**URBANDALE COMMUNITY SCHOOL DISTRICT**
**CURRICULUM FRAMEWORK OUTLINE**

**SUBJECT:** **Mathematics**
**COURSE TITLE:** **Applications of Algebra** **2 Credits/2 Semesters**
**PREREQUISITES:** **Junior or Senior; Algebra II credits or Trigonometry credit (Trigonometry may be taken in concurrent semester.)**

**COURSE DESCRIPTION:**
Applications of Algebra is a two-semester course designed to prepare students for further study of mathematics. The students review and continue to develop the properties and applications of algebraic, logarithmic, and trigonometric functions and are introduced to selected pre-calculus topics. This class provides a valuable background for those wishing to continue their study of mathematics.

**STANDARDS AND COURSE BENCHMARKS WITH INDICATORS:**
**In order that our students may achieve the maximum benefit from their talents and abilities, the students of Urbandale Community School District's Applications of Algebra course should be able to…**

**Standard II: Understand quantities.**

**Benchmark: Reason quantitatively and use units to solve problems. Iowa Core: HSN.Q.A.1, 2, 3**
Indicators: Choose and interpret the scale and the origin in graphs and data displays.
Define appropriate quantities for the purpose of descriptive modeling.
Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

**Benchmark: Use complex numbers in polynomial identities and equations. Iowa Core: HSN.CN.C. 7, 9**
Indicators: Solve quadratic equations with real coefficients that have complex solutions.
Know the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

**Standard III: Understand the use of expressions.**

**Benchmark: Understand the relationship between zeros and factors of polynomials. Iowa Core: HSA.APR.B.2, 3**
Indicator: Use the zeros of polynomials to construct a rough graph of the function defined by the polynomial.

**Standard IV: Create equations.**

**Benchmark: Create equations that describe numbers or relationships. A.CED.1, 3**

Indicator: Create equations in one variable and use them to solve problems (include equations arising from linear and quadratic functions, and simple rational and exponential functions.)

Represent constraints by equations or inequalities, and by systems of equations and/or inequalities, and interpret solutions as viable or nonviable options in a modeling context.

**Standard V: Demonstrate reasoning with equations and inequalities.**

**Benchmark: Understand solving equations as a process of reasoning and explain the reasoning. Iowa Core HSAA.REI.A.2**

Indicators: Solve simple rational equations in one variable, and give examples showing how extraneous solutions may arise.

Solve simple radical equations in one variable, and give examples showing how extraneous solutions may arise.

**Benchmark: Solve equations and inequalities in one variable. Iowa Core: HSA.REI.B.4, C5, 6**

Indicators: Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other.

Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables.

**Benchmark: Represent and solve equations and inequalities graphically. Iowa Core: HSA.REI.D.12**

Indicators: Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality).

Graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.

**Benchmark: Solve systems of equations. Iowa Core: HSA.REI.9, 10**

Indicators: Find the inverse of a matrix if it exists and use it to solve systems of linear equations (using technology for matrices of dimension $3 \times 3$ or greater).

Demonstrate an understanding that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

**Standard VI: Understand functions.**

**Benchmark: Interpret functions that arise in applications in terms of a context. Iowa Core: HSF.IF.B.4, 5**

Indicators: For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

For a function that models a relationship between two quantities, sketch graphs showing key features given a verbal description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes.

**Benchmark: Analyze functions using different representations. Iowa Core: HSF.IF.C.8**

Indicators: Use the properties of exponents to interpret expressions for exponential functions.

**Benchmark: Build a function that models a relationship between two quantities. Iowa Core: HSF.BF1**

Indicators: Combine standard function types using arithmetic operations.

Compose functions. For example, if T(y) is the temperature in the atmosphere as a function of height, and h(t) is the height of a weather balloon as a function of time, then T(h(t)) is the temperature at the location of the weather balloon as a function of time.

**Benchmark: Build new functions from existing functions. Iowa Core: HSF.BF. B.3, 4, 5**

Indicators: Identify the effect on the graph of replacing f(x) by f(x) + k, k f(x), f(kx), and f(x + k) for specific values of k (both positive and negative); find the value of k given the graphs, include recognizing even and odd functions from their graphs and algebraic expressions for them.

Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) =2 x^3 or f(x) = (x+1)/(x–1) for $x \neq 1$.

Verify by composition that one function is the inverse of another.

Read values of an inverse function from a graph or a table, given that the function has an inverse.

Produce an invertible function from a non-invertible function by restricting the domain.

Demonstrate an understanding of the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.

**Benchmark: Construct and compare linear, quadratic, and exponential models and solve problems. Iowa Core: HSF.LE.A.1, 2, 3, 4**

Indicators:
- Prove that exponential functions grow by equal factors over equal intervals.
- Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.
- Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph.
- Construct linear and exponential functions, including arithmetic and geometric sequences, given a description of a relationship.
- Construct linear and exponential functions, including arithmetic and geometric sequences, given two input-output pairs (include reading these from a table).
- Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function.
- For exponential models, express as a logarithm the solution to ab^ct = d where a, c, and d are numbers and the base b is 2, 10, or e; evaluate the logarithm using technology.

**Benchmark: Extend the domain of trigonometric functions using unit circle. Iowa Core: HSF.TF.A.1, 2, 3, 4**

Indicators:
- Demonstrate an understanding of radian measure of an angle as the length of the arc on the unit circle subtended by the angle
- Explain how the unit circle in the coordinate plane enables the extension of trigonometric functions to all real numbers, interpreted as radian measures of angles traversed counterclockwise around the unit circle.
- 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 $\pi-x$, $\pi+x$, and $2\pi-x$ in terms of their values for x, where x is any real number.
- Use special triangles to determine geometrically the values of sine, cosine, tangent for $\pi/3$, $\pi/4$ and $\pi/6$.
- Use the unit circle to express the values of sine, cosine, and tangent for $\pi-x$, $\pi+x$, and $2\pi-x$ in terms of their values for x, where x is any real number.
- Use the unit circle to explain symmetry (odd and even) and periodicity of trigonometric functions.
- Use the unit circle to explain symmetry (odd and even) of trigonometric functions.
- Use the unit circle to explain periodicity of trigonometric functions.

Explain the relationship between unit circle trig function definitions and right triangle trig.

**Benchmark: Model periodic phenomena with trigonometric functions. Iowa Core: HSF.TF.B.5, 6**

Indicators: Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.

Demonstrate an understanding that restricting a trigonometric function to a domain on which it is always increasing or always decreasing allows its inverse to be constructed.

Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context.

**Standard VIII: Understand geometry.**

**Benchmark: Use coordinates to prove simple geometric theorems algebraically. Iowa Core: HSG.GPE.B.7**

Indicators: Use coordinates to compute perimeters of polygons (e.g., using the distance formula).

Use coordinates to compute areas of triangles and rectangles.