Tennessee Mathematics Standards
2009-2010 Implementation

Algebra II
3103

Standard 1 – Mathematical Processes

CLE 3103.1.1   Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely in mathematical reasoning.

CLE 3103.1.2   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 3103.1.3   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 3103.1.4   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 3103.1.5   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 3103.1.6   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 3103.1.7   Use technologies appropriately to develop understanding of abstract mathematical ideas, to facilitate problem solving, and to produce accurate and reliable models.

Checks for Understanding (Formative/Summative Assessment):

- ✓ 3103.1.1   Create and analyze scatter-plots of non-linear and transcendental functions.
- ✓ 3103.1.2   Compare and contrast sampling techniques and identify the best technique for a given situation.
- ✓ 3103.1.3   Use calculators to identify regression equations for nonlinear data.
- ✓ 3103.1.4   Identify the weaknesses of calculators and other technologies in representing non-linear data, such as graphs approaching vertical asymptotes, and use alternative techniques to identify these issues and correctly solve problems.
- ✓ 3103.1.5   Determine the accuracy and reliability of a mathematical model.
- ✓ 3103.1.6   Use graphical representations to perform operations on complex numbers.
- ✓ 3103.1.7   Use the unit circle to determine the exact value of trigonometric functions for commonly used angles (0°, 30°, 45°, 60°…).
- ✓ 3103.1.8   Understand and describe the inverse relationship between exponential and logarithmic functions.
- ✓ 3103.1.9   Translate the syntax of technology to appropriate mathematical notation for non-linear and transcendental functions.
- ✓ 3103.1.10 Interpret the results of mathematical modeling in various contexts to answer questions.

SPI 3103.1.1   Move flexibly between multiple representations (contextual, physical, written, verbal, iconic/pictorial, graphical, tabular, and symbolic) of non-linear and transcendental functions to solve problems, to model mathematical ideas, and to communicate solution strategies.

SPI 3103.1.2   Recognize and describe errors in data collection and analysis as well as identifying representations of data as being accurate or misleading.

SPI 3103.1.3   Use technology tools to identify and describe patterns in data using non-linear and transcendental functions that approximate data as well as using those functions to solve contextual problems.

SPI 3103.1.4   Use mathematical language, symbols, definitions, proofs and counterexamples correctly and precisely to effectively communicate reasoning in the process of solving problems via mathematical modeling with both linear and non-linear functions.

Standard 2 – Number & Operations

CLE 3103.2.1   Understand the hierarchy of the complex number system and relationships between the elements, properties and operations.

CLE 3103.2.2   Connect numeric, analytic, graphical and verbal representations of both real and complex numbers.

CLE 3103.2.3   Use appropriate technology (including graphing calculators and computer spreadsheets) to solve problems, recognize patterns and collect and analyze data.

CLE 3103.2.4   Understand the capabilities and limitations of technology when performing operations, graphing, and solving equations involving complex numbers.

Checks for Understanding (Formative/Summative Assessment):

✓   3103.2.1   Understand that to solve certain problems and equations, the real number system needs to be extended from real numbers to complex numbers.

✓   3103.2.2   Define and give examples of each of the types of numbers in the complex number system.

✓   3103.2.3   Identify and apply properties of complex numbers (including simplification and standard form).

✓   3103.2.4   Add and subtract complex numbers.

✓   3103.2.5   Multiply complex numbers.

✓   3103.2.6   Define and utilize the complex conjugates to write the quotient of two complex numbers in standard form.

✓   3103.2.7   Graph complex numbers in the complex plane and recognize differences and similarities with the graphical representations of real numbers graphed on the number line.

✓   3103.2.8   Solve quadratic equations over the complex number system.

✓   3103.2.9   Find and describe geometrically the absolute value of a complex number.

✓   3103.2.10   Draw conclusions based on number concepts, algebraic properties, and/or relationships between expressions and numbers over complex numbers.

✓   3103.2.11   Understand the capabilities and limitations of technology. Make estimations without a calculator to detect potential errors.

✓   3103.2.12   Select and use appropriate methods to make estimations without technology when solving contextual problems.

✓   3103.2.13   Analyze and evaluate contextual situations involving any type of number from the complex number system.

State Performance Indicators:

SPI 3103.2.1   Describe any number in the complex number system.
SPI 3103.2.2   Compute with all real and complex numbers.
SPI 3103.2.3   Use the number system, from real to complex, to solve equations and contextual problems.

Standard 3 – Algebra

CLE 3103.3.1   Understand and apply properties of rational exponents and perform basic operations to simplify algebraic expressions.

CLE 3103.3.2   Understand, analyze, transform and generalize mathematical patterns, relations and functions using properties and various representations.

CLE 3103.3.3   Analyze and apply various methods to solve equations, absolute values, inequalities, and systems of equations over complex numbers.

CLE 3103.3.4   Graph and compare equations and inequalities in two variables. Identify and understand the relationships between the algebraic and geometric properties of the graph.

CLE 3103.3.5   Use mathematical models involving equations and systems of equations to represent, interpret and analyze quantitative relationships, change in various contexts, and other real-world phenomena.

Checks for Understanding (Formative/Summative Assessment)

- 3103.3.1   Perform operations on algebraic expressions and justify the procedures.
- 3103.3.2   Determine the domain of a function represented in either symbolic or graphical form.
- 3103.3.3   Determine and graph the inverse of a function with and without technology.
- 3103.3.4   Analyze the effect of changing various parameters on functions and their graphs.
- 3103.3.5   Graph piece-wise and step functions.
- 3103.3.6   Simplify expressions and solve equations containing radicals.
- 3103.3.7   Solve quadratic equations by factoring, graphing, completing the square, extracting square roots and using the quadratic formula.
- 3103.3.8   Solve a three by three system of linear equations algebraically and by using inverse matrices and determinants with and without technology.
- 3103.3.9   Find an equation for a parabola when given its graph or when given its roots.
- 3103.3.10 Given a quadratic equation use the discriminant to determine the nature of the roots.
- 3103.3.11 Describe and articulate the characteristics and parameters of a parent function.
- 3103.3.12 Understand the relationship between real zeros of a function and the x-intercepts of its graph.
- 3103.3.13 Solve problems using exponential functions requiring the use of logarithms for their solutions.
- 3103.3.14 Define and use arithmetic and geometric sequences and series including using sigma and pi notation.
- 3103.3.15 Find the sum of an geometric series whose common ratio, r, is in the interval (-1,1).
- 3103.3.16 Prove basic properties of logarithms using properties of exponents and apply those properties to solve problems.
- 3103.3.17 Know that the logarithm and exponential functions are inverses and use this information to solve real-world problems.
- 3103.3.18 Solve compound inequalities involving disjunction and conjunction and linear inequalities containing absolute values.
- 3103.3.19 Solve linear programming problems.
- 3103.3.20 Understand the relationships between the equations of conic sections and their graphs.
- 3103.3.21 Factor polynomials using a variety of methods including the factor theorem, synthetic division, long division, sums and differences of cubes, and grouping.

✓　3103.3.22　Determine the number and possible types of zeros for a polynomial function and find the rational roots.

✓　3103.3.23　Understand the connection between the roots, zeros, x-intercepts, factors of polynomials, and solutions of polynomial equations.

State Performance Indicators

SPI 3103.3.1　Add, subtract and multiply polynomials; divide a polynomial by a lower degree polynomial.

SPI 3103.3.2　Solve quadratic equations and systems, and determine roots of a higher order polynomial.

SPI 3103.3.3　Add, subtract, multiply, divide and simplify rational expressions including those with rational and negative exponents.

SPI 3103.3.4　Use the formulas for the general term and summation of finite arithmetic and both finite and infinite geometric series.

SPI 3103.3.5　Describe the domain and range of functions and articulate restrictions imposed either by the operations or by the contextual situations which the functions represent.

SPI 3103.3.6　Combine functions (such as polynomial, rational, radical and absolute value expressions) by addition, subtraction, multiplication, division, or by composition and evaluate at specified values of their variables.

SPI 3103.3.7　Identify whether a function has an inverse, whether two functions are inverses of each other, and/or explain why their graphs are reflections over the line y = x.

SPI 3103.3.8　Solve systems of three linear equations in three variables.

SPI 3103.3.9　Graph the solution set of two or three linear or quadratic inequalities.

SPI 3103.3.10　Identify and/or graph a variety of functions and their transformations.

SPI 3103.3.11　Graph conic sections (circles, parabolas, ellipses and hyperbolas) and understand the relationship between the standard form and the key characteristics of the graph.

SPI 3103.3.12　Interpret graphs that depict real-world phenomena.

SPI 3103.3.13　Solve contextual problems using quadratic, rational, radical and exponential equations, finite geometric series or systems of equations.

SPI 3103.3.14　Solve problems involving the binomial theorem and its connection to Pascal's Triangle, combinatorics, and probability.

Standard 4 – Geometry & Measurement

CLE 3103.4.1　Understand the trigonometric functions and their relationship to the unit circle.

CLE 3103.4.2　Know and use the basic identities of sine, cosine, and tangent as well as their reciprocals.

CLE 3103.4.3　Graph all six trigonometric functions and identify their key characteristics.

CLE 3103.4.4　Know and use the Law of Sines to find missing sides and angles of a triangle, including the ambiguous case.

CLE 3103.4.5　Use trigonometric concepts, properties and graphs to solve problems.

Checks for Understanding (Formative/Summative Assessment):

✓　3103.4.1　Convert between radians and degrees and vice versa.

✓　3103.4.2　Determine the period and the amplitude of a periodic function.

✓　3103.4.3　Extend the trigonometric functions to periodic functions on the real line by defining them as functions on the unit circle.

✓　3103.4.4　Understand the relationship between the radius, the central angle, and radian measure.

✓　3103.4.5　Determine the domain and range of the six trigonometric functions given a graph.

✓　3103.4.6　Know and be able to use the fundamental trigonometric identities, including the Pythagorean identities, reciprocal identities, sum of sine and cosine, and odd and even identities.

State Performance Indicators:
SPI 3103.4.1   Exhibit knowledge of unit circle trigonometry.
SPI 3103.4.2   Match graphs of basic trigonometric functions with their equations.
SPI 3103.4.3   Describe and articulate the characteristics and parameters of parent trigonometric
                  functions to solve contextual problems.

Standard 5 – Data Analysis, Statistics, & Probability

CLE 3103.5.1   Describe, interpret, and apply quantitative data.
CLE 3103.5.2   Evaluate and critique various ways of collecting data and using information based on
                  data published in the media.
CLE 3103.5.3   Use data and statistical thinking to draw inferences, make predictions, justify conclusions
                  and identify and explain misleading uses of data.
CLE 3103.5.4   Develop an understanding of probability concepts in order to make informed decisions.

Checks for Understanding (Formative/Summative Assessment):
- ✓ 3103.5.1   Collect, represent and describe both linear and non-linear data developed from contextual situations.
- ✓ 3103.5.2   Organize and display data using appropriate methods (including spreadsheets and technology tools) to detect patterns and departures from patterns.
- ✓ 3103.5.3   Read and interpret data from a two-way table.
- ✓ 3103.5.4   Understand the impact of various sampling methods and use them to draw valid conclusions.
- ✓ 3103.5.5   Calculate measures of central tendency and spread (variance and standard deviation).
- ✓ 3103.5.6   Use technology to find the appropriate regression equation for both linear and non-linear data.
- ✓ 3103.5.7   Recognize when the correlation coefficient measures goodness of fit and does not imply causation.
- ✓ 3103.5.8   Know the Empirical Rule for one, two and three standard deviations for a normal distribution.
- ✓ 3103.5.9   Use data to detect patterns.
- ✓ 3103.5.10 Design simple experiments to collect data to answer questions of interest.
- ✓ 3103.5.11 Evaluate published data by considering the source, the design of the study and the analysis and representation (or misrepresentation) of the data.
- ✓ 3103.5.12 Investigate bias and the phrasing of questions during data acquisition to formulate reasonable conclusions.
- ✓ 3103.5.13 Apply both theoretical and experimental probability to analyze the likelihood of an event.

State Performance Indicators:
SPI 3103.5.1   Compute, compare and explain summary statistics for distributions of data including measures of center and spread.
SPI 3103.5.2   Compare data sets using graphs and summary statistics.
SPI 3103.5.3   Analyze patterns in a scatter-plot and describe relationships in both linear and non-linear data.
SPI 3103.5.4   Apply the characteristics of the normal distribution.
SPI 3103.5.5   Determine differences between randomized experiments and observational studies.
SPI 3103.5.6   Find the regression curve that best fits both linear and non-linear data (using technology such as a graphing calculator) and use it to make predictions.
SPI 3103.5.7   Determine/recognize when the correlation coefficient measures goodness of fit.

SPI 3103.5.8   Apply probability concepts such as conditional probability and independent events to calculate simple probability.