

Tennessee Mathematics Standards

Approved July 30, 2010

Advanced Algebra & Trigonometry Course #3124

NOTE: This course is designed as an alternative to the Pre-Calculus course and it is not intended for students to take both courses while in high school due to the overlap in content. Students choosing this course would be less likely to enroll in a STEM Calculus course upon entering college. However, this course will provide a foundation for students entering a business application Calculus course or below.

Standard 1 – Mathematical Processes

Course Level Expectations

CLE 3124.1.1 Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.

CLE 3124.1.2 Apply and adapt a variety of appropriate strategies to problem solving, including testing cases, estimation, and then checking induced errors and the reasonableness of the solution.

CLE 3124.1.3 Develop inductive and deductive reasoning to independently make and evaluate mathematical arguments and construct appropriate proofs; include various types of reasoning, logic, and intuition.

CLE 3124.1.4 Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic), to solve problems, to model mathematical ideas, and to communicate solution strategies.

CLE 3124.1.5 Recognize and use mathematical ideas and processes that arise in different settings, with an emphasis on formulating a problem in mathematical terms, interpreting the solutions, mathematical ideas, and communication of solution strategies.

CLE 3124.1.6 Employ reading and writing to recognize the major themes of mathematical processes, the historical development of mathematics, and the connections between mathematics and the real world.

CLE 3124.1.7 Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.

Check for Understanding (Formative/Summative Assessment):

- ✓ 3124.1.1 Give a sequence of algebraic or mathematical reasons to establish the validity of a simple numerical property or relationship.
- ✓ 3124.1.2 Use algebraic properties to develop a valid sequence of mathematical statements.
- ✓ 3124.1.3 Derive and apply the formulas for the area of the triangle and the sector of a circle.
- ✓ 3124.1.4 Organize and display data in a spreadsheet in order to recognize patterns and solve problems.
- ✓ 3124.1.5 Conduct simple experiments or investigations to collect non-linear data to answer questions of interest and to identify a particular model function from a family of functions.
- ✓ 3124.1.6 Analyze situations, develop mathematical models, or solve problems using linear, quadratic, exponential, or logarithmic equations or inequalities symbolically or graphically.
- ✓ 3124.1.7 Make inferences or predictions using an algebraic model of a situation.
- ✓ 3124.1.8 Draw qualitative graphs of functions and describe their general shape/trend.
- ✓ 3124.1.9 Use graphing calculators and computer spreadsheets to analyze qualities of a function.
- ✓ 3124.1.10 Discuss interpolation vs. extrapolation and the validity of the resulting estimates.
- ✓ 3124.1.11 Correctly use summation notation; expand and collect expressions in both finite and infinite settings.
- ✓ 3124.1.12 Understand the different representations of a function; discuss the criteria (type of function and problem under consideration) for determining which representation is most helpful.

Standard 2 – Number & Operations

Course Level Expectations

- CLE 3124.2.1 Understand the capabilities and the limitations of calculators and computers in solving problems.
- CLE 3124.2.2 Represent, interpret or compare expressions for real numbers, including expressions utilizing exponents and logarithms.
- CLE 3124.2.3 Develop the arithmetic and properties of the complex numbers

Check for Understanding (Formative/Summative Assessment)

- ✓ 3124.2.1 Use calculators appropriately; make estimations without a calculator regularly to detect potential errors.
- ✓ 3124.2.2 Compare exponential and logarithmic expressions.
- ✓ 3124.2.3 Define the number i and perform all the arithmetic operations including division and calculating the modulus of a complex number.
- ✓ 3124.2.4 Classify real numbers and order real numbers that include transcendental expressions, including roots and fractions of π and e . Discuss

the problems with ordering the complex numbers in relationship to their arithmetic operations.

- ✓ 3124.2.5 Demonstrate round-off error, over-flow error, and errors in mode settings (ex. Degree vs. radians) with particular examples

Standard 3 – Algebra

Course Level Expectations

- CLE 3124.3.1 Derive and use the formulas for the general term and summation of finite or infinite arithmetic and geometric series, if they exist.
- CLE 3124.3.2 Identify or analyze the distinguishing properties of exponential, polynomial, logarithmic, trigonometric, and rational functions from tables, graphs, and equations.
- CLE 3124.3.3 Understand how the algebraic properties of an equation transform the geometric properties of its graph.
- CLE 3124.3.4 Solve nonlinear inequalities (quadratic, trigonometric, conic, exponential, and logarithmic).
- CLE 3124.3.5 Solve problems by converting the given verbal information into an appropriate mathematical model involving equations or systems of equations; apply appropriate techniques to analyze these mathematical models; and interpret the solution obtained in written form using appropriate units of measurement.
- CLE 3124.3.6 Understand the properties of conic sections whether displayed in equation or graphical form.
- CLE 3124.3.7 Use the binomial theorem to solve problems.

Check for Understanding (Formative/Summative Assessment)

- ✓ 3124.3.1 Find the sum, if it exists, of finite and infinite arithmetic series.
- ✓ 3124.3.2 Find the sum of an infinite geometric series whose common ratio, r , is in the interval $[-1, 1]$.
- ✓ 3124.3.3 Find the sum of a finite arithmetic series.
- ✓ 3124.3.4 Determine the domain and range of a function, in interval notation, given various forms and contexts.
- ✓ 3124.3.5 Explain why the graph of a function and its inverse are reflections of one another over the line $y = x$.
- ✓ 3124.3.6 Identify whether a function has an inverse and when functions are inverses of each other.
- ✓ 3124.3.7 Prove basic properties of a logarithm using properties of its inverse and apply those properties to solve problems.
- ✓ 3124.3.8 Explain the relationship between the real zeros and the x -intercept of the graph of a function (polynomial, rational, exponential, logarithmic, and trigonometric).
- ✓ 3124.3.9 Find the inverse of an exponential or a logarithmic function.

- ✓ 3124.3.10 Identify the real zeros of the graph of a function (polynomial, rational, exponential, logarithmic, trigonometric) in equation or graphical form.
- ✓ 3124.3.11 Determine when a rational function is undefined; discuss the end behavior of rational functions
- ✓ 3124.3.12 Determine the domain and range of a piecewise function.
- ✓ 3124.3.13 For a given graph, locate maximums, minimums, increasing and decreasing intervals, and zeroes.
- ✓ 3124.3.14 Identify characteristics of graphs based on a set of conditions or on a general equation such as $y = ax^2 + c$.
- ✓ 3124.3.15 Sketch the graph of a given a rational function and locate vertical, horizontal, and slant asymptotes, and holes in the graph if they exist.
- ✓ 3124.3.16 Given a function, describe the transformation of the graph resulting from the manipulation of the algebraic properties of the equation.
- ✓ 3124.3.17 Solve nonlinear inequalities by graphing (solutions in interval notation if one-variable).
- ✓ 3124.3.18 Solve systems of nonlinear inequalities by graphing and with numerical (tabular) methods.
- ✓ 3124.3.19 Solve real world problems that can be modeled using quadratic or exponential functions.
- ✓ 3124.3.20 Graph circles and demonstrate an understanding of the relationship between their standard algebraic form and the graphical characteristics.
- ✓ 3124.3.21 From an equation in standard form, graph the appropriate conic section.
- ✓ 3124.3.22 Graph ellipses and hyperbolas and demonstrate understanding of the relationship between their standard algebraic form and the graphical characteristics.
- ✓ 3124.3.23 Demonstrate the issues of graphing circles on a calculator, including required screen settings.
- ✓ 3124.3.24 Display all of the conic sections as portions of a cone.
- ✓ 3124.3.25 Accurately and completely describe the graph of a function using mathematical terminology, including a complete analysis of informative points, intervals, domain and range, concavity, descriptions of function change such as intervals of increasing, and end behavior.
- ✓ 3124.3.26 Use the Binomial Theorem to perform a binomial expansion.

Standard 4 – Geometry & Measurement

Course Level Expectations:

- CLE 3124.4.1 Understand basic right triangle trigonometry and use it to solve problems.
- CLE 3124.4.2 Know how the trigonometric functions can be extended to the periodic functions on the real number line, derive basic formulas of these functions, and use these functions and formulas to solve problems.
- CLE 3124.4.3 Solve trigonometric equations.
- CLE 3124.4.4 Apply trigonometric identities to rewrite expressions and solve equations.
- CLE 3124.4.5 Apply vectors to solve real world problems.
- CLE 3124.4.6 Understand the measure of angles and the relationship to the circle; convert between degrees and radians.
- CLE 3124.4.7 Develop the measurement of arcs of circles; calculate angular and linear velocity.

Check for Understanding (Formative/Summative Assessment)

- ✓ 3124.4.1 Solve problems using the fact that trigonometric ratios (sine, cosine, and tangent) stay constant in similar triangles.
- ✓ 3124.4.2 Apply properties of 30° - 60° - 90° and 45° - 45° - 90° right triangles and reference angles to find trigonometric ratios for the following angles (and any coterminal angles) without a calculator: 30° , 45° , 60° , 120° , 135° , 150° , 210° , 225° , 240° , 300° , 315° , 330°
- ✓ 3124.4.3 Be able to find trigonometric ratios of 0° , 90° , 180° , 270° (and any coterminal angles) or identify the values as undefined.
- ✓ 3124.4.4 Use the definitions of sine, cosine and tangent as ratios of sides in a right triangle to solve problems about lengths of sides and measures of angles.
- ✓ 3124.4.5 Match a trigonometric equation with its graph.
- ✓ 3124.4.6 Know that the trigonometric functions sine, cosine, and tangent can be extended to periodic functions on the real number line.
- ✓ 3124.4.7 Determine the radian measure of an angle and explain how radian measurement is related to a circle of radius 1.
- ✓ 3124.4.8 Convert from radians to degrees and from degrees to radians.
- ✓ 3124.4.9 Calculate the arc length (s) of a circle with radius (r) subtended by a central angle of measure t radians.
- ✓ 3124.4.10 Use the Law of Cosines and the Law of Sines (including the ambiguous case) to find unknown sides and angles of a triangle.
- ✓ 3124.4.11 Apply the Laws of Sines and Cosines to solve a non-right triangle.
- ✓ 3124.4.12 Know and use the following trigonometric identities in verifying other identities: Pythagorean, Reciprocal, Quotient, Sum/Difference, Double Angle
- ✓ 3124.4.13 Know and use the following trigonometric identities in solving trigonometric equations: Pythagorean, Reciprocal, Quotient, Sum/Difference, Double Angle
- ✓ 3124.4.14 Apply the Pythagorean and Reciprocal Identities to verify identities

- and solve equations.
- ✓ 3124.4.15 Multiply a vector by a scalar both algebraically and graphically.
 - ✓ 3124.4.16 Add vectors both algebraically and graphically.
 - ✓ 3124.4.17 Calculate magnitude and direction of a vector.
 - ✓ 3124.4.18 Use vectors to model velocity and direction to solve problems.
 - ✓ 3124.4.19 Graph a trigonometric function and identify characteristics such as period, amplitude, phase shift, and asymptotes.
 - ✓ 3124.4.20 Graph trig functions as well as their reciprocals; also, identify their key characteristics.
 - ✓ 3124.4.21 Develop the relationship between angular velocity and linear velocity; calculate both velocities in the context of pulleys and connected wheels.

Standard 5 – Data Analysis, Statistics, & Probability

Course Level Expectations

- CLE 3124.5.1 Create scatter plots, analyze patterns and describe relationships that exist in a set of linear and non-linear paired data to make predictions.
- CLE 3124.5.2 Identify and interpret the correlation coefficient for a linear bivariate data set.
- CLE 3124.5.3 Examine all aspects of using regression equations to act as a model for a real world situation, including interpolation, extrapolation and validity of model.

Check for Understanding (Formative/Summative Assessment)

- ✓ 3124.5.1 Construct a scatter plot of a set of paired data.
- ✓ 3124.5.2 Explain when it is appropriate to use a regression equation to make predictions.
- ✓ 3124.5.3 Find the quadratic or exponential regression equations for a data set using a graphing calculator, spreadsheet, and/or estimation.
- ✓ 3124.5.4 Find the equation of the regression line that best fits data with a linear trend.
- ✓ 3124.5.5 Find the regression equation that best fits exponential data.
- ✓ 3124.5.6 Use a regression equation to make predictions.
- ✓ 3124.5.7 Recognize that the correlation coefficient is a number in the interval $[-1, 1]$ that measures the strength of the linear relationship between two variables.
- ✓ 3124.5.8 Visually estimate the correlation coefficient (e.g., positive or negative, closer to 0, 0.5, or 1.0) of a scatterplot.
- ✓ 3124.5.9 Recognize and explain the potential errors caused by extrapolating from data.

- ✓ 3124.5.10 Use interpolation to calculate a new data point between two existing data points and identify potential errors.
- ✓ 3124.5.11 Use extrapolation to construct new data points that fit a given trend and identify potential errors.