School District of Marshfield Course Syllabus

Course Name: Math 110 – College Algebra PS
Length of Course: Spring Semester
Credit: 1/2

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:

Definition of function, linear and non-linear functions and graphs including logarithmic and exponential functions; systems of linear equations; theory of polynomial equations and optional topics such as mathematical induction, matrix solution of linear systems and Cramer;s rule. MS Course Fees: Estimated cost of university placement exam is $30 and estimated cost of university credit course withdrawal fee is $50 (the second fee is only assessed if the student drops the college credit portion of the course after initially committing to taking the college credit course mid-January).

NOTE: This is a NCAA approved course.

NOTE: This is only offered in the spring semester. Students must have tested into Math 110 through the UW Math Placement Exam in order to take Math 110 for college credit. Students may opt to take Math 110 solely for high school credit under the UW grading policy.

NOTE: A graphing calculator (approximately $100 purchase) is required for this course. This class meets for one semester.

PREREQUISITE: Senior status, Math 105, and completion of three years of math or Instructor's recommendation.

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.
Use properties of rational and irrational numbers. N-RN: 3	3. Explain why the sum or product of two rational numbers is rational; that the sum of a rational number and an irrational number is irrational; and that the product of a nonzero rational number and an irrational number is irrational.
Vector and Matrix Quantities (N-VM)	
Perform operations on matrices and use matrices in applications. N-VM: 7, 8, 9, 10	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)	
Write expressions in equivalent forms to solve problems. A-SSE: 3a, 3b, 3c	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%.*
Arithmetic with Polynomials and Rational Expressions (A-APR)	
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: 6	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.
Rewrite rational expressions. A-APR: 7	7. (+)Understand that rational expressions form a system analogous to the rational numbers, closed under addition, subtraction, multiplication, and division by a nonzero rational expression; add, subtract, multiply, and divide rational expressions.
Creating Equations (A-CED)	
Create equations that describe numbers or relationships. A-CED: 1, 2, 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.

	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)	
Solve equations and inequalities in one variable. A-REI: 3, 4a, 4b	3. Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters. 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: 5, 6, 7, 8, 9	5. 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 produces a system with the same solutions. 6. Solve systems of linear equations exactly and approximately (e.g., with graphs), focusing on pairs of linear equations in two variables. 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 $x^2 + y^2 = 3$. 8. (+) Represent a system of linear equations as a single matrix equation in a vector variable. 9. (+) 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).
Represent and solve equations and inequalities graphically. A-REI: 10, 11, 12	10. Understand 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). 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.

	12. Graph the solutions to a linear inequality in two variables as a half-plane (excluding the boundary in the case of a strict inequality), and graph the solution set to a system of linear inequalities in two variables as the intersection of the corresponding half-planes.
Wisconsin Standards for Mathematics- Functions	
Interpreting Functions (F-IF)	
Understand the concept of a function and use function notation. F-IF: 1, 2	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.
Interpret functions that arise in applications in terms of the context. F-IF: 4, 5, 6	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.* 6. Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph.
Analyze functions using different representations. F-IF: 7a, 7b, 7c, 7d, 7e, 8a, 8b	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.*
Building Functions (F-BF)	
Build a function that models a relationship between two quantities. F-BF: 1c	1. Write a function that describes a relationship between two quantities. c. (+) 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.*
Build new functions from existing functions. F-BF: 3, 4a, 4b, 4c, 4d, 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* $x \neq 1$. b. (+) Verify by composition that one function is the inverse of another. c. (+) Read values of an inverse function from a graph or a table, given that the function has an inverse. d. (+) Produce an invertible function from a non-invertible function by restricting the domain. 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.	1. Distinguish between situations that can be modeled with linear functions and with exponential functions.

F-LE: 1a, 1b, 1c, 3, 4	a. Prove that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. b. Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. c. Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another. 3. Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or (more generally) as a polynomial function. 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.
Wisconsin Standards for Mathematics- Geometry	
Congruence (G-CO)	
Experiment with transformations in the plane. G-CO: 1, 2	1. Know precise definitions of angle, circle, perpendicular line, parallel line, and line segment, based on the undefined notions of point, line, distance along a line, and distance around a circular arc. 2. Represent transformations in the plane using, e.g., transparencies and geometry software; describe transformations as functions that take points in the plane as inputs and give other points as outputs. Compare transformations that preserve distance and angle to those that do not (e.g., translation versus horizontal stretch).
Expressing Geometric Properties with Equations (G-GPE)	
Translate between the geometric description and the equation for a conic section. G-GPE: 1, 2, 3	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. 3. (+) Derive the equations of ellipses and hyperbolas given the foci, using the fact that the sum or difference of distances from the foci is constant.
Use coordinates to prove simple geometric theorems algebraically. G-GPE: 5	Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems (e.g., find the equation of a line parallel or perpendicular to a given line that passes through a given point).
Wisconsin Standards for Mathematics- Statistics and Probability	
Interpreting Categorical and Quantitative Data (ID)	
Interpret linear models. S-ID: 7	7. Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.

Key Vocabulary:			
Sets of Real Numbers	Set Notation, and Interval Notation	Intersection and Union	Cartesian Coordinate system
Linear Equations/Inequalities	Linear Systems of Equations/Inequalities	Quadratic Equations	Polynomials
Long Division with Polynomials	Synthetic Division with Polynomials	Quadratic Formula	Discriminant
Rational Expressions/Equations	Absolute Value Equations/Inequalities	Midpoint Formula and Distance Formula	Pythagorean Theorem
Parallel and Perpendicular Lines	Slope-Intercept Form	Point-Slope Form	Standard Form both Linear and Quadratic
Elimination Method	Substitution Method	Cramer's Rule	Factor
Greatest Common Factor	Factoring by Grouping	Difference of Squares	Difference of Cubes
Sum of Cubes	Perfect Square Trinomial	Completing the Square	Square Root Principle
One Solution	No Solution	Infinitely Many Solutions	Extraneous Roots
Relation	Function	Domain	Range
Quadratic Function	Cubic Function	Square Root Function	Cube Root Function
Absolute Value Function	Step Function	Rational Function	Maximum and Minimum Values
Increasing, Decreasing, and Constant Intervals	Horizontal and Vertical Asymptotes	Matrices	Exponential Growth and Decay
Composite Functions	One-to-one Functions	Inverse Functions	Exponential Functions
Logarithmic Functions	Function Notation	Simplest Radical Form	Remainder Theorem

Topics/Content Outline- Units and Themes:

Quarter 3:

- Algebra and Geometry Review Topics
- Solving Equations and Inequalities
- Functions and their graphs

Quarter 4:

- Polynomial/ Rational Functions
- Exponential Functions and Logarithms
- Matrices

Primary Resource(s):	
College Algebra Enhanced with Graphing Utilities Prentice Hall ISBN: 0-131-49104-0 © 2006	Math XL, Pearson Realize