

Grade 10 Mathematics

Full Curriculum Guide

Algebra II + Advanced Functions + Trigonometry + Modeling

Purpose: Build a rigorous Algebra II-level foundation while developing advanced function reasoning, analytic geometry, trigonometry, statistics, probability, financial mathematics and mathematical modeling.

Course	Grade 10 Mathematics / Algebra II foundation
Primary audience	Grade 10 students / equivalent high-school level
ROED model	Live online instruction small groups concept-focused learning
Structure	Algebra II progression + advanced functions + geometry/trigonometry/data/finance
Major strands	Algebra • Functions • Geometry • Trigonometry • Statistics • Probability • Financial Mathematics

Prepared as the master Grade 10 curriculum framework for ROED. This document outlines advanced function families, analytic geometry, trigonometry, data modeling, financial applications, and comprehensive end-of-year outcomes.

1. Course Overview

Grade 10 Mathematics at ROED is the natural continuation of the Grade 9 Algebra I foundation. The emphasis shifts from mastering the core linear/quadratic/exponential toolkit to understanding broader families of functions and using algebra as a system for modeling.

Students deepen polynomial reasoning, rational and radical algebra, complex numbers, transformations, inverse functions, exponential/logarithmic relationships, systems and optimization. They also encounter conic sections, sequences and series, introductory trigonometry, statistics and probability, and advanced financial modeling.

Central philosophy: advanced mathematics should remain connected. Students should see how algebraic expressions create functions, how functions create graphs and models, how geometry supplies structure, and how data and financial situations provide meaningful applications.

2. Course Mission & Learning Philosophy

- Build a coherent Algebra II foundation rather than a collection of disconnected techniques.
- Move students from solving equations toward analyzing and transforming entire function families.
- Connect symbolic, graphical, numerical and verbal representations.
- Develop fluency with polynomial, rational, radical, exponential, logarithmic, quadratic and trigonometric relationships.
- Use modeling to show why advanced mathematics matters.
- Develop statistical and probabilistic reasoning alongside algebraic reasoning.
- Use technology strategically for graphing, regression, simulation, financial models and verification.
- Provide appropriate Core and Extension pathways so advanced topics add depth without becoming unnecessary barriers.

3. Grade 9 • Grade 10 Progression

Area	Grade 9 role	Grade 10 role
Linear functions	Core mastery	Review within advanced function systems
Systems	Linear systems	Nonlinear systems, inequalities, optimization
Polynomials	Operations/factoring	Higher-degree polynomials, division, zeros
Quadratics	Core solving/modeling	Deeper forms, complex roots, optimization
Exponential	Core growth/decay	Logarithms and advanced exponential modeling
Radicals	Basic operations	Rational exponents and advanced radical/rational algebra
Functions	Formal introduction	Composition, inverses, transformations, piecewise
Geometry	Coordinate foundation	Conics and analytic geometry
Sequences	Foundation/patterns	Formal sequences, series and combinatorics
Statistics	Bivariate data	Regression, spread, sampling and model quality
Probability	Compound probability	Counting, conditional probability, simulation
Financial math	Core applications	Interest, annuities, loans and financial modeling
Trigonometry	—	Formal introductory trigonometry

4. Suggested Course Sequence

The sequence below organizes the master Grade 10 / Algebra II progression across 10 core units, establishing deep command of advanced function families, coordinate conics, analytic trigonometry, probability modeling, and financial mathematics.

Order	Unit	Primary focus
1	Polynomial, Rational, Radical & Complex Expressions	Algebra II algebraic foundations
2	Advanced Functions & Transformations	Composition, inverses, transformations, piecewise
3	Quadratic, Absolute-Value & Piecewise Functions	Deeper nonlinear function analysis
4	Exponential & Logarithmic Functions	Growth, decay, inverses and logs
5	Systems, Inequalities & Linear Programming	Nonlinear systems and optimization
6	Conics & Analytic Geometry	Circles, parabolas, ellipses, hyperbolas
7	Sequences, Series & Combinatorics	Patterns, sums and counting
8	Trigonometry	Triangles, unit circle, graphs and modeling
9	Statistics, Probability & Data Modeling	Data, regression, uncertainty and probability
10	Financial Mathematics & Mathematical Modeling	Interest, loans, annuities and capstone models

Curriculum Progression Note: Units 1 through 10 provide a rigorous Algebra II framework that integrates algebraic fluency with function analysis, coordinate geometry, analytic trigonometry, and real-world optimization models.

Unit 1 Polynomial, Rational, Radical & Complex Expressions

Learning Goal: Students enter Algebra II with strong control of polynomial structure, rational/radical algebra, and the complex number system.

CORE TOPICS:

- Polynomial vocabulary: degree, leading coefficient, terms, factors and zeros.
- Operations with higher-degree polynomials.
- Factoring higher-degree polynomials using appropriate methods.
- Polynomial long division.
- Synthetic division.
- Remainder Theorem and Factor Theorem.
- Polynomial zeros and their relationship to factors and graphs.
- End behavior and basic polynomial-function behavior.
- Rational expressions: simplify, multiply, divide, add and subtract.
- Domain restrictions and excluded values.
- Radical expressions and rational exponents.
- Simplifying, multiplying and adding/subtracting radicals.
- Rationalizing denominators.
- Complex numbers and the imaginary unit i .
- Powers of i ; operations with complex numbers.
- Complex conjugates and division of complex numbers.
- Complex solutions of quadratic equations.
- Connections among factors, zeros, roots and graphs.

EXTENSION:

More advanced polynomial factoring, multiplicity, complex roots and deeper polynomial analysis.

REAL-WORLD APPLICATIONS:

Algebraic modeling, engineering/science formulas, polynomial models and exact-vs-approximate reasoning.

END-OF-UNIT OUTCOMES:

- Perform major polynomial operations accurately.
- Use division and the Remainder/Factor Theorems.
- Connect polynomial factors, zeros and graphs.
- Manipulate rational and radical expressions with domain awareness.
- Perform operations with complex numbers and interpret complex solutions.

Unit 2 - Advanced Functions & Transformations

Learning Goal: Students move beyond individual equations to study functions as objects that can be transformed, combined, restricted and inverted.

CORE TOPICS:

- Review function notation, domain and range.
- Function transformations: translations, reflections and stretches/compressions.
- Transformations using $f(x)+k$, $f(x-h)$, $af(x)$ and $f(bx)$.
- Graph and interpret transformed function families.
- Function composition.
- Evaluating composite functions.
- Inverse functions and inverse notation $f^{-1}(x)$.
- Graphical relationship between a function and its inverse.
- Domain restrictions needed for inverse functions.
- Verify inverse relationships algebraically and graphically.
- Piecewise-defined functions.
- Evaluating and graphing piecewise functions.
- Continuity/discontinuity conceptually.
- Compare function families using tables, graphs and equations.
- Choose an appropriate function model for a situation.

EXTENSION:

More advanced composition and inverse-function problems, including restrictions and parameter analysis.

REAL-WORLD APPLICATIONS:

Tax brackets, shipping costs, utility pricing, pricing tiers, piecewise fees and transformed real-world models.

END-OF-UNIT OUTCOMES:

- Transform function graphs and predict the effect of parameter changes.
- Compose functions in meaningful contexts.
- Find and verify inverse functions when appropriate.
- Represent and interpret piecewise functions.
- Compare different function families and select appropriate models.

Unit 3 Quadratic, Absolute-Value & Piecewise Functions

Learning Goal: Students deepen Grade 9 quadratic knowledge and develop more sophisticated analysis of absolute-value and piecewise functions.

CORE TOPICS:

- Quadratic function review through standard, factored and vertex forms.
- Vertex, axis of symmetry, intercepts and direction of opening.
- Parameter effects on quadratic graphs.
- Completing the square as a structural method.
- Quadratic formula and discriminant review/deeper use.
- Complex roots and their connection to graphs.
- Quadratic inequalities.
- Systems involving linear and quadratic functions.
- Optimization using quadratic models.
- Absolute-value functions and transformations.
- Absolute-value equations and inequalities.
- Piecewise functions and domain restrictions.
- Graphing piecewise relationships.
- Modeling distance, error, cost and threshold situations.
- Compare quadratic, absolute-value and piecewise behavior.

EXTENSION:

More complex parameter analysis, nonlinear systems and advanced optimization.

REAL-WORLD APPLICATIONS:

Projectile motion, area optimization, revenue/profit, distance from a reference point and tiered pricing.

END-OF-UNIT OUTCOMES:

- Analyze quadratic graphs beyond basic identification.
- Use multiple methods to solve quadratic equations.
- Interpret the discriminant and complex solutions.
- Solve quadratic inequalities and basic nonlinear systems.
- Build and interpret absolute-value and piecewise models.

Unit 4 Exponential & Logarithmic Functions

Learning Goal: Students develop logarithms as inverse functions and use exponential/logarithmic models for growth, decay and real-world phenomena.

CORE TOPICS:

- Exponential functions $y = ab^x$.
- Initial value and growth/decay factor.
- Discrete versus continuous exponential growth.
- Percent growth and decay.
- Transformations of exponential functions.
- Comparing linear, quadratic and exponential behavior.
- Logarithms as inverses of exponentials.
- Common logarithm and natural logarithm.
- Evaluating and interpreting logarithms.
- Properties of logarithms: product, quotient and power rules.
- Change-of-base concept and calculator use.
- Solving exponential equations using logarithms.
- Solving logarithmic equations.
- Domain restrictions for logarithmic expressions.
- Graphing exponential and logarithmic functions.
- Inverse relationship and reflection across $y = x$.
- Real-world exponential/logarithmic modeling.
- Recognize limitations of a model.

EXTENSION:

More advanced exponential/logarithmic equations and parameter analysis.

REAL-WORLD APPLICATIONS:

Compound interest, continuous growth, half-life, population, depreciation, pH, sound intensity and other growth/scale models.

END-OF-UNIT OUTCOMES:

- Build and interpret exponential models.
- Use logarithms as inverse operations.
- Apply logarithm properties correctly.
- Solve exponential and logarithmic equations.
- Interpret exponential/logarithmic graphs and parameters in context.

Unit 5- Systems, Inequalities & Linear Programming

Learning Goal: Students extend Grade 9 systems into nonlinear systems, multivariable constraints and optimization.

CORE TOPICS:

- Review systems of linear equations.
- Linear + quadratic systems.
- Other introductory nonlinear systems when appropriate.
- Graphical and algebraic solution methods.
- Systems of linear inequalities in two variables.
- Graphing half-planes and identifying solution regions.
- Systems of nonlinear inequalities conceptually.
- Constraints and feasible regions.
- Objective functions.
- Linear programming and optimization.
- Maximum/minimum problems.
- Interpreting solutions in context.
- Matrices as an ROED advanced extension.
- Matrix notation and operations.
- Augmented matrices and row operations.
- Solving systems with matrices.
- Interpretation and verification of matrix solutions.

EXTENSION:

Matrix methods beyond basic systems, larger systems and more advanced linear algebra ideas.

REAL-WORLD APPLICATIONS:

Production planning, resource allocation, diet/mixture problems, scheduling, business constraints and optimization.

END-OF-UNIT OUTCOMES:

- Solve linear and basic nonlinear systems.
- Represent systems of inequalities graphically.
- Identify feasible regions and optimize an objective function.
- Interpret mathematical solutions within real constraints.
- Use matrices as an alternative system-solving method when appropriate.

Unit 6 Conics & Analytic Geometry

Learning Goal: Students connect algebraic equations to geometric curves and strengthen coordinate-based mathematical reasoning.

CORE TOPICS:

- Coordinate geometry review.
- Distance and midpoint formulas.
- Slope and equations of lines.
- Parallel and perpendicular relationships.
- Circle equations in standard form.
- Center and radius from an equation or graph.
- Completing the square to identify circle features.
- Parabolas as conic sections.
- Standard forms and transformations of parabolas.
- Focus/directrix concept.
- Ellipses: standard form, center, vertices and basic graphing.
- Hyperbolas: standard form, center, vertices and asymptotes.
- Translations and transformations of conics.
- Connecting conics to quadratic and rational relationships.
- Coordinate modeling and geometric interpretation.

EXTENSION:

More advanced conic derivations, focus/directrix work and parameter analysis.

REAL-WORLD APPLICATIONS:

Architecture, satellite dishes, bridges, optics, navigation, design and engineering.

END-OF-UNIT OUTCOMES:

- Identify and graph major conic sections.
- Extract geometric information from equations.
- Use completing-square reasoning where appropriate.
- Connect algebraic and geometric representations.
- Use coordinate geometry to model real situations.

Unit 7 - Sequences, Series & Combinatorics

Learning Goal: Students formalize sequences and series and connect recursive patterns, formulas and counting to algebra and probability.

CORE TOPICS:

- Arithmetic sequences.
- Geometric sequences.
- Recursive versus explicit formulas.
- Finding the n th term.
- Common difference and common ratio.
- Arithmetic series.
- Geometric series.
- Finite sums.
- Sigma notation.
- Infinite geometric series conceptually and convergence conditions.
- Applications of sequences and series.
- Factorials.
- Fundamental counting principle.
- Permutations.
- Combinations.
- Distinguishing permutations from combinations.
- Counting in probability contexts.
- Binomial theorem as an extension.
- Pascal's triangle and binomial coefficients.

EXTENSION:

Binomial theorem in greater depth, advanced counting identities and more complex infinite-series reasoning.

REAL-WORLD APPLICATIONS:

Installment patterns, population models, savings schedules, counting arrangements and probability.

END-OF-UNIT OUTCOMES:

- Write and interpret explicit and recursive sequences.
- Find terms and sums of arithmetic/geometric sequences.
- Use sigma notation and series formulas.
- Apply permutations and combinations appropriately.
- Connect counting methods with probability and polynomial expansion.

Unit 8 Trigonometry

Learning Goal: Students establish a rigorous introductory trigonometry foundation for further mathematics, science and engineering.

CORE TOPICS:

- Right-triangle trigonometric ratios: sine, cosine and tangent.
- SOH-CAH-TOA and reciprocal relationships conceptually.
- Find missing sides and angles.
- Angles of elevation and depression.
- Real-world right-triangle applications.
- Radians and degree measure.
- Unit-circle definition of sine and cosine.
- Special-angle exact values.
- Quadrants and reference angles.
- Basic tangent values and unit-circle interpretation.
- Graphs of sine, cosine and tangent.
- Amplitude, period, midline and phase shift.
- Transformations of trigonometric functions.
- Basic trigonometric identities.
- Pythagorean identity.
- Basic trigonometric equations over specified intervals.
- Periodic modeling.
- Circular motion, waves and other applications.

EXTENSION:

More complex identities, multiple-angle identities and more sophisticated trigonometric equations.

REAL-WORLD APPLICATIONS:

Waves, Ferris wheels, tides, sound, daylight, circular motion, navigation and right-triangle measurement.

END-OF-UNIT OUTCOMES:

- Use sine, cosine and tangent to solve right-triangle problems.
- Work confidently with degrees and radians.
- Use the unit circle for common exact values.
- Graph and transform basic trigonometric functions.
- Solve basic trigonometric equations and model periodic situations.

Unit 9 Statistics, Probability & Data Modeling

Learning Goal: Students deepen statistical reasoning beyond Grade 9 by analyzing distributions, modeling data and connecting probability with inference-oriented thinking.

CORE TOPICS:

- Review distributions: center and spread.
- Standard deviation and interpretation.
- Normal distribution conceptually.
- Z-scores as standardized measures.
- Scatter plots and correlation.
- Linear regression and model interpretation.
- Residuals and model quality.
- Interpolation versus extrapolation.
- Sampling methods.
- Representative samples and sampling bias.
- Experimental design and observational studies.
- Association versus causation.
- Two-way tables and conditional probability connections.
- Compound probability.
- Simulation and randomization.
- Expected value in practical contexts.
- Choosing and comparing statistical models.
- Communicating uncertainty and limitations.

EXTENSION:

Introductory confidence intervals, margin of error and statistical inference concepts without turning the course into AP Statistics.

REAL-WORLD APPLICATIONS:

Surveys, sports, science experiments, public data, business analytics and decision-making.

END-OF-UNIT OUTCOMES:

- Interpret center, spread and standard deviation.
- Analyze bivariate relationships and regression output.
- Evaluate sampling and study design.
- Distinguish association from causation.
- Use probability and simulation to reason about uncertainty.

Unit 10 Financial Mathematics & Mathematical Modeling

Learning Goal: Students use Algebra II tools to model financial decisions and complete integrated quantitative investigations.

CORE TOPICS:

- Budgeting: income, fixed expenses, variable expenses and savings.
- Percent increase/decrease and inflation.
- Compound interest.
- Discrete and continuous growth models.
- Future value and present-value concepts.
- Annuities and repeated deposits conceptually and algebraically.
- Loans and total repayment.
- Monthly payment concepts.
- Amortization schedules and interpretation.
- Comparing loans and financing options.
- Depreciation: linear and exponential models.
- Investment growth and risk/return concepts.
- Cost, revenue and profit functions.
- Break-even analysis.
- Quadratic optimization in financial contexts.
- Systems for comparing plans.
- Data-based financial decision making.
- Capstone mathematical modeling projects.

EXTENSION:

More sophisticated annuity/amortization calculations and advanced financial modeling where appropriate.

REAL-WORLD APPLICATIONS:

Personal finance, investing, loans, business models, depreciation, subscriptions, pricing and long-term savings.

END-OF-UNIT OUTCOMES:

- Build realistic financial models.
- Compare savings, investment and loan scenarios.
- Interpret interest, repayment and depreciation.
- Use functions and systems to analyze financial decisions.
- Communicate assumptions, calculations, limitations and conclusions.

Mathematical Practices - Embedded All Year

The eight mathematical practices should be visible across lessons, assignments, projects, discussions and assessments. At Grade 10, particular emphasis should be placed on modeling, structural reasoning, precision and communicating why a method works.

- **1. Make sense of problems and persevere:** identify structure, constraints and productive strategies.
- **2. Reason abstractly and quantitatively:** move fluently between symbols, quantities, graphs and context.
- **3. Construct arguments and critique reasoning:** justify procedures and evaluate mathematical claims.
- **4. Model with mathematics:** construct, interpret and critique functions, equations and data models.
- **5. Use tools strategically:** use graphers, calculators, spreadsheets, geometry tools and simulations appropriately.
- **6. Attend to precision:** use correct notation, units, domains, restrictions, intervals and appropriate accuracy.
- **7. Look for and make use of structure:** recognize algebraic patterns, transformations, factors and function-family behavior.
- **8. Look for and express regularity in repeated reasoning:** generalize patterns and identify reusable methods.

Digital Mathematics & Technology

- Use Desmos or an equivalent graphing tool for transformations, function families, systems and modeling.
- Use spreadsheets for sequences, financial models, amortization and repeated calculations.
- Use regression tools for statistical modeling and residual analysis.
- Use simulations for probability and randomization investigations.
- Use digital geometry tools to explore conics and transformations.
- Use calculators strategically for logarithms, trigonometric values and numerical verification.
- Require students to explain and verify technology-generated results rather than treating technology as an authority.

Assessment Framework

Assessment should measure conceptual understanding, procedural fluency, application, modeling, reasoning and communication.

Assessment	Purpose
Diagnostic/readiness	Identify Grade 9 prerequisite gaps before advanced content.
Formative checks	Detect misconceptions during instruction.
Skill practice	Develop accurate algebraic and computational fluency.
Reasoning tasks	Assess explanation, proof-like reasoning and mathematical communication.
Unit assessments	Measure mastery of core unit outcomes.
Modeling projects	Integrate functions, data, finance, geometry or probability.
Cumulative review	Maintain earlier Algebra 1 and Algebra II skills.

Homework & Practice Philosophy

- Use homework to reinforce taught ideas and develop fluency.
- Mix procedural questions with reasoning, modeling and error analysis.
- Use spaced retrieval of Grade 9 concepts throughout Grade 10.
- Include occasional technology-free reasoning so students retain algebraic independence.
- Avoid making advanced extension material the sole measure of Grade 10 success.
- Use challenge problems for students ready for deeper Algebra II, trigonometric or modeling work.

Differentiation at ROED

Student profile	ROED response
Prerequisite gaps	Targeted Grade 9 review while preserving access to Grade 10 content.
On-level	Core Algebra II instruction, applications and reasoning.
Strong mastery	Deeper modeling, proofs/justifications and challenging function analysis.
Advanced	Extension in matrices, conics, complex numbers, combinatorics, trig identities and statistical inference.
Needs additional practice	Scaffolds, multiple representations, guided practice and retrieval.
Fast procedural solver	Increase modeling, explanation, representation-switching and error analysis.

Suggested Integrated Projects

- **Financial Growth Investigation:** compare savings, compound interest, annuities and loan scenarios using exponential and sequence models.
- **Business Optimization Challenge:** construct cost, revenue and profit models and use systems/quadratics/linear programming to investigate constraints and optimization.
- **Polynomial Modeling Project:** analyze a higher-degree polynomial, identify factors/zeros, graph behavior and interpret the model.
- **Periodic Phenomena Project:** model a real periodic situation with sine/cosine and interpret amplitude, period and phase.
- **Data & Regression Investigation:** analyze a dataset, fit a model, examine residuals and discuss sampling and causation limitations.
- **Conic Design Project:** investigate a circle, parabola, ellipse or hyperbola in architecture, engineering or technology.
- **Probability Simulation:** compare theoretical probability, counting methods and simulated outcomes.

End-of-Year Grade 10 Outcomes

By the end of the Grade 10 Core program, a successful student should be able to:

- Manipulate polynomial, rational and radical expressions accurately.
- Use polynomial division and the Remainder/Factor Theorems.
- Understand polynomial zeros and their connection to factors and graphs.
- Operate with complex numbers and interpret complex solutions.
- Transform, compose and invert functions when appropriate.
- Analyze quadratic, absolute-value, piecewise, exponential and logarithmic functions.
- Solve systems and inequalities, including introductory nonlinear systems.
- Use feasible regions and objective functions for basic optimization.
- Understand circles and the major conic sections at an appropriate Algebra II level.
- Analyze arithmetic/geometric sequences and series.
- Apply permutations and combinations to counting and probability.
- Use right-triangle trigonometry, radians, the unit circle and basic trig graphs.
- Analyze statistical distributions, regression, sampling and uncertainty.
- Use probability models, simulation and expected value.
- Build financial models involving interest, annuities, loans, depreciation and cost/profit.
- Use technology strategically while independently checking mathematical reasonableness.
- Communicate advanced mathematical reasoning clearly using multiple representations.

Final Curriculum Map - One-Page Reference

Unit	Core focus	Major integrated/application focus
1	Polynomial, rational, radical & complex algebra	Zeros, division, complex solutions
2	Advanced functions & transformations	Composition, inverses, piecewise models
3	Quadratic, absolute-value & piecewise	Nonlinear analysis and optimization
4	Exponential & logarithmic functions	Growth, decay and inverse relationships
5	Systems, inequalities & linear programming	Constraints and optimization
6	Conics & analytic geometry	Circles, parabolas, ellipses, hyperbolas
7	Sequences, series & combinatorics	Patterns, sums, counting and probability
8	Trigonometry	Triangles, unit circle, graphs, periodic modeling
9	Statistics, probability & data modeling	Regression, sampling and uncertainty
10	Financial mathematics & modeling	Interest, annuities, loans, depreciation, capstone

Curriculum design principle: Grade 10 is ROED's Algebra II and advanced-functions year. Grade 9 establishes Algebra I; Grade 10 broadens and deepens that algebra into polynomial, rational, exponential, logarithmic and trigonometric function families while connecting mathematics to geometry, data, probability and financial modeling.