School District of Marshfield Course Syllabus

Course Name: Algebra II Honors
Length of Course: 1 Year
Credit: 1

Program Goal:

The School District of Marshfield Mathematics Program will prepare students for college and career in the 21st century by ensuring ***all*** students learn based on skills and knowledge needed to succeed in post-secondary education/training, career, and life. The 4K through High School Mathematics curriculum is designed to support every student in achieving success. Students will be placed in to the driver's seat. Innovative educators will tailor instruction to student need through engaging learning activities and relevant assessment.

Course Description:

This course involves the study of linear functions, complex numbers, absolute value equation, systems of equations, matrices, quadratic equations and functions, polynomial equations and functions, inverses and radical functions, exponential and logarithmic functions, trigonometric functions, rational functions, conic sections, sequence and series, probability, and statistics.

NOTE: Students are required to have a graphing calculator.
PREREQUISITE: Successful Completion of Geometry H or Algebra I H concurrent with Geometry R/H or Instructor's Consent.

Standards:	
Wisconsin Standards for Mathematical Practice (MP)	
MP: 1, 2, 3, 4, 5, 6, 7, 8	1. Make sense of problems and persevere in solving them. 2. Reason abstractly and quantitatively. 3. Construct viable arguments and critique the reasoning of others. 4. Model with mathematics. 5. Use appropriate tools strategically. 6. Attend to precision. 7. Look for and make use of structure. 8. Look for and express regularity in repeated reasoning.
Wisconsin Standards for Mathematics- Number and Quantity	
The Real Number System (N-RN)	
Extend the properties of exponents to rational exponents. N-RN: 1, 2	1. Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. *For example, we define* $5^{1/3}$ *to be the cube root of 5 because we want* $(5^{1/3})^3 = 5(^{1/3})^3$ *to hold, so* $(5^{1/3})^3$ *must equal 5.* 2. Rewrite expressions involving radicals and rational exponents using the properties of exponents.
Quantities (N-Q)	
Reason quantitatively and use units to solve problems. N-Q: 2	2. Define appropriate quantities for the purpose of descriptive modeling.
The Complex Number System (N-CN)	
Perform arithmetic operations with complex numbers. N-CN: 1, 2	1. Know there is a complex number i such that $i^2 = -1$, and every complex number has the form $a + bi$ with a and b real. 2. Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.
Use complex numbers in polynomial identities and equations. N-CN: 7	7. Solve quadratic equations with real coefficients that have complex solutions.
Vector and Matrix Quantities (N-VM)	
Perform operations on matrices and use matrices in applications. N-VM: 6, 7, 8, 9, 10	6. (+) Use matrices to represent and manipulate data, e.g., to represent payoffs or incidence relationships in a network. 7. (+) Multiply matrices by scalars to produce new matrices, e.g., as when all of the payoffs in a game are doubled. 8. (+) Add, subtract, and multiply matrices of appropriate dimensions. 9. (+) Understand that, unlike multiplication of numbers, matrix multiplication for square matrices is not a commutative operation, but still satisfies the associative and distributive properties.

	10. (+) Understand 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. The determinant of a square matrix is nonzero if and only if the matrix has a multiplicative inverse.
Wisconsin Standards for Mathematics- Algebra	
Seeing Structure in Expressions (A-SSE)	
Interpret the structure of expressions. A-SSE: 1a, 1b, 2	1. Interpret expressions that represent a quantity in terms of its context. a. Interpret parts of an expression, such as terms, factors, and coefficients. b. Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example, interpret* $P(1+r)^n$ *as the product of P and a factor not depending on P.* 2. Use the structure of an expression to identify ways to rewrite it. *For example, see* $x^4 - y^4$ *as* $(x^2)^2 - (y^2)^2$, *thus recognizing it as a difference of squares that can be factored as* $(x^2 - y^2)(x^2 + y^2)$.
Write expressions in equivalent forms to solve problems. A-SSE: 3a, 3b, 3c, 4	3. Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression. a. Factor a quadratic expression to reveal the zeros of the function it defines. b. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. c. Use the properties of exponents to transform expressions for exponential functions. *For example, the expression* 1.15^t *can be rewritten as* $(1.15^{1/12})^{12t} \approx 1.012^{12t}$ *to reveal the approximate equivalent monthly interest rate if the annual rate is 15%.* 4. Derive the formula for the sum of a finite geometric when the common ratio is not 1), and use the formula to solve problems. *For example, calculate mortgage payments.*
Arithmetic with Polynomials and Rational Expressions (A-APR)	
Perform arithmetic operations on polynomials. A-APR: 1	1. Understand that polynomials form a system analogous to the integers, namely, they are closed under the operations of addition, subtraction, and multiplication; add, subtract, and multiply polynomials.
Understand the relationship between zeros and factors of polynomials. A-APR: 2, 3	2. Know and apply the Remainder Theorem: For a polynomial $p(x)$ and a number a, the remainder on division by $x - a$ is $p(a)$, so $p(a) = 0$ if and only if $(x - a)$ is a factor of $p(x)$. 3. Identify zeros of polynomials when suitable factorizations are available, and use the zeros to construct a rough graph of the function defined by the polynomial.

Use polynomial identities to solve problems. A-APR: 4, 6	4. Prove polynomial identities and use them to describe numerical relationships. *For example, the polynomial identity* $(x^2 + y^2)^2 = (x^2 - y^2)^2 + (2xy)^2$ *can be used to generate Pythagorean triples.* 6. Rewrite simple rational expressions in different forms; write a(x)/b(x) in the form q(x) + r(x)/b(x), where a(x), b(x), q(x), and r(x) are polynomials with the degree of r(x) less than the degree of b(x), using inspection, long division, or, for the more complicated examples, a computer algebra system.
Creating Equations (A-CED)	
Create equations that describe numbers or relationships. A-CED: 1, 2, 3, 4	1. Create equations and inequalities in one variable and use them to solve problems. *Include equations arising from linear and quadratic functions, and simple rational and exponential functions.* 2. Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales. 3. 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. *For example, represent inequalities describing nutritional and cost constraints on combinations of different foods.* 4. Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. *For example, rearrange Ohm's law V =IR to highlight resistance R.*
Reasoning with Equations and Inequalities (A-REI)	
Understand solving equations as a process of reasoning and explain the reasoning. A-REI: 1, 2	1. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method. 2. Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
Solve equations and inequalities in one variable. A-REI: 4a, 4b	4. Solve quadratic equations in one variable. a. Use the method of completing the square to transform any quadratic equation in x into an equation of the form $(x - p)^2 = q$ that has the same solutions. Derive the quadratic formula from this form. b. Solve quadratic equations by inspection (e.g., for $x^2 = 49$), taking square roots, completing the square, the quadratic formula and factoring, as appropriate to the initial form of the equation. Recognize when the quadratic formula gives complex solutions and write them as $a \pm bi$ for real numbers a and b.

Solve systems of equations. A-REI: 7	7. Solve a simple system consisting of a linear equation and a quadratic equation in two variables algebraically and graphically. *For example, find the points of intersection between the line* $y = –3x$ and the circle $x^2 + y^2 = 3$.
Represent and solve equations and inequalities graphically. A-REI: 11	11. Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; find the solutions approximately, e.g., using technology to graph the functions, make tables of values, or find successive approximations. Include cases where $f(x)$ and/or $g(x)$ are linear, polynomial, rational, absolute value, exponential, and logarithmic functions.
Wisconsin Standards for Mathematics- Functions	
Interpreting Functions (F-IF)	
Understand the concept of a function and use function notation. F-IF: 1, 2, 3	1. Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. If f is a function and x is an element of its domain, then $f(x)$ denotes the output of f corresponding to the input x. The graph of f is the graph of the equation $y = f(x)$. 2. Use function notation, evaluate functions for inputs in their domains, and interpret statements that use function notation in terms of a context. 3. Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example, the Fibonacci sequence is defined recursively by* $f(0) = f(1) = 1$, $f(n+1) = f(n) + f(n-1)$ *for* $n \geq 1$.
Interpret functions that arise in applications in terms of the context. F-IF: 4, 5	4. For a function that models a relationship between two quantities, interpret key features of graphs and tables in terms of the quantities, and 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.* 5. Relate the domain of a function to its graph and, where applicable, to the quantitative relationship it describes. *For example, if the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.*
Analyze functions using different representations. F-IF: 7a, 7b, 7c, 7d, 7e, 8a, 8b, 9	7. Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. a. Graph linear and quadratic functions and show intercepts, maxima, and minima. b. Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions.

	c. Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. d. (+) Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. e. Graph exponential and logarithmic functions, showing intercepts and end behavior, and trigonometric functions, showing period, midline, and amplitude. 8. Write a function defined by an expression in different but equivalent forms to reveal and explain different properties of the function. a. Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values, and symmetry of the graph, and interpret these in terms of a context. *b.* 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.* 9. Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). *For example, given a graph of one quadratic function and an algebraic expression for another, say which has the larger maximum.*
Building Functions (F-BF)	
Build a function that models a relationship between two quantities. F-BF: 1a, 1b, 2	1. Write a function that describes a relationship between two quantities. a. Determine an explicit expression, a recursive process, or steps for calculation from a context. b. Combine standard function types using arithmetic operations. *For example, build a function that models the temperature of a cooling body by adding a constant function to a decaying exponential, and relate these functions to the model.* 2. Write arithmetic and geometric sequences both recursively and with an explicit formula, use them to model situations, and translate between the two forms.
Build new functions from existing functions. F-BF: 3, 4a, 5	3. 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. Experiment with cases and illustrate an explanation of the effects on the graph using technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* 4. Find inverse functions.

	a. 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,* $f(x) = 2x^3$ *or* $f(x) = (x+1)/(x–1)$ *for* $x \neq 1$. 5. (+) Understand the inverse relationship between exponents and logarithms and use this relationship to solve problems involving logarithms and exponents.
Linear, Quadratic and Exponential Models (F-LE)	
Construct and compare linear, quadratic, and exponential models and solve problems. F-LE: 2, 4	2. Construct linear and exponential functions, including arithmetic and geometric sequences, given a graph, a description of a relationship, or two input-output pairs (include reading these from a table). 4. 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.
Interpret expressions for functions in terms of the situation they model. F-LE: 5	5. Interpret the parameters in a linear or exponential function.
Trigonometric Functions (F-TF)	
Extend the domain of trigonometric functions using the unit circle. F-TF: 1, 2	1. Understand radian measure of an angle as the length of the arc on the unit circle subtended by the angle. 2. 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.
Model periodic phenomena with trigonometric functions. F-TF: 5	5. Choose trigonometric functions to model periodic phenomena with specified amplitude, frequency, and midline.
Prove and apply trigonometric identities. F-TF: 8	8. Prove the Pythagorean identity $\sin^2(\theta) + \cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant of the angle.
Wisconsin Standards for Mathematics- Geometry	
Expressing Geometric Properties with Equations (G-GPE)	
Translate between the geometric description and the equation for a conic section. G-GPE: 1, 2	1. Derive the equation of a circle of given center and radius using the Pythagorean Theorem; complete the square to find the center and radius of a circle given by an equation. 2. Derive the equation of a parabola given a focus and directrix.
Wisconsin Standards for Mathematics- Statistics and Probability	
Interpreting Categorical and Quantitative Data (S-ID)	
Summarize, represent, and interpret data on a single count or measurement variable. S-ID: 4	4. 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.

Making Inferences and Justifying Conclusions (S-IC)	
Understand and evaluate random processes underlying statistical experiments. S-IC: 1, 2	1. Understand statistics as a process for making inferences about population parameters based on a random sample from that population. 2. Decide if a specified model is consistent with results from a given data-generating process, e.g., using simulation. *For example, a model says a spinning coin falls heads up with probability 0.5. Would a result of 5 tails in a row cause you to question the model?*
Make inferences and justify conclusions from sample surveys, experiments, and observational studies. S-IC: 3, 4, 5, 6	3. Recognize the purposes of and differences among sample surveys, experiments, and observational studies; explain how randomization relates to each. 4. 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. 5. Use data from a randomized experiment to compare two treatments; use simulations to decide if differences between parameters are significant. 6. Evaluate reports based on data.

Key Vocabulary:

Conditional Probability	Geometric Sequences and Series	Properties of Logarithms	Arithmetic Sequences and Series
Factor Theorem	Roots/Zeros/Solutions	Common Logarithms	Base of e
Square Root Functions	Rational Zero Theorem	Completing the Square	Inverse Operations/Functions
Parent Functions	Exponents	Natural Logarithms	Transformations
Complex Numbers	Augmented Matrix	Reciprocal Functions	Control Group
Reflection	Nth Root Functions	Logarithms	Correlation
Synthetic	Radicals	Variation Functions	Causation
Discriminant	Rational	Conjugate	Statistical Analysis
Remainder Theorem	Radical Functions	Parabolas	Polynomials
Coefficient Matrix	Common Difference	Step Function	Dimensions
Explicit Definition	Exponential Functions	Interval Notation	Matrix
Set Builder Notation	Sigma Notation	Piecewise Function	Recursive Definition
Reduced Row Echelon Form	Completing the Square	Degree of a Polynomial	Rational Root Theorem
Polynomial Function	Pascal’s Triangle	Imaginary Number	Complex Conjugate
Complex Number	Zero of a Function	Quadratic Function	Standard Form
Vertex Form	Rational Function	Binomial Theorem	Remainder Theorem
Exponential Function	Synthetic Division	Turning Point	Asymptote
Radian	Logarithmic Function	Extraneous Solution	Inverse Variation
Unit Circle	Composite Function	Index	Inverse Function
Independent Events	Mutually Exclusive	Standard Deviation	Periodic Function

Experimental Group	Scalar Multiplication	Trigonometric Identity	Reciprocal Trigonometric Function
Standard Position	Statistic	Random Sample	Probability
Law of Sines	Law of Cosines	Conic Section	Ellipse
Hyperbola	Transverse Axis	Constant Matrix	Identity Matrix
Inverse Matrix	Control Group	Zero Matrix	Square Matrix
Variable Matrix	Margin of Error	Normal Distribution	Experiment

Topics/Content Outline- Units and Themes:

Quarter 1:

- Linear Functions and Systems
- Quadratic Functions and Equations
- Polynomial Functions

Quarter 2:

- Rational Functions
- Rational Exponents and Radical Functions
- Exponentials and Logarithmic Functions

Quarter 3:

- Trigonometric Functions
- Trigonometric Equations and Identities
- Conic Sections

Quarter 4:

- Matrices
- Data Analysis and Statistics
- Probability

Primary Resource(s):

enVision Algebra 2 Prentice Hall ISBN: 0-328-93159-4 © 2018	Math XL, Pearson Realize