract, multiply and divide radicals • *rationalize* denominators • solve equations that contain radicals or *radical expressions*
QEF.3.AII.2	Extend the number system to include the *complex numbers* • define the set of complex numbers • add, subtract, multiply, and divide complex numbers • rationalize denominators
QEF.3.AII.3	*Analyze and solve quadratic equations with and without appropriate technology by • factoring • graphing • extracting the square root • *completing the square* • using the *quadratic formula*
QEF.3.AII.4	*Derive the quadratic formula and use it to solve equations
QEF.3.AII.5	Develop and analyze, with and without appropriate technology, quadratic relations • graph a *parabolic* relationship when given its equation • write an equation when given its *roots* (*zeros* or solutions) or graph • determine the nature of the solutions graphically and by evaluating the *discriminant* • determine the *maximum* or *minimum* values and the *axis of symmetry* both graphically and algebraically
QEF.3.AII.6	Apply the concepts of quadratic equations and functions to model real world situations by using appropriate technology when needed

Key: QEF.3.AII.1 = Quadratic Equations and Functions. Standard 3. Algebra II. 1st Student Learning Expectation

CONTENT STANDARD 4: Students will use algebraic, graphical, and numerical methods to analyze, compare, translate, and solve polynomial and rational equations.

PRF.4.AII.1	Determine the factors of polynomials by • using factoring techniques including grouping and the sum or difference of two cubes • using long division • using *synthetic division*
PRF.4.AII.2	*Analyze and sketch, with and without appropriate technology, the graph of a given polynomial function, determining the characteristics of domain and range, maximum and minimum points, end behavior, zeros, multiplicity of zeros, y-intercept, and symmetry
PRF.4.AII.3	*Write the equation of a polynomial function given its roots
PRF.4.AII.4	Identify the equation of a polynomial function given its graph or table
PRF.4.AII.5	*Identify the characteristics of graphs of power functions of the form $f(x) = ax^n$, for negative integral values of n, including domain, range, end behavior, and behavior at x = 0, and compare these characteristics to the graphs of related positive integral power functions
PRF.4.AII.6	Simplify, add, subtract, multiply, and divide with *rational expressions*
PRF.4.AII.7	Establish the relationship between radical expressions and expressions containing *rational exponents*
PRF.4.AII.8	Simplify variable expressions containing rational exponents using the laws of exponents

Key: PRF.4.AII.1 = Polynomial and Rational Functions. Standard 4. Algebra II. 1st Student Learning Expectation

CONTENT STANDARD 5. Students will graph exponential functions and relate them to logarithms. They will solve real world problems using exponential functions.

ELF.5.AII.1	*Recognize the graphs of exponential functions distinguishing between growth and decay
ELF.5.AII.2	*Graph exponential functions and identify key characteristics: domain, range, intercepts, asymptotes, and end behavior
ELF.5.AII.3	Identify the effect that changes in the parameters of the base have on the graph of the exponential function
ELF.5.AII.4	*Recognize and solve problems that can be modeled using exponential functions
ELF.5.AII.5	Establish the relationship between exponential and *logarithmic functions*
ELF.5.AII.6	Evaluate simple logarithms using the definition (Ex. $\log_3 81$)
ELF.5.AII.7	*Use properties of logarithms to manipulate logarithmic expressions

Key: ELF.5.AII.1 = Exponential and Logarithmic Functions. Standard 5. Algebra II. 1st Student Learning Expectation

CONTENT STANDARD 6. Students will evaluate and interpret data, make predictions based on data, and apply basic understanding of probability to solve real world problems.

DAP.6.AII.1	*Find regression line for scatter plot, using appropriate technology, and interpret the correlation coefficient
DAP.6.AII.2	*Interpret and use the correlation coefficient to assess the strength of the linear relationship between two variables
DAP.6.AII.3	*Find the quadratic curve of best fit using appropriate technology
DAP.6.AII.4	*Identify strengths and weaknesses of using regression equations to approximate data
DAP.6.AII.5	*Compute and explain measures of spread (range, percentiles, variance, standard deviation)
DAP.6.AII.6	*Describe the characteristics of a Gaussian normal distribution

Key: DAP.6.AII.1 = Data Analysis and Probability. Standard 6. Algebra II. 1st Student Learning Expectation

Absolute Value Equation	An equation described by y = $\lvert x \rvert$
**Asymptote*	A line that a graph approaches, but does not reach, as x- or x- values increase in the positive or negative direction
Axis of Symmetry	The line about which a figure is symmetric
Combinations	Subsets chosen from a larger set of objects in which the order of the items doesn't matter (Ex. the number of different committees of three that can be chosen from a group of twelve members)
Completing the Square	A process used to create a perfect square trinomial
Composition of Functions	Suppose *f* and *g* are functions such that the range of g is a subset of the domain of *f*, then the composite function f ◦ g can be described by the equation [f ◦ g](x) = f[g(x)]
Conditional Probability	If A and B are events, the probability of A assuming B holds is equal to the probability of both A and B being favorable divided by the probability of B
Dependent Event	The outcome of a dependent event is affected by the outcome of another event.
Determinant	A square array of numbers or expressions enclosed between two parallel vertical bars
Direct Variation	A linear function of the form y = kx where k is the constant of variation and k ≠ 0
Discriminate	The expression $b^2 - 4ac$ obtained from a quadratic equation $ax^2+bx+c = 0$
Domain	Set of all first coordinates from the ordered pairs of a relation
End Behavior	A reference to the graph of a polynomial function as rising or falling to the right and rising or falling to the left
Even Function	A function whose graph is symmetric to the y-axis. $f(-x) = f(x)$
Exponential Function	A function in which the variable(s) occur in the exponent and can be expressed in the form $f(x) = ab^x$ or $b>0$
Function	A special type of relation in which each element of the domain is paired with exactly one element of the range
Fundamental Counting Theorem	If event *M* can occur in *m* ways and is followed by an event *N* that can occur *n* ways, then the event *M* followed by the event *N* can occur in $m \cdot n$.
**Gaussian Normal Distribution*	A symmetric bell-shaped distribution
I	The square root of -1. (an imaginary number)
Independent Event	The outcome of an independent event is not affected by the outcome of another event.
Indices	The number that indicates the root of a radical
Inequalities	Statements indicating the two quantities are not equal, utilizing symbols > (greater than) or < (less than) and ≥ or ≤
Inverse Function	Two functions *f* and *g* are inverse functions if and only if both their compositions are the identity function. Ex. [*f* ◦ *g*](x) = x and [*g* ◦ *f*](x) = x
Inverse Variation	*Y* is inversely proportional to x, $y = \frac{k}{x}$ for some constant *k*
Joint Variation	*Z* is jointly proportional to x and y, z = kxy for some constant k
Linear Function	A function that has a constant rate of change and can be modeled by a straight line

Linear Programming	A method for finding the maximum or minimum value of a function in two variables subject to given constraints on the variables
Logarithmic Function	A function of the form $y = \log_b x$, where $b > 0$, $x > 0$ and $b \neq 1$
Matrix	A rectangular array of variables or constants in horizontal rows and vertical columns, usually enclosed in brackets
Matrix Inverse	For matrix A, the inverse of A is A^{-1} where $A \cdot A^{-1} = 1$
Maximum	The greatest value of the function if it has such an extreme value
Minimum	The least value of the function if it has such an extreme value
Mutually Exclusive Event	Two events are mutually exclusive if their outcomes can never be the same.
Odd Function	The function whose graph is symmetric to the origin Ex. $f(-x) = -f(x)$
Parabola	The graph of a quadratic equation
**Periodic Function*	A function whose graph repeats at regular intervals
Permutation	An arrangement of things in a certain order
Perpendicular Bisector	A line or segment that is perpendicular to the segment at its midpoint
Piece-wise Function	Functions using different rules for different parts of the domain
Point-slope form	A linear equation in the form $(y - y_1) = m(x - x_1)$ where m is the slope and (x_1, y_1) are the coordinates of a given point on the line
Quadratic Formula	The solutions of a quadratic equation of the form $ax^2 + bx + c = 0$, where $a \neq 0$, are given by the quadratic formula, which is $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Quadratic Function	A function described by an equation that can be written in the form $f(x) = ax^2 + bx + c$, where $a \neq 0$
Radical Expression	An expression that contains a radical whose radicand may contain variables
Radical	A radical symbol $\sqrt{\ }$ and its radicand
Range	The set of all second coordinates from the ordered pairs of a relation
Rational Exponent	An exponent written in the form $\frac{a}{b}$, where *a* is an integer and *b* is a natural number
Rational Expression	An expression that can be written in the form $\frac{P}{Q}$, where P and Q are polynomials $Q \neq 0$
Rationalize the Denominator	The process of eliminating a radical from the denominator
Relation	A set of ordered pairs of data
Root	A solution of an equation

Slope-intercept form	A linear equation in the form $y = mx + b$, where m is the slope of the line and b is the y-intercept
Standard Form (of a linear equation)	An equation in the form $Ax + By = C$, where A, B, and C are integers and A and B are not both 0.
Step Function	A function whose graph is a series of disjoint line segments or steps
Synthetic Division	A simpler method than long division used to divide a polynomial by a binomial
System of Linear Equations	A set of equations with the same variables
System of Linear Inequalities	A set of inequalities with the same variables
Transformations	Transformations of graphs including translations, reflections, vertical stretches and vertical shrinks
**Variance (s^2)*	A measure of spread for a one-variable data set that uses squaring to eliminate the effect of the different sign of the individual deviations It is the sum of squares of the deviations divided by one less than the number of values
Vertical Asymptote	A vertical line to which a graph becomes arbitrarily close as the value of f(x) increases or decreases without bound
Zeros	For any function $f(x)$, if $f(a) = 0$, then a is a zero of the function