



MTH303: Algebra II

This course builds upon algebraic concepts covered in Algebra. Students extend their knowledge and understanding by solving open-ended problems and thinking critically. Topics include functions and their graphs, quadratic functions, inverse functions, advanced polynomial functions, and conic sections. Students are introduced to rational, radical, exponential, and logarithmic functions; sequences and series; data analysis; and matrices.

Compared to MTH302, this course has a more rigorous pace as well as more challenging assignments and assessments. This course requires the use of a graphing calculator equivalent to a TI-84 and includes tutorials and activities for using a handheld graphing calculator. MTH303 also covers additional topics such as linear programming, advanced factoring techniques, even and odd functions, graphing radical functions, quadratic inequalities, the binomial theorem, weighted averages, advanced operations with matrices, and putting conic sections into graphing form.

COURSE LENGTH: Two semesters or 180 hours of instruction

MATERIALS: *Algebra II: A Reference Guide and Problem Sets*
TI-84 graphing calculator

PREREQUISITES: Successful completion of Algebra I and Geometry

SEMESTER ONE

Unit 1: Numbers, Expressions, and Equations

In this unit, students review the order of operations, set definitions, properties of the real number system, and other symbols and terminology. Various strategies for solving linear and absolute value equations are introduced as are strategies for using formulas to solve real-world applications.

- Semester Introduction
- Sets of Numbers
- Number Lines and Absolute Value
- Number Properties
- Evaluating Expressions
- Solving Equations
- Solving Absolute Value Equations
- Applications: Formulas

Unit 2: Linear Equations and Systems

Representations and applications of linear relationships are the focus of this unit. Students interpret and create graphs, tables, and equations that represent linear relationships. In addition to simple linear equations, students also use systems of linear equations to solve real-world problems.

- Graphs of Lines
- Forms of Linear Equations
- Writing Equations of Lines
- Applications: Linear Equations
- Systems of Linear Equations, Part 1
- Systems of Linear Equations, Part 2
- Applications: Linear Systems

Unit 3: Functions

Students explore real-world situations regarding input and output, and learn how to graph equations and differentiate between functions and relations. Functions covered include some that are continuous, discontinuous, and discrete-valued. Step functions, such as the least and greatest integer functions, are introduced. Students learn to estimate and calculate domains and ranges of functions and to compose complicated functions from simpler ones. Students learn to express situations in function notation, calculate domains and ranges, and write sums, differences, products, quotients, and compositions of functions.

- Function Basics
- Function Equations
- Absolute Value Functions
- Piecewise Functions
- Step Functions
- Function Operations, Part 1
- Function Operations, Part 2
- Function Inverses

Unit 4: Inequalities

In this unit, students solve and graph linear inequalities in one variable including conjunctions, disjunctions, and absolute value inequalities. Students also solve and graph inequalities in two variables and systems of inequalities in two variables. They also use linear programming to solve real-world problems.

- Inequalities in One Variable
- Compound Inequalities
- Absolute Value Inequalities
- Inequalities in Two Variables
- Systems of Linear Inequalities
- Linear Programming

Unit 5: Polynomials and Power Functions

Students learn to identify, evaluate, graph, and write polynomial functions. They review adding, subtracting, and multiplying polynomials as well as algebraic factoring patterns. Students use these patterns and the zero product property to solve polynomial equations. Additionally, students graph power functions and identify the end behavior of various members of the power function graph family. Students also become familiar with the properties of even and odd functions.

- Working with Polynomials
- Multiplying Polynomials
- Factoring Patterns
- More Factoring Patterns
- Solving Polynomial Equations
- Power Functions

Unit 6: Rational Equations

Students learn to add, subtract, multiply, and divide rational expressions. Students learn to simplify compound fractions and solve rational equations. They also explore graphs and end behavior of rational functions including asymptotes and zeros.

- Dividing Monomials and Polynomials
- Operations with Rational Expressions, Part 1
- Operations with Rational Expressions, Part 2
- Compound Fractions
- Solving Rational Equations, Part 1
- Solving Rational Equations, Part 2
- Reciprocal Power Functions
- Graphing Rational Functions

Unit 7: Radicals and Complex Numbers

Students learn to identify, add, subtract, multiply, and divide radicals, and to factor out perfect squares. Students solve real-world problems involving applications of radical equations, and convert between rational exponent and radical form of an expression. They learn to identify, graph, find the modulus of, add, subtract, multiply, and divide imaginary and complex numbers.

- Simplifying Radical Expressions
- Fractional Exponents and Higher Roots
- Graphing Radical Functions
- Solving Radical Equations
- Imaginary Numbers
- Complex Numbers
- Multiplying and Dividing Complex Numbers
- Solving Equations with Complex Solutions

Unit 8: Quadratic Functions

Students learn how to graph quadratic functions and identify the equations of quadratic functions when given a graph. Students also use the zero product property, completing the square, and the quadratic formula to solve quadratic equations. They explore the Quadratic Formula and how factors of quadratic polynomials relate to x-intercepts of graphs of quadratic functions. Applications include projectile motion, geometry, and other areas.

- Graphing Quadratic Functions
- Properties of Quadratic Functions
- Solving Quadratic Equations, Part 1
- Solving Quadratic Equations, Part 2
- Quadratic Inequalities
- Finding a Quadratic from Points
- Applications: Quadratic Functions

Unit 9: Semester Review and Test

- Semester Review
- Semester Test

SEMESTER TWO

Unit 1: Solving and Graphing Polynomials

Students learn polynomial long division and the technique of synthetic division to divide polynomials. Additionally, they learn to apply the remainder theorem and they use the factor and rational roots theorems to factor polynomials over the real and complex numbers. Uses of graphs and technology for factoring polynomials and solving polynomial equations are also covered.

- Semester Introduction
- Polynomial Long Division
- Synthetic Division
- The Polynomial Remainder Theorem
- Factors and Rational Roots
- Graphing Polynomials
- Factoring Polynomials Completely
- Applications: Polynomials

Unit 2: Exponents and Logarithms

Students discover how exponential functions can be used to describe situations in the real world, such as exponential decay and growth. They define the logarithmic function in terms of its relationship with the exponential function and graph both exponential and logarithmic functions. Students learn to apply multiplication and division laws of exponents to exponential and logarithmic expressions and equations.

- Exponential Expressions and Equations, Part 1
- Exponential Expressions and Equations, Part 2
- Graphing Exponential Functions
- Applications: Growth and Decay
- Logarithms
- Using Logs to Solve Exponential Equations
- Solving Logarithmic Equations
- Graphing Logarithmic Functions
- Applications: Logarithms

Unit 3: Sequences and Series

Students explore arithmetic and geometric sequences, learning the concept of series as a sum of terms in a sequence and finding sums of finite arithmetic and geometric series. Students also use and interpret sigma notation to describe sums. Throughout the unit, students use sequences and series to solve several types of real-world problems, and use spreadsheets to calculate terms of sequences and series.

- Sequences and Patterns
- Arithmetic Sequences
- Geometric Sequences
- Applications: Sequences
- Series and Sigma Notation
- Arithmetic Series
- Geometric Series
- Applications: Series
- Technology: Sequences and Series

Unit 4: Counting and Probability

Students review counting principles including identifying and calculating permutations and combinations. They calculate probabilities of simple, dependent, independent, and binomial events. They also use probability to make predictions and relate the binomial theorem to Pascal's triangle.

- Counting Principles
- Permutations and Factorials
- Combinations
- Basic Probability
- Probability with and Without Replacement
- Independent and Dependent Events
- Mutually Exclusive Events
- Binomial probability
- Making Predictions

Unit 5: Statistics

Students learn about the measures of center—mode, median, and mean—and the measures of spread—range, variance, and standard deviation. They learn how to produce and interpret bar, box-and-whisker, and scatter plots. Students explore common sampling techniques and learn how to use the properties of normal distributions to compare values.

- Measures of Center
- Variability
- Samples
- Graphs of Univariate Data
- Frequency Distributions
- The Normal Distribution
- Lines of Best Fit

Unit 6: Vectors and Matrices

In this unit, students learn how to add, subtract, multiply, and determinants of matrices. Students also use matrices to solve systems of equations, transform figures, and solve real-world problems.

- Matrices and Vectors
- Operations with Matrices
- Matrix Multiplication
- Transforming Points and Figures
- Determinants and Cramer's Rule, Part 1
- Determinants and Cramer's Rule, Part 2
- Identity and Inverse Matrices
- Using Matrices to Solve Linear Systems

Unit 7: Conic Sections

Students learn about conic sections that are points or lines and curved conic sections, including circles, ellipses, hyperbolas, and parabolas. They learn how to graph conic sections, how to use algebraic reasoning to create equations of conics when given descriptions or graphs, and how to solve real-world problems.



- Introduction to Conic Sections
- Circles
- Ellipses
- Hyperbolas
- Parabolas
- Putting Conics into Graphing Form, Part 1
- Putting Conics into Graphing Form, Part 2

Unit 8: Semester Review and Test

- Semester Review
- Semester Test