SALINE AREA SCHOOLS
COURSE OUTCOMES

ALGEBRA II

The Course
Algebra II is a 1-credit course (one semester in the high school block or one year in the middle school) that serves as the second in a sequence of college preparatory mathematics courses at Saline Area Schools. The key content for this second course is the study of nonlinear functions and equations, including linear, quadratic, polynomial, rational, radical and exponential. Graphing calculators will be used extensively to produce and study the graphs of various functions. In this way, the course will build upon the algebraic skills developed in Algebra I, enhancing and refining these skills in such a way as to allow students to deal successfully with increasingly complex problems.

Prerequisites
Before studying Algebra II, all students must be competent in basic algebraic concepts, including operations with integers, evaluating algebraic expressions, and solving and graphing linear equations and inequalities. The importance of being able to solve multi-step linear equations systematically before entering Algebra II cannot be over emphasized.

In addition, students should have received exposure in both their prealgebra and Algebra I courses to elementary geometry concepts such as lines, segments, rays, angles and plane figures, the perimeter and area of rectangles and the radius, diameter, circumference and area of a circle. Students should have experience with elementary statistical concepts, including mean (average), median, mode and range and different graphical representations of data such as scatter plots, line plots, frequency tables, histograms, box plots and stem-and-leaf plots. The prerequisites for Algebra II can be satisfied by successfully completing Algebra I.

Philosophy
In Algebra II, broad concepts and widely applicable methods are emphasized. The focus of the course is neither manipulation nor memorization of an extensive taxonomy of computational methods, properties, theorems, or problem types. Although facility with manipulation and computational competence are important outcomes of the course, they are not the core of the course. Through the unifying themes of functions, their graphs and their roots, the course becomes a cohesive whole, rather than a collection of unrelated topics. These themes are developed using linear, polynomial, rational, radical and exponential functions. In addition, the concept of mathematical modeling is introduced and used to solve a wide variety of problems in various contexts.

Symbolic reasoning and calculations with symbols are central in algebra. Through the study of algebra, a student develops an understanding of the symbolic language of the mathematics and the sciences. To this end, it is imperative that the student views algebra as more than just a game where the object is to arrive at the "right answer." Instead, algebra must be viewed as logical process, and the student must understand that the communication of the process used to arrive at the answer is, in fact, more important than the answer itself.

The cohesive nature of the course must be emphasized through incremental development of the techniques and skills of algebra with continuous distributed review and frequent cumulative testing. Graphing linear functions is not a topic that can be taught early in the course and then not seen again until the final exam. Unifying themes must be revisited over and over again, with continual applications to increasingly complicated problems.

In addition to increasing student's facilities and skills with algebra, student proficiencies in basic geometry and statistics should be periodically reinforced and extended, especially as these topics are prominent on the high school MEAP test.

Objectives

1. Students can distinguish between a relation and a function and can identify relations and functions as well as their domains and ranges algebraically (from their formulas or equations), numerically (from lists of ordered pairs) and graphically.

2. Students understand that the graph of a function is the graph of the set of *all* ordered pairs (x,y) that *satisfy* the equation $y = f(x)$. Students should be able to graph functions by plotting points, and can find the zeros of a function by solving the equation $f(x) = 0$. Students are able to produce the graph of a function in an arbitrary viewing window and find the roots of a function on a graphing calculator.

3. Students are able to solve linear equations, find the zeros of a linear function and use linear equations to solve problems.

4. Students are able to compute the slope of a line, interpret slope as a rate of change and graph linear equations in slope-intercept form.

5. Students understand the meaning of exponents, including zero and negative exponents and can apply the laws of exponents. They can express both large and small numbers using scientific notation and can solve problems involving exponential growth and decay.

6. Students and can add, subtract, multiply and divide expressions involving monomials and polynomials. They can factor polynomials using greatest common factors, difference of two squares, sums and differences of two cubes, can factor trinomials by trial and error and can factor by grouping. Students can find the roots of a polynomial equation using the zero product property and identify the zeros of a polynomial function with the x-intercepts of its graph.

7. Students can solve problems involving both direct and inverse variation using ratios, proportions and percents.

8. Students can find both the domain and zeros of a rational function and recognize the existence of vertical asymptotes on the graph of a rational function. They can add, subtract, multiply, divide and simplify rational expressions, simplify complex fractions and solve rational equations, recognizing restrictions and identifying extraneous roots.

9. Students can find both real and complex roots of quadratic equations by extracting square roots, by completing the square and by the quadratic formula and can use quadratic functions to solve problems. Students can also solve quadratic inequalities by analyzing the sign in factored form.

10. Students can find both the domain and zeros of a radical function, can solve equations involving radicals identifying extraneous roots and are able to simplify expressions involving radicals. Students can use radicals to solve problems in geometry.

11. Students appreciate mathematics as a system of logic based on axioms, postulates, definitions and theorems (properties). To this end, students are able to *prove* that the solution of the equation $2x + 3 = 5$ is 1 by *justifying* each step in the solution process with an axiom, postulate, definition or theorem (property). Although it is impractical to demand such detail each time a linear equation is solved, students must appreciate the need for and be proficient at showing the steps that lead to the solution of an equation or inequality.

Syllabus

The syllabus of topics is intended to indicate the topics to be covered in all sections of Algebra II. Although the Final Exam for Algebra II will be based on the topics listed in this topical outline, teachers may enrich the course with additional topics.

Textbook: McDougall-Littell, Algebra I, Larsen, et.al.

Chapter S. Functions and Their Graphs*
S.1 The Real Number Line and the Cartesian Plane
S.2 Functions and Relations
S.3 Function Notation
S.4 Functions and Their Graphs
S.5 The Implied Domain of a Function
S.6 Using Functions to Solve Problems
S.7 Linear Functions and Their Graphs
S.8 Slope and the Slope-Intercept Form of a Linear Equation
S.9 Slope and Rate of Change

Chapter 8. Exponents and Exponential Functions
8.1 Multiplication Properties of Exponents
8.2 Zero and Negative Exponents
8.3 Division Properties of Exponents
8.4 Scientific Notation
8.5 Exponential Growth Functions
8.6 Exponential Decay Functions

Chapter 10. Polynomials and Factoring
10.1 Adding and Subtracting Polynomials
10.2 Multiplying Polynomials
10.3 Special Products of Polynomials
10.4 Solving Polynomial Equations in Factored Form
10.5 Factoring $x^2 + bx + c$
10.6 Factoring $ax^2 + bx + c$
10.7 Factoring Special Products
10.8 Factoring Using the Distributive Property
S.10 Factoring Sums and Differences of Perfect Cubes*
S.11 Factoring by Grouping*

Chapter 11. Rational Equations and Functions
11.1 Ratio and Proportion
11.2 Percents
11.3 Direct and Inverse Variation
11.4 Simplifying Rational Expressions
11.5 Multiplying and Dividing Rational Expressions
11.6 Adding and Subtracting Rational Expressions
S.12 Simplifying Complex Fractions*
11.7 Dividing Polynomials
11.8 Rational Equations and Functions

Chapter 9. Quadratic Equations and Functions
9.1 Solving Quadratic Equations by Finding Square Roots
9.2 Simplifying Radicals
S.13 Imaginary Numbers*
S.14 Complex Numbers*
9.3 Graphing Quadratic Functions
9.4 Solving Quadratic Equations by Graphing
S.15 Solving Quadratic Equations by Completing the Square*
9.5 Solving Quadratic Equations by the Quadratic Formula
9.6 Applications of the Discriminate
9.7 Graphing Quadratic Inequalities
S.16 Solving Quadratic Inequalities Using Sign Charts*
9.8 Comparing Linear, Exponential and Quadratic Models

Chapter 12. Radicals and Connections to Geometry
12.1 Square Root Functions
12.2 Operations with Radical Expressions
12.3 Solving Radical Equations
12.4 Completing the Square
12.5 The Pythagorean Theorem and Its Converse
12.6 The Distance and Midpoint Formulas
12.7 Trigonometric Ratios
12.8 Logical Reasoning and Proof

TOTAL = 54 SECTIONS
Every Algebra 2 class (middle and high school) must cover all 54 topics/sections.
**** = Supplementary Topic (not included in the textbook)***