URBANDALE COMMUNITY SCHOOL DISTRICT
CURRICULUM FRAMEWORK OUTLINE

SUBJECT: **Mathematics**
COURSE TITLE: **Algebra II**
PREREQUISITES: **Geometry** **2 Credits/2 Semesters**

COURSE DESCRIPTION:
Algebra II enhances the problem-solving process started in Algebra I by continuing to develop the basic and advanced properties of functions and algebra. Algebra II gives students the opportunity to model real data by understanding and applying the algebraic concepts of equations and inequalities, basic relations and functions, polynomials, matrices, conics, and exponential functions. Students in Algebra II are able to describe the world around them by utilizing estimation, technology, graphing techniques, and statistics. Algebra II is designed to meet part of the three-year entrance requirements for mathematics to most colleges. Algebra II provides a valuable background for those entering technical fields and also serves as a useful course for other college-bound students.

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 Algebra II course should be able to…

Standard I: Understand the real and complex number systems.

Benchmark: Perform arithmetic operations with complex numbers. (Iowa Core: HSN.CN.A.1, 2)
Indicators: Define imaginary and complex numbers.
Perform operations on complex numbers.

Benchmark: Use complex numbers in polynomial identities and equations. (Iowa Core: HSN.CN.C.7, 8, 9)
Indicators: Solve quadratic equations with real coefficients that have complex solutions.
Extend polynomial identities to the complex numbers. For example, rewrite x^2 + 4 as (x + 2i)(x – 2i).
Know and be able to explain the Fundamental Theorem of Algebra; show that it is true for quadratic polynomials.

Benchmark: Perform operations on matrices and use matrices in applications. (Iowa Core: HSN.VM.C.6, 7, 8, 9, 10, 11, 12)
Indicators: Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network.
Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled.

Add, subtract, and multiply matrices of appropriate dimensions.
Demonstrate understanding that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.
Demonstrate understanding that the zero and identity matrices play a role in matrix addition and multiplication similar to the role of 0 and 1 in the real numbers.
Demonstrate understanding that the determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
Multiply a vector (regarded as a matrix with one column) by a matrix of suitable dimensions to produce another vector. Work with matrices as transformations of vectors.
Work with 2 × 2 matrices as transformations of the plane.
Interpret the absolute value of the determinant of a 2 x 2 matrix in terms of area.

Standard III: Understand the use of expressions.

Benchmark: Interpret the structure of expressions. (Iowa Core: HSA.SSE.A.2)
Indicators: Use factoring patterns.

Benchmark: Write expressions in equivalent forms to solve problems. (Iowa Core: HSA.SSE.C.4)
Indicators: Derive the formula for the sum of a finite geometric series (when the common ratio is not 1), and use the formula to solve problems.

Benchmark: Perform arithmetic operations on polynomials. (Iowa Core: HSA.APR.A.1)
Indicators: Add, subtract, and multiply polynomials and describe how closure applies under these operations.

Benchmark: Demonstrate understanding of the relationship between zeros and factors of polynomials. (Iowa Core: HSA.APR.B.2, 3)
Indicators: Know and apply the Remainder Theorem.
Find zeros of functions by factoring.
Graph a function using zeros.

Benchmark: Use polynomial identities to solve problems. (Iowa Core: HSA.APR.C.4, 5)
Indicators: Prove polynomial identities and use them to describe numerical relationships.
Know and apply the Binomial Theorem for the expansion of (x + y)^n.

Benchmark: Rewrite rational expressions. (Iowa Core: HSA.APR.C.6, 7)
Indicators: Divide polynomials using a variety of methods.
Demonstrate rational expressions are a closed system.

Perform operations on rational expressions.

Standard IV: Create equations.

Benchmark: Create equations that describe numbers or relationships. (Iowa Core: HSA.CED.A.1, 2, 3, 4)

Indicator: Use equations and inequalities to model real world applications and check reasonableness of answers.

Standard V: Demonstrate reasoning with equations and inequalities.

Benchmark: Demonstrate an understanding of solving equations as a process of reasoning and explain the reasoning. (Iowa Core: HSA.REI.A.2)

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

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

Benchmark: Solve systems of equations. (Iowa Core: HAS.REI.C.8, 9)

Indicators: Represent a system of linear equations as a single matrix equation in a vector variable.

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

Benchmark: Represent and solve equations and inequalities graphically. (Iowa Core: HSA.REI.D.11)

Indicators: Use a graphing calculator to graph linear and nonlinear equations.

Use a graphing calculator to solve equations.

Graph a system of linear inequalities to solve a linear programming model.

Standard VI: Understand functions.

Benchmark: Interpret functions that arise in applications in terms of a context. (Iowa Core: HSF.IF.B.4, 5, 6)

Indicator: For a function, identify key features that include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.

Sketch a graph with key features that include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity

State appropriate domain.

Calculate, interpret, and estimate the rate of change from a graph.

Benchmark: Analyze functions using different representations. (Iowa Core: HSF.IF.C.7b, 7e, 8a, 8b, 9)

Indicators:
- Graph polynomial, square root, and cube root functions.
- Graph piecewise-defined functions, including step functions and absolute value functions.
- Graph exponential and logarithmic functions, showing intercepts and end behavior.
- Use the process of factoring in a polynomial function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context.
- Use the properties of exponents to interpret expressions for exponential functions. For example, identify percent rate of change in functions such as y = (1.02)^t, y = (0.97)^t, y = (1.01)^(12t), y = (1.2)^(t/10), and classify them as representing exponential growth or decay.
- Compare properties of two functions each represented in a different way.

Benchmark: Build a function that models a relationship between two quantities. (Iowa Core: HSF.BF.A.1b)

Indicators:
- Create new functions using arithmetic operations and composition.
- Determine a recursive process, i.e., arithmetic / geometric series.
- Determine steps for calculation from a context.
- Write arithmetic and geometric sequences both recursively and with an explicit formula, and translate between the two forms.
- Use arithmetic and geometric sequences to model situations.

Benchmark: Build new functions from existing functions. (Iowa Core: HSF.BF. B. 3, 4a)

Indicators:
- Recognize even and odd functions from their graphs and algebraic expressions.
- Use graphing calculators to explore graphs and perform geometric transformations.
- Write the inverse of a function.

Benchmark: Construct and compare linear, quadratic, and exponential models and solve problems. (Iowa Core: HSF.LE.A.4)

Indicators:
- 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)

Indicators:
- Demonstrate understanding of a radian measure of an angle as the length of the arc on the unit circle subtended by the angle.
- Explain the relationship between unit circle trig function definitions and right triangle trig.

Benchmark: Model periodic phenomena with trigonometric functions. (Iowa Core: F.TF.B.5)

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

Benchmark: Prove and apply trigonometric identities. F.TF.8

Indicators: Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$.

Use the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.

Standard VII: Understand statistics & probability.

Benchmark: Summarize, represent, and interpret data on a single count or measurement variable. (Iowa Core: HSS.ID.A.4)

Indicators: Use the mean and standard deviation of a data set to fit it to a normal distribution and to estimate population percentages.

Recognize that there are data sets for which such a procedure is not appropriate.

Use calculators, spreadsheets, and tables to estimate areas under the normal curve.

Benchmark: Understand and evaluate random processes underlying statistical experiments. (Iowa Core: HSS.IC.A.1, 2)

Indicators: Demonstrate an understanding of statistics as a process for making inferences about population parameters based on a random sample from that population.

Decide if a specified model is consistent with results from a given data-generating process.

Benchmark: Make inferences and justify conclusions from sample surveys, experiments, and observational studies. (Iowa Core: HSS.IC.B. 3, 4, 5, 6)

Indicators: Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each.

Use data from a sample survey to estimate a population mean or proportion.

Develop a margin of error through the use of simulation models for random sampling.

Use data from a randomized experiment to compare two treatments.

Use simulations to decide if differences between parameters are significant.

Evaluate reports based on data.

Benchmark: Use probability to evaluate outcomes of decisions. (Iowa Core: HSS.MD.B.6, 7)

Indicators: Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).

Analyze decisions and strategies using probability concepts.